Stantec

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Project Release Specifications

ImmuCell Corporation	*Customer Name*
ImmuCell Mast Out Design	*Project Name*
Portland, ME	*Project Location*
191504176	*Project No*

ImmuCell Interior Fit-Out Package

Specification Coversheet Revision History

Number	Date	Description	By
0	8/19/2016	Interior Fit-Out - Issued for Construction	Hoyt, Marla

Concrete

Spec #	Description	Revision	Rev Date
033000	CAST-IN-PLACE CONCRETE, IMMUCELL FIT-OUT	0	8/19/2016

Metals

Spec #	Description	Revision	Rev Date
054000	COLD-FORMED METAL FRAMING, IMMUCELL FIT-OUT	0	8/19/2016
055200	STAINLESS STEEL PLATFORMS, IMMUCELL FIT-OUT	0	8/19/2016

Wood, Plastics & Composites

Spec #	Description	Revision	Rev Date
066101	FIBERGLASS REINFORCED PLASTIC FLOOR PLATE, IMMUCELL FIT-OUT	0	8/19/2016
066103	FIBERGLASS REINFORCED PLASTIC STAIR TREAD COVER, IMMUCELL FIT-OUT	0	8/19/2016

Thermal & Moisture Protection

Spec #	Description	Revision	Rev Date
078413	FIRESTOPPING, IMMUCELL FIT-OUT	0	8/19/2016
079200	JOINT SEALANTS, IMMUCELL FIT-OUT	0	8/19/2016

Openings

Spec #	Description	Revision	Rev Date
081113	HOLLOW METAL DOORS AND FRAMES, IMMUCELL FIT-OUT	0	8/19/2016
081119	STAINLESS-STEEL DOORS AND FRAMES, IMMUCELL FIT-OUT	0	8/19/2016
081300	FIBERGLASS REINFORCED PANEL (FRP) DOORS AND FRAMES, IMMUCELL FIT-OUT	0	8/19/2016

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083327	FABRIC DOOR, IMMUCELL FIT-OUT	0	8/19/2016
085113	ALUMINUM WINDOWS, IMMUCELL FIT-OUT	0	8/19/2016
085123	STAINLESS STEEL WINDOWS, IMMUCELL FIT-OUT	0	8/19/2016
087100	DOOR HARDWARE, IMMUCELL FIT-OUT		
088000	GLAZING, IMMUCELL FIT-OUT	0	8/19/2016

Finishes

Spec #	Description	Revision	Rev Date
092216	NON-STRUCTURAL METAL FRAMING, IMMUCELL FIT-OUT	0	8/19/2016
096519	RESILIENT TILE FLOORING, IMMUCELL FIT-OUT	0	8/19/2016
096723	RESINOUS FLOORING, IMMUCELL FIT-OUT	0	8/19/2016
096813	TILE CARPETING, IMMUCELL FIT-OUT	0	8/19/2016
099123	INTERIOR PAINTING, IMMUCELL FIT-OUT	0	8/19/2016
099600	HIGH-PERFORMANCE COATINGS, IMMUCELL FIT-OUT	0	8/19/2016

Specialties

Spec #	Description	Revision	Rev Date
102113	TOILET COMPARTMENTS, IMMUCELL FIT-OUT	0	8/19/2016
102600	WALL PROTECTION, IMMUCELL FIT-OUT	0	8/19/2016
102800	TOILET ACCESSORIES, IMMUCELL FIT-OUT	0	8/19/2016
104413	FIRE EXTINGUISHER CABINETS, IMMUCELL FIT-OUT	0	8/19/2016
104416	FIRE EXTINGUISHERS, IMMUCELL FIT-OUT	0	8/19/2016
105113	METAL LOCKERS, IMMUCELL FIT-OUT	0	8/19/2016

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Furnishings

Spec #	Description	Revision	Rev Date
123200	MANUFACTURED WOOD CASEWORK, IMMUCELL FIT-OUT	0	8/19/2016
123553	LABORATORY CASEWORK, IMMUCELL FIT-OUT	0	8/19/2016

Special Construction

Spec #	Description	Revision	Rev Date
132100	CONTROLLED ENVIRONMENT ROOMS, IMMUCELL FIT-OUT	0	8/19/2016

Fire Suppression

Spec #	Description	Revision	Rev Date
210500	COMMON WORK RESULTS FOR FIRE SUPPRESSION, IMMUCELL FIT-OUT	0	8/19/2016
210523	GENERAL-DUTY VALVES FOR WATER-BASED FIRE-SUPPRESSION PIPING, IMMUCELL FIT-OUT	0	8/19/2016
210548	VIBRATION AND SEISMIC CONTROLS FOR FIRE SUPPRESSION PIPING AND EQUIPMENT, IMMUCELL FIT-OUT	0	8/19/2016
210553	IDENTIFICATION FOR FIRE PROTECTION PIPING AND EQUIPMENT, IMMUCELL FIT-OUT	0	8/19/2016
211000	WATER BASED FIRE SUPPRESSION SYSTEMS, IMMUCELL FIT-OUT	0	8/19/2016
211339	FOAM WATER SYSTEMS, IMMUCELL FIT-OUT	0	8/19/2016

Plumbing

Spec #	Description	Revision	Rev Date
220500	COMMON WORK RESULTS FOR PLUMBING, IMMUCELL FIT-OUT	0	8/19/2016
220519	METERS AND GAUGES FOR PLUMBING PIPING, IMMUCELL FIT-OUT	0	8/19/2016
220523	GENERAL-DUTY VALVES FOR PLUMBING PIPING, IMMUCELL FIT-OUT	0	8/19/2016
220529	HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT, IMMUCELL FIT-OUT	0	8/19/2016

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220553	IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT, IMMUCELL FIT-OUT	0	8/19/2016
220700	PLUMBING INSULATION, IMMUCELL FIT-OUT	0	8/19/2016
221116	DOMESTIC WATER PIPING, IMMUCELL FIT-OUT	0	8/19/2016
221119	DOMESTIC WATER PIPING SPECIALTIES, IMMUCELL FIT-OUT	0	8/19/2016
221316	SANITARY AND PROCESS WASTE AND VENT PIPING, IMMUCELL FIT-OUT	0	8/19/2016
221319	SANITARY AND PROCESS WASTE PIPING SPECIALTIES, IMMUCELL FIT-OUT	0	8/19/2016
221513	GENERAL-SERVICE COMPRESSED-AIR PIPING, IMMUCELL FIT-OUT	0	8/19/2016
221519	GENERAL-SERVICE PACKAGED AIR COMPRESSORS AND RECEIVERS, IMMUCELL FIT-OUT	0	8/19/2016
223500	DOMESTIC WATER HEAT EXCHANGERS, IMMUCELL FIT-OUT	0	8/19/2016
224000	PLUMBING FIXTURES, IMMUCELL FIT-OUT	0	8/19/2016
224500	EMERGENCY PLUMBING FIXTURES, IMMUCELL FIT-OUT	0	8/19/2016

Heating, Ventilation & Air Conditioning

Spec #	Description	Revision	Rev Date
230500	COMMON WORK RESULTS FOR HVAC, IMMUCELL FIT-OUT	0	8/19/2016
230501	CLEAN STEAM GENERATORS, IMMUCELL FIT-OUT	0	8/19/2016
230513	COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT, IMMUCELL FIT-OUT	0	8/19/2016
230516	EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING, IMMUCELL FIT-OUT	0	8/19/2016
230519	METERS AND GAUGES FOR HVAC PIPING, IMMUCELL FIT-OUT	0	8/19/2016
230523	VALVES, IMMUCELL FIT-OUT	0	8/19/2016

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230529	HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT, IMMUCELL FIT-OUT	0	8/19/2016
23054813	VIBRATION CONTROLS FOR HVAC, IMMUCELL FIT-OUT	0	8/19/2016
230553	IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT, IMMUCELL FIT-OUT	0	8/19/2016
230593	TESTING, ADJUSTING, AND BALANCING FOR HVAC, IMMUCELL FIT-OUT	0	8/19/2016
230700	MECHANICAL SYSTEMS INSULATION, IMMUCELL FIT-OUT	0	8/19/2016
230800	COMMISSIONING OF HVAC, IMMUCELL FIT-OUT	0	8/19/2016
230900	INSTRUMENTATION AND CONTROL FOR HVAC, IMMUCELL FIT-OUT	0	8/19/2016
23099311	SEQUENCE OF OPERATIONS FOR HVAC DDC, IMMUCELL FIT-OUT	0	8/19/2016
231123	NATURAL GAS PIPING, IMMUCELL FIT-OUT	0	8/19/2016
232113	HYDRONIC PIPING, IMMUCELL FIT-OUT	0	8/19/2016
232123	HYDRONIC PUMPS, IMMUCELL FIT-OUT	0	8/19/2016
232213	STEAM AND CONDENSATE HEATING PIPING, IMMUCELL FIT-OUT	0	8/19/2016
232223	STEAM CONDENSATE PUMPS, IMMUCELL FIT-OUT	0	8/19/2016
232500	HVAC WATER TREATMENT, IMMUCELL FIT-OUT	0	8/19/2016
233113	METAL DUCTS, IMMUCELL FIT-OUT	0	8/19/2016
233300	AIR DUCT ACCESSORIES, IMMUCELL FIT-OUT	0	8/19/2016
233416	CENTRIFUGAL HVAC FANS, IMMUCELL FIT-OUT	0	8/19/2016
233423	HVAC POWER VENTILATORS, IMMUCELL FIT-OUT	0	8/19/2016
23371313	AIR DIFFUSERS, IMMUCELL FIT-OUT	0	8/19/2016

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23371323	REGISTERS AND GRILLES, IMMUCELL FIT-OUT	0	8/19/2016
235100	BREECHINGS, CHIMNEYS, AND STACKS, IMMUCELL FIT-OUT	0	8/19/2016
235239	FIRE-TUBE BOILERS, IMMUCELL FIT-OUT	0	8/19/2016
235316	DEAERATORS, IMMUCELL FIT-OUT	0	8/19/2016
236426	ROTARY SCREW WATER CHILLERS, IMMUCELL FIT-OUT	0	8/19/2016
237413	PACKAGED, OUTDOOR, CENTRAL-STATION AIR-HANDLING UNITS, IMMUCELL FIT-OUT	0	8/19/2016
238216	AIR COILS, IMMUCELL FIT-OUT	0	8/19/2016
238219	FAN COIL UNITS, IMMUCELL FIT-OUT	0	8/19/2016
238239	UNIT HEATERS, IMMUCELL FIT-OUT	0	8/19/2016

Electrical

Spec #	Description	Revision	Rev Date
260500	COMMON WORK RESULTS FOR ELECTRICAL, IMMUCELL FIT-OUT	0	8/19/2016
260519	LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES, IMMUCELL FIT-OUT	0	8/19/2016
260526	GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS, IMMUCELL FIT-OUT	0	8/19/2016
260529	HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS, IMMUCELL FIT-OUT	0	8/19/2016
260533	RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS, IMMUCELL FIT-OUT	0	8/19/2016
260548	VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS, IMMUCELL FIT-OUT	0	8/19/2016
260553	IDENTIFICATION FOR ELECTRICAL SYSTEMS, IMMUCELL FIT-OUT	0	8/19/2016
260573	OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY, IMMUCELL FIT-OUT	0	8/19/2016

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260923	LIGHTING CONTROL DEVICES, IMMUCELL FIT-OUT	0	8/19/2016
262200	LOW VOLTAGE TRANSFORMERS, IMMUCELL FIT-OUT	0	8/19/2016
262416	PANELBOARDS, IMMUCELL FIT-OUT	0	8/19/2016
262420	SWITCHBOARDS, IMMUCELL FIT-OUT	0	8/19/2016
262726	WIRING DEVICES, IMMUCELL FIT-OUT	0	8/19/2016
262813	FUSES, IMMUCELL FIT-OUT	0	8/19/2016
262816	ENCLOSED SWITCHES AND CIRCUIT BREAKERS, IMMUCELL FIT-OUT	0	8/19/2016
262913	ENCLOSED CONTROLLERS, IMMUCELL FIT-OUT	0	8/19/2016
262923	VARIABLE FREQUENCY CONTROLLERS, IMMUCELL FIT-OUT	0	8/19/2016
263213	ENGINE GENERATORS, IMMUCELL FIT-OUT	0	8/19/2016
263353	UNINTERRUPTIBLE POWER SUPPLY (UPS), IMMUCELL FIT-OUT	0	8/19/2016
263600	TRANSFER SWITCHES, IMMUCELL FIT-OUT	0	8/19/2016
265100	INTERIOR LIGHTING, IMMUCELL FIT-OUT	0	8/19/2016

Communications

Spec #	Description	Revision	Rev Date
270500	COMMON WORK RESULTS FOR COMMUNICATIONS, IMMUCELL FIT-OUT	0	8/19/2016
270526	GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS, IMMUCELL FIT-OUT	0	8/19/2016
270800	TESTING OF COMMUNICATIONS CABLING SYSTEMS, IMMUCELL FIT-OUT	0	8/19/2016
271500	COMMUNICATIONS HORIZONTAL CABLING, IMMUCELL FIT-OUT	0	8/19/2016
275116	PUBLILC ADDRESS AND MASS NOTIFICATION SYSTEMS, IMMUCELL FIT-OUT	0	8/19/2016

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Electronic, Safety & Security

Spec #	Description	Revision	Rev Date
280500	COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY, IMMUCELL FIT-OUT	0	8/19/2016
280513	CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY, IMMUCELL FIT-OUT	0	8/19/2016
280544	SLEEVES AND SLEEVE SEALS FOR ELECTRONIC SAFETY AND SECURITY PATHWAYS AND CABLING, IMMUCELL FIT-OUT	0	8/19/2016
282300	VIDEO SURVEILLANCE, IMMUCELL FIT-OUT	0	8/19/2016
283111	DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM, IMMUCELL FIT-OUT	0	8/19/2016

Exterior Improvements

Spec #	Description	Revision	Rev Date
323113	CHAIN LINK FENCES AND GATES, IMMUCELL FIT-OUT	0	8/19/2016

Process Interconnections

Spec #	Description	Revision	Rev Date
400513	COMMON WORK RESULTS FOR PROCESS PIPING, IMMUCELL FIT-OUT	0	8/19/2016
40051319	STAINLESS STEEL PROCESS PIPING, IMMUCELL FIT-OUT	0	8/19/2016
400529	HANGERS AND SUPPORTS FOR PROCESS PIPING, IMMUCELL FIT-OUT	0	8/19/2016
400553	IDENTIFICATION FOR PROCESS PIPING, IMMUCELL FIT-OUT	0	8/19/2016
400610	SCHEDULES FOR GAS AND VAPOR PROCESS PIPING, IMMUCELL FIT-OUT	0	8/19/2016
400620	SCHEDULES FOR LIQUIDS PROCESS PIPING, IMMUCELL FIT-OUT	0	8/19/2016
404200	PROCESS PIPING AND EQUIPMENT INSULATION, IMMUCELL FIT-OUT	0	8/19/2016

CONFIDENTIAL DOCUMENT

033000

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Design Specification

CAST-IN-PLACE CONCRETE

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

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Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
033000	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixtures.
c. Ready-mix concrete manufacturer.
d. Concrete Subcontractor.
e. Special concrete finish Subcontractor.

2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, and concrete protection.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.

C. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

D. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.

1. Location of construction joints is subject to approval of the Owner.

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Waterstops.
4. Curing compounds.
5. Floor and slab treatments.
6. Bonding agents.
7. Adhesives.
8. Vapor retarders.
9. Semirigid joint filler.
10. Joint-filler strips.

B. Material Test Reports: For the following, from a qualified testing agency:

1. Aggregates: Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

C. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

D. Field quality-control reports.

E. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on concrete mixtures.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

1.9 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301 (ACI 301M).
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

B. Hot-Weather Placement: Comply with ACI 301 (ACI 301M) and as follows:

1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301 (ACI 301M).
2. ACI 117 (ACI 117M).

2.2 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Plywood, metal, or other approved panel materials.
2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

a. High-density overlay, Class 1 or better.
b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
c. Structural 1, B-B or better; mill oiled and edge sealed.
d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.

3. Overlaid Finnish birch plywood.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.

D. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

E. Form Ties: Factory-fabricated, removable or snap-off glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that leave no corrodible metal closer than 1 inch (25 mm) to the plane of exposed concrete surface.
2. Furnish ties that, when removed, leave holes no larger than 1 inch (25 mm) in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.3 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

B. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, plain, fabricated from as-drawn steel wire into flat sheets.

2.4 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel bars, cut true to length with ends square and free of burrs.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
3. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

2.5 CONCRETE MATERIALS

A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

B. Cementitious Materials:

1. Portland Cement: ASTM C 150/C 150M, Type I/II, gray.
2. Fly Ash: ASTM C 618, Class F or C.
3. Slag Cement: ASTM C 989/C 989M, Grade 100 or 120.

C. Normal-Weight Aggregates: ASTM C 33/C 33M, coarse aggregate or better, graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: 1 inch (25 mm) nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Air-Entraining Admixture: ASTM C 260/C 260M.

E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.

3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

F. Water: ASTM C 94/C 94M and potable.

2.6 WATERSTOPS

A. Chemically Resistant Flexible Waterstops: Thermoplastic elastomer rubber waterstops with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints; resistant to oils, solvents, and chemicals. Factory fabricate corners, intersections, and directional changes.

1. Profile: Ribbed with center bulb.
2. Dimensions: 6 inches by 3/16 inch thick (150 mm by 4.75 mm thick; nontapered.

B. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch (19 by 25 mm).

C. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer-modified chloroprene rubber, for adhesive bonding to concrete, 3/8 by 3/4 inch (10 by 19 mm).

2.7 VAPOR RETARDERS

A. Sheet Vapor Retarder: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape.

2.8 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.

2.9 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

2.10 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, according to ASTM D 2240.

C. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:

1. Types I and II, nonload bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.11 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301 (ACI 301M).

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash: 25 percent.
2. Combined Fly Ash and Pozzolan: 25 percent.
3. Slag Cement: 50 percent.
4. Combined Fly Ash or Pozzolan and Slag Cement: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing or high-range water-reducing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a w/c ratio below 0.50.

2.12 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Footings: Normal-weight concrete.

1. Minimum Compressive Strength: 3000 psi (20.7 MPa) at 28 days.
2. Maximum W/C Ratio: 0.50.
3. Slump Limit: 4 inches (100 mm), plus or minus 1 inch (25 mm).
4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch (25-mm) nominal maximum aggregate size.

B. Foundation Walls: Normal-weight concrete.

1. Minimum Compressive Strength: As indicated at 28 days.
2. Maximum W/C Ratio: 0.45.
3. Slump Limit: 4 inches (100 mm), plus or minus 1 inch (25 mm).
4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch (25-mm) nominal maximum aggregate size.

C. Slabs-on-Grade and Curbs: Normal-weight concrete.

1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
2. Maximum W/C Ratio: 0.40.
3. Minimum Cementitious Materials Content: 540 lb/cu. yd. (320 kg/cu. m).
4. Slump Limit: 4 inches (100 mm), plus or minus 1 inch (25 mm).
5. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

D. Suspended Slabs: Normal-weight concrete.

1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
2. Maximum W/C Ratio: 0.45.
3. Minimum Cementitious Materials Content: 540 lb/cu. yd. (320 kg/cu. m).
4. Slump Limit: 4 inches (100 mm) plus or minus 1 inch (25 mm).
5. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

2.13 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.14 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd. (0.76 cu. m) or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For mixer capacity larger than 1 cu. yd. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301 (ACI 301M), to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 (ACI 117M).

C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:

1. Class A, 1/8 inch (3.2 mm) for smooth-formed finished surfaces.
2. Class B, 1/4 inch (6 mm) for rough-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEM INSTALLATION

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.

3.3 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material are not acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Owner.

3.4 SHORING AND RESHORING INSTALLATION

A. Comply with ACI 318 (ACI 318M) and ACI 301 (ACI 301M) for design, installation, and removal of shoring and reshoring.

1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 VAPOR-RETARDER INSTALLATION

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.

1. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.

3.6 STEEL REINFORCEMENT INSTALLATION

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded-wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.7 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Owner.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.
3. Space vertical joints in walls 40 feet maximum. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
4. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch (3.2 mm). Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
2. Terminate full-width joint-filler strips not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished concrete surface where joint sealants are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.8 WATERSTOP INSTALLATION

A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.

B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

3.9 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Owner.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301 (ACI 301M).

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.

If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301 (ACI 301M).
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

3.10 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view.

C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.11 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
2. Finish surfaces to the following tolerances, according to ASTM E 1155 (ASTM E 1155M), for a randomly trafficked floor surface:

    a. Specified overall values of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15.

C. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Owner before application.

3.12 MISCELLANEOUS CONCRETE ITEM INSTALLATION

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
3. Install dowel rods to connect concrete base to concrete floor.
4. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

3.13 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 (ACI 301M) for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

    a. Water.
    b. Continuous water-fog spray.
    c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.

    a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
    b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
    c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies does not interfere with bonding of floor covering used on Project.

3.14 LIQUID FLOOR TREATMENT APPLICATION

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.

1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.

2. Do not apply to concrete that is less than seven days' old.
3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.

B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.15 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least one month(s). Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches (50 mm) deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.16 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Owner. Remove and replace concrete that cannot be repaired and patched to Owner's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension to solid concrete. Limit cut depth to 3/4 inch (19 mm). Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar matches surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Owner.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch (19-mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Owner's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Owner's approval.

3.17 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Inspections:

1. Steel reinforcement placement.
2. Headed bolts and studs.
3. Verification of use of required design mixture.
4. Curing procedures and maintenance of curing temperature.

5. Verification of concrete strength before removal of shores and forms from beams and slabs.

C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172/C 172M shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. (76 cu. m) or fraction thereof of each concrete mixture placed each day.

    a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

3. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
4. Air Content: ASTM C 231/C 231M, pressure method, for normal-weight concrete;one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
5. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below or 80 deg F (27 deg C) and above, and one test for each composite sample.
6. Unit Weight: ASTM C 567/C 567M, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
7. Compression Test Specimens: ASTM C 31/C 31M.

    a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
    b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.

8. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.

    a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
    b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
10. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).

11. Test results shall be reported in writing to Owner, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
12. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Owner but will not be used as sole basis for approval or rejection of concrete.
13. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Owner. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Owner.
14. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
15. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

D. Measure floor and slab flatness and levelness according to ASTM E 1155 (ASTM E 1155M) within 48 hours of finishing.

3.18 PROTECTION OF LIQUID FLOOR TREATMENTS

A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION 033000

CONFIDENTIAL DOCUMENT

054000

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

COLD-FORMED METAL FRAMING

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

054000

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
054000	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Interior load-bearing wall framing.

B. Related Sections include the following:

1. Division 09 Section "Non-Structural Metal Framing" for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.

C. Cold-Formed Steel Framing, General: Design according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions."

1. Headers: Design according to AISI's "Standard for Cold-Formed Steel Framing - Header Design."

1.3 SUBMITTALS

A. Product Data: For each type of cold-formed metal framing product and accessory indicated.

B. Shop Drawings: Show layout, spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

1. For cold-formed metal framing indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Product Test Reports: From a qualified testing agency, unless otherwise stated, indicating that each of the following complies with requirements, based on evaluation of comprehensive tests for current products:

1. Steel sheet.
2. Expansion anchors.
3. Power-actuated anchors.

4. Mechanical fasteners.
5. Vertical deflection clips.
6. Miscellaneous structural clips and accessories.

D. Research/Evaluation Reports: For cold-formed metal framing.

1.4 QUALITY ASSURANCE

A. Product Tests: Mill certificates or data from a qualified independent testing agency, or in-house testing with calibrated test equipment indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, ductility, and metallic-coating thickness.

B. Fire-Test-Response Characteristics: Where indicated, provide cold-formed metal framing identical to that of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

C. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:

1. Grade: ST50H for 8” studs.
2. Coating: G60.

B. Steel Sheet for Vertical Deflection Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:

1. Grade: 50, Class 1 or 2.
2. Coating: G90.

2.2 LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch for 8" studs.
2. Flange Width: 1-3/8 inches for 8" studs.
3. Section Properties: 8" studs: Ix = 4.63 in^4, Sx = 0.930 in^3, Ma = 27.85 k-in.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and as follows:

1. Minimum Base-Metal Thickness: Matching steel studs.
2. Flange Width: 1-1/4 inches.

C. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: Matching steel studs.
2. Flange Width: Matching steel studs.
3. Section Properties: Matching steel studs.

2.3 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

1. Supplementary framing.
2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. Anchor clips.
5. End clips.
6. Foundation clips.
7. Gusset plates.
8. Stud kickers, knee braces, and girts.
9. Joist hangers and end closures.
10. Hole reinforcing plates.
11. Backer plates.

2.4 ANCHORS, CLIPS, AND FASTENERS

A. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

B. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.

C. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.

1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

2.5 FABRICATION

A. Fabricate cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.

1. Fabricate framing assemblies using jigs or templates.
2. Cut framing members by sawing or shearing; do not torch cut.
3. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.

    a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three exposed screw threads.

4. Fasten other materials to cold-formed metal framing by welding, bolting, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.

D. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.

a. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.

H. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.

I. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.3 NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:

1. Anchor Spacing: 24 inches.

B. Squarely seat studs against top and bottom tracks with gap not exceeding of 1/8 inch between the end of wall framing member and the web of track. Fasten both flanges of studs to top and bottom tracks. Space studs as follows:

1. Stud Spacing: 16 inches.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.

D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.

E. Align floor and roof framing over studs. Where framing cannot be aligned, continuously reinforce track to transfer loads.

F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure as indicated.

G. Install headers over wall openings wider than stud spacing. Locate headers above openings as indicated. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.

1. Frame wall openings with not less than a double stud at each jamb of frame as indicated on Shop Drawings. Fasten jamb members together to uniformly distribute loads.
2. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.

H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.

1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.

I. Install horizontal bridging in stud system, spaced 48 inches. Fasten at each stud intersection.

1. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of 2 screws into each flange of the clip angle for framing members up to 6 inches deep.

J. Install steel sheet diagonal bracing straps to both stud flanges, terminate at and fasten to reinforced top and bottom tracks. Fasten clip-angle connectors to multiple studs at ends of bracing and anchor to structure.

K. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.4 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

CONFIDENTIAL DOCUMENT

055200

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

STAINLESS STEEL PLATFORMS

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
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The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

055200

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
055200	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 055200 – STAINLESS STEEL PLATFORMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Stainless Steel framing and supports for platforms.
2. Handrails and guardrails.

1.2 SUBMITTALS

A. Shop Drawings:

1. Provide detail fabrication and erection shop drawings of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
2. Provide templates for anchors and bolts specified for installation under other Sections.

B. Mill Certificates shall be provided signed by manufacturers of stainless-steel sheet certifying that products furnished comply with requirements.

C. Welding Certificates shall be provided with copies of certificates for welding procedures and personnel.

D. Qualification Data:

1. For firms and persons as described under subsection 1.3 "Quality Assurance," include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.3 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm experienced in producing metal fabrications similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

B. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.6, "Structural Welding Code—Stainless Steel."
2. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone re-certification.

1.4 PROJECT CONDITIONS

A. Field Measurements: Where metal fabrications are indicated to attach to walls and other construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

B. Structural Performance of Handrails and Railings: Provide handrails and railings complying with requirements in ASTM E 985 for structural performance, based on testing performed according to ASTM E 894 and ASTM E 935.

1.5 COORDINATION

A. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: For metal fabrications exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

2.2 FERROUS METALS

A. Stainless Steel Sheet, Strip, Plate, and Flat Bar: ASTM A 666

B. Stainless Steel Tubing: ASTM A 269, Grade 304 (Fy = 42ksi).

C. Stainless Steel Pipe: ASTM A312 as required by structural loads.

D. Stainless Steel Angles: ASTM A276, Grade 304 (Fy = 42ksi).

E. Rolled-Stainless-Steel Floor Plate: ASTM A 793.

2.3 FASTENERS

A. General: Provide

1. Type 304 or 316 stainless-steel fasteners and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5. Select fasteners for type, grade, and class required.
2. Material: Alloy Group 1 or 2 stainless-steel bolts complying with ASTM F 593 (ASTM F 738M) and nuts complying with ASTM F 594 / ASTM F 836M.

B. Expansion Anchors: Provide anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

C. Epoxy Anchorages: The adhesive shall be a two component epoxy acrylate resin dispensed from a self contained pump style cartridge in which the components are mixed. Anchor holes shall be drilled with bits meeting ANSI Standard B94.12, as recommended by the adhesive supplier.

D. "HIT-RE 500", Hilti Corporation.

2.4 GROUT

A. Nonshrink, Epoxy Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous, high strength grout. Provide grout specifically recommended by manufacturer for applications.

2.5 FABRICATION, GENERAL

A. Fabricate assembly in accordance with “Part 3 – Execution”.

B. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

C. Shear and punch metals cleanly and accurately. Remove burrs.

D. Ease exposed edges to a radius of approximately 1/32 inch, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

E. Weld corners and seams continuously and comply with general welding requirements, below.

F. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

G. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

H. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.

I. Allow for thermal movement resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening up of joints, overstressing of components, failure of connections, and other detrimental effects. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

J. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.

K. Remove sharp or rough areas on exposed traffic surfaces.

L. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.

M. Fit exposed connections accurately together to form hairline joints.

N. Welding: Comply with AWS recommendations and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

O. Fabricate toeplates to fit units and weld to units in shop.

1. Toeplate Height: minimum 4 inches, unless otherwise indicated or required by code.

2.6 STEEL TUBE HANDRAILS AND RAILINGS

A. General: Fabricate handrails and railings to comply with requirements indicated for code, design, dimensions, details, finish, and member sizes, including wall thickness of tube, post spacings, and anchorage, but not less than that needed to withstand indicated loads.

B. Configuration: 1-1/2-inch-round top and bottom rails (if applicable) and intermediate rails.

C. Interconnect members by butt-welding or welding with internal connectors, at fabricator's option, unless otherwise indicated. At tee and cross intersections, cope ends of intersecting members to fit contour of tube to which end is joined, and weld all around.

D. Form changes in direction of handrails and rails by inserting prefabricated flush-elbow fittings.

E. Close exposed ends of handrail and railing members with prefabricated end fittings.

F. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated. Close ends of returns, unless clearance between end of rail and wall is 1/4 inch or less.

2.7 BRACKETS, FLANGES, FITTINGS, AND ANCHORS

A. Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting railings and for attaching to other work. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.

B. Connect railing posts to stair framing by direct welding, unless otherwise indicated.

C. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thickness and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

2.8 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports that are not a part of structural-steel framework as necessary to complete the Work.

B. Fabricate units from structural-steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.

C. Fabricate units from slotted channel framing where indicated.

D. Furnish inserts if units must be installed after concrete is placed.

2.9 STAINLESS-STEEL FINISHES

A. Remove tool and die marks and stretch lines or blend into finish.

B. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.

C. Provide Bright, Directional Polish: No. 4 finish.

D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal fabrications to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

D. Fit exposed connections accurately together to form hairline joints. Weld connections that are

not to be left as exposed joints but cannot be shop welded because of shipping size limitations.

E. Attach toeplates by welding at locations indicated.

F. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings, if any.

B. Install pipe columns on concrete footings and slabs with grouted baseplates. Position and grout column baseplates as specified above for setting and grouting bearing and leveling plates.

3.3 INSTALLING STEEL TUBE RAILINGS AND HANDRAILS

A. Adjust handrails and railing systems before anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated or, if not indicated, as required by design loads.

B. Plumb posts in each direction. Secure posts and railing ends to building. Anchor posts to steel by welding directly to steel supporting members.

END OF SECTION 055200

CONFIDENTIAL DOCUMENT

066101

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

FIBERGLASS REINFORCED PLASTIC FLOOR PLATE

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
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ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

066101

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
066101	0	8/19/2016	Interior Fit-Out - Issued for Construction

C. Resin shall be Isophthalic Polyester, with chemical formulations as necessary to provide the corrosion resistance, strength and other physical properties as required.

D. All finished surfaces of FRP items and fabrications shall be smooth, resin-rich, free of voids and without dry spots, cracks, crazes or unreinforced areas. All glass fibers shall be well covered with resin to protect against their exposure due to wear or weathering.

E. All floor plate products shall have a tested flame spread rating of 25 or less per ASTM E-84 Tunnel Test. Plate shall not burn past the 25 mm reference mark and will be classified HB per ASTM D635.

F. All mechanical plate clips shall be manufactured of Type 316SS (stainless steel).

2.3 MOLDED FRP FLOOR PLATE

A. Manufacture: Floor plate shall be of a one-piece molded construction manufactured by building up multiple layers of resin-impregnated fiberglass reinforcements which are continuous and equally oriented in the length and width directions. The plate shall have a nominal thickness as specified on contract drawings. Percentage of glass (by weight) shall not exceed 35% so as to achieve maximum corrosion resistance, and as required to maintain the structural requirements of the Contract. After molding, no dry glass fibers shall be visible on any surface. All surfaces shall be smooth and uniform with no evidence of fiber orientation irregularities, interlaminar voids, porosity, resin rich or resin starved areas.

B. Non-slip surfacing: Floor plate shall have a gritted surface, integrally molded into the plate during the manufacturing process. Plates which are secondarily gritted shall not be allowed.

C. Fire rating: Floor plate shall be fire retardant with a tested flame spread rating of 25 or less when tested in accordance with ASTM E 84. Certifications shall be dated within the past two years and test data performed only on the resin shall not be acceptable.

D. Resin system: The resin system used in the manufacture of the plate shall be Vi-Corr®. Manufacturer may be required to submit corrosion data from tests performed on actual plate products in standard chemical environments. Corrosion resistance data of the base resin from the manufacturer is not a true indicator of plate product corrosion resistance and shall not be accepted.

E. Color: As chosen by owner.

F. Depth: 3/4" with a tolerance of plus or minus 1/16".

G. Load/Deflection: Plate load/deflection requirements at the required span (shown below) shall be less than manufacturers published maximum recommended loads. Load/deflection not to exceed the following :

1. Uniform distributed load over an 24" span: 100 pounds per square foot, with a maximum deflection of 0.093" for 3/4" thick plate.

H. Substitutions: Other products of equal strength, stiffness, corrosion resistance and overall quality may be submitted with the proper supporting data to the engineer for approval.

2.4 FLOOR PLATE FABRICATION

A. Measurements: Floor Plate supplied shall meet the dimensional requirements and tolerances as shown or specified. The Contractor shall provide and/or verify measurements in field for work fabricated to fit field conditions as required by plate manufacturer to complete the work. When field dimensions are not required, contractor shall determine correct size and locations of required holes or cutouts from field dimensions before plate fabrication.

B. Layout: Each plate section shall be readily removable, except where indicated on drawings. Manufacturer to provide openings and holes where located on the contract drawings. Plate openings which fit around protrusions (pipes, cables, machinery, etc.) shall be discontinuous at approximately the centerline of opening so each section of plate is readily removable. Additional supports at openings shall be provided by the Contractor.

C. Sealing: All shop fabricated plate cuts shall sealed to provide maximum corrosion resistance. All field fabricated plate cuts shall be coated similarly by the contractor in accordance with the manufacturer's instructions.

D. Hardware: Type 316 stainless steel hold-down clips shall be provided and spaced at a maximum of four feet apart with a minimum of four per piece of plate, or as recommended by the manufacturer. All floor plates are to be bolted in place.

PART 3 - EXECUTION

3.1 INSPECTION

A. Shop inspection is authorized as required by the Owner and shall be at Owner's expense. The fabricator shall give ample notice to Contractor prior to the beginning of any fabrication work so that inspection may be provided. The plate shall be as free, as commercially possible, from visual defects such as foreign inclusions, delamination, blisters, resin burns, air bubbles and pits. The surface shall have a smooth finish (except for grit top surfaces).

3.2 INSTALLATION

A. Contractor shall install plates in accordance with manufacturer’s assembly drawings. Lock plate panels securely in place with hold-down fasteners as specified herein. Field cut and drill fiberglass reinforced plastic products with carbide or diamond tipped bits and blades. Seal cut or drilled surfaces in accordance with manufacturer's instructions. Follow manufacturer's instructions when cutting or drilling fiberglass products or using resin products; provide adequate ventilation.

END OF SECTION 066101

CONFIDENTIAL DOCUMENT

066103

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

FIBERGLASS REINFORCED PLASTIC STAIR TREAD COVER

ImmuCell
Portland, ME

Reviews / Approvals

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The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

066103

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
066103	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 066103 - FIBERGLASS REINFORCED PLASTIC STAIR TREAD COVER

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. The Contractor shall furnish, fabricate (where necessary), and install all fiberglass reinforced plastic (FRP) items, with all appurtenances, accessories and incidentals necessary to produce a complete, operable and serviceable installation as shown on the Contract Drawings and as specified herein, and in accordance with the requirements of the Contract Documents.

1.2 REFERENCES

A. The publications listed below (latest revision applicable) form a part of this specification to the extent referenced herein. The publications are referred to within the text by the designation only.

1. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) Test Methods:

a. ASTM D 635 Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position.
b. ASTM E 84 Surface Burning Characteristics of Building Materials.

1.3 SUBMITTALS

A. The Contractor shall furnish shop drawings of all stair tread covers and accessories in accordance with the provisions of this Section.

B. The Contractor shall furnish manufacturer's shop drawings clearly showing material sizes, types, styles, part or catalog numbers, complete details for the fabrication and erection of components including, but not limited to, location, lengths, type and sizes of fasteners, clip angles, member sizes, and connection details.

C. The Contractor shall submit the manufacturer’s published literature including structural design data, structural properties data, corrosion resistance tables, certificates of compliance, test reports as applicable, concrete anchor systems and their allowable load tables, and design calculations for systems not sized or designed in the contract documents.

D. The Contractor may be requested to submit sample pieces of each item specified herein for acceptance by the Engineer as to quality and color. Sample pieces shall be manufactured by the method to be used in the Work.

1.4 QUALITY ASSURANCE

A. All items to be provided under this Section shall be furnished only by manufacturers having a minimum of ten (10) years experience in the design and manufacture of similar products and systems. Additionally, if requested, a record of at least five (5) previous, separate, similar successful installations in the last five (5) years shall be provided.

B. Manufacturer shall offer a 3 year limited warranty on all FRP products against defects in materials and workmanship.

C. Manufacturer shall be certified to the ISO 9001-2008 standard.

D. Manufacturer shall provide proof of certification from at least two other quality assurance programs for its facilities or products (DNV, ABS, USCG, AARR).

1.5 PRODUCT DELIVERY AND STORAGE

A. Delivery of Materials: Manufactured materials shall be delivered in original, unbroken pallets, packages, containers, or bundles bearing the label of the manufacturer. Adhesives, resins and their catalysts and hardeners shall be crated or boxed separately and noted as such to facilitate their movement to a dry indoor storage facility.

B. Storage of Products: All materials shall be carefully handled to prevent them from abrasion, cracking, chipping, twisting, other deformations, and other types of damage. Adhesives, resins and their catalysts are to be stored in dry indoor storage facilities between 70 and 85 degrees Fahrenheit (21 to 29 degrees Celsius) until they are required.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Stair tread covers shall be Fiberplate® as manufactured by:

Fibergrate Composite Structures Inc.
5151 Belt Line Road, Suite 1212
Dallas, Texas 75254-7028 USA
(800) 527-4043 Phone (972) 250-1530 Fax

Website: www.fibergrate.com
E-mail: info@fibergrate.com

2.2 GENERAL

A. All FRP items furnished under this Section shall be composed of fiberglass reinforcement and resin in qualities, quantities, properties, arrangements and dimensions as necessary to meet the design requirements and dimensions as specified in the Contract Documents.

B. Fiberglass reinforcement shall be continuous roving in sufficient quantities as needed by the application and/or physical properties required.

C. Resin shall be Isophthalic Polyester, with chemical formulations as necessary to provide the corrosion resistance, strength and other physical properties as required.

D. All finished surfaces of FRP items and fabrications shall be smooth, resin-rich, free of voids and without dry spots, cracks, crazes or unreinforced areas. All glass fibers shall be well covered with resin to protect against their exposure due to wear or weathering.

E. All Stair Tread Covers shall have a tested flame spread rating of 25 or less per ASTM E-84 Tunnel Test. Plate shall not burn past the 25 mm reference mark and will be classified HB per ASTM D635.

F. All mechanical plate clips shall be manufactured of Type 316SS (stainless steel).

2.3 MOLDED FRP STAIR TREAD COVERS

A. Manufacture: Stair Tread Cover shall be of a one piece molded construction manufactured by building up multiple layers of resin-impregnated, bi-directional fiberglass mat reinforcements which are continuous and equally oriented in the length and width directions. The cover shall have a nominal thickness of 1/8". Percentage of glass (by weight) shall not exceed 35% so as to achieve maximum corrosion resistance, and as required to maintain the structural requirements of the Contract. After molding, no dry glass fibers shall be visible on any surface. All surfaces shall be smooth and uniform with no evidence of fiber orientation irregularities, interlaminar voids, resin rich or resin starved areas.

B. Non-slip surfacing: Stair Tread Cover shall have an aluminum oxide grit surface, integrally molded into the cover.

C. Fire rating: Stair Tread Cover shall be fire retardant with a tested flame spread rating of 25 or less when tested in accordance with ASTM E 84. Certifications shall be dated within the past two years and test data performed only on the resin shall not be acceptable.

D. Resin system: The resin system used in the manufacture of the plate shall be Vi-Corr® or approved equal. Manufacturer may be required to submit corrosion data from tests performed on actual plate products in standard chemical environments. Corrosion resistance data of the base resin from the manufacturer is not a true indicator of plate product corrosion resistance and shall not be accepted.

E. Color: Chosen by owner. Nosing of the tread shall be readily discernable from the landing of the tread for compliance with OSHA standards.

F. Depth: 1/4" with a tolerance of plus or minus 1/16".

G. Load/Deflection: Stair Tread Covers are to be fully supported over fiberglass stair treads.

H. Substitutions: Other products of equal strength, stiffness, corrosion resistance and overall quality may be submitted with the proper supporting data to the engineer for approval.

2.4 STAIR TREAD COVER FABRICATION

A. Measurements: Stair Tread Covers supplied shall meet the dimensional requirements and tolerances as shown or specified. The Contractor shall provide and/or verify measurements in field for work fabricated to fit field conditions as required by manufacturer to complete the work.

When field dimensions are not required, contractor shall determine correct size and locations of required holes or cutouts from field dimensions before plate fabrication. Contractor shall provide manufacturer with hold-down clip spacing or shall field locate. If field locating clip spacing for open grating treads, set tread in place and mark hole locations from the bottom to avoid bar interference. If field locating clip spacing for solid, existing concrete or wood treads, mark desired hole from the top, then turn tread over and drill from the bottom to minimize damage to twist drills by contact with the aluminum oxide grit.

B. Sealing: All shop fabricated plate cuts and holes shall be coated with vinyl ester resin to provide maximum corrosion resistance. All field fabricated plate cuts shall be coated similarly by the contractor in accordance with the manufacturer's instructions.

C. Hardware: Type 316 stainless steel hold-down clips shall be provided and spaced at a maximum of three feet apart with a minimum of four per cover, or as recommended by the manufacturer. Fasteners should be low profile round or truss head bolts or screws.

PART 3 - EXECUTION

3.1 INSPECTION

A. Shop inspection is authorized as required by the Owner and shall be at Owner's expense. The fabricator shall give ample notice to Contractor prior to the beginning of any fabrication work so that inspection may be provided. The cover shall be as free, as commercially possible, from visual defects such as foreign inclusions, delamination, blisters, resin burns, air bubbles and pits. The surface shall have a smooth finish (except for grit top surfaces).

3.2 INSTALLATION

A. Contractor shall install covers in accordance with manufacturer’s assembly drawings. Lock tread covers securely in place with hold-down fasteners as specified herein. Field cut and drill fiberglass reinforced plastic products with carbide or diamond tipped bits and blades. Seal cut or drilled surfaces in accordance with manufacturer's instructions. Follow manufacturer's instructions when cutting or drilling fiberglass products or using resin products; provide adequate ventilation.

END OF SECTION 066103

CONFIDENTIAL DOCUMENT

078413

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

FIRESTOPPING

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

078413

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
078413	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 078413 - FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes through-penetration firestop systems for penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items.

B. Related Sections include the following:

1. Division 07 Section "Fire-Resistive Joint Systems."
2. Division 21 Sections specifying fire-suppression piping penetrations.
3. Division 22 and 23 Sections specifying duct and piping penetrations.
4. Division 26, 27, and 28 Sections specifying cable and conduit penetrations.

1.3 PERFORMANCE REQUIREMENTS

A. General: For penetrations through the following fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.

1. Fire-resistance-rated walls including fire partitions and fire barriers.
2. Fire-resistance-rated horizontal assemblies including floor/ceiling assemblies.

B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per ASTM E 814:

1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
2. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:

a. Penetrations located outside wall cavities.
b. Penetrations located outside fire-resistance-rated shaft enclosures.

C. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.

1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
2. For floor penetrations with annular spaces exceeding 4 inches in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved, either by installing floor plates or by other means.
3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For each through-penetration firestop system, show each type of construction condition penetrated, relationships to adjoining construction, and type of penetrating item. Include firestop design designation of qualified testing and inspecting agency that evidences compliance with requirements for each condition indicated.

1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop system configuration for construction and penetrating items.

C. Through-Penetration Firestop System Schedule: Indicate locations of each through-penetration firestop system, along with the following information:

1. Types of penetrating items.
2. Types of constructions penetrated, including fire-resistance ratings and, where applicable, thicknesses of construction penetrated.
3. Through-penetration firestop systems for each location identified by firestop design designation of qualified testing and inspecting agency.

D. Qualification Data: For Installer.

E. Product Certificates: For through-penetration firestop system products, signed by product manufacturer.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FMG according to FMG 4991, "Approval of Firestop Contractors."

B. Installer Qualifications: A firm experienced in installing through-penetration firestop systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance

C. Source Limitations: Obtain through-penetration firestop systems, for each kind of penetration and construction condition indicated, through one source from a single manufacturer.

D. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:

1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life if applicable, qualified testing and inspecting agency's classification marking applicable to Project, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestop system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilate through-penetration firestop systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.

C. Notify Owner's inspecting agency at least seven days in advance of through-penetration firestop system installations; confirm dates and times on days preceding each series of installations.

D. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until each installation has been examined by Owner and building inspector, if required by authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 FIRESTOPPING, GENERAL

A. Compatibility: Provide through-penetration firestop systems that are compatible with one another; with the substrates forming openings; and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.

B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by qualified testing and inspecting agency for firestop systems indicated.[Accessories include, but are not limited to, the following items:]

1. Permanent forming/damming/backing materials, including the following:
    a. Slag-/rock-wool-fiber insulation.
    b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
    c. Fire-rated form board.
    d. Fillers for sealants.
2. Temporary forming materials.
3. Substrate primers.
4. Collars.
5. Steel sleeves.

2.2 FILL MATERIALS

A. General: Provide through-penetration firestop systems containing the types of fill materials indicated in the Through-Penetration Firestop System Schedule at the end of Part 3 by referencing the types of materials described in this Article. Fill materials are those referred to in directories of referenced testing and inspecting agencies as "fill," "void," or "cavity" materials.

B. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

C. Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.

D. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

E. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized steel sheet.

F. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.

G. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

H. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

I. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives.

J. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

K. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and other surfaces requiring a nonslumping, gunnable sealant, unless indicated firestop system limits use to nonsag grade for both opening conditions.

2.3 MIXING

A. For those products requiring mixing before application, comply with through-penetration firestop system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with firestop system manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestop system's seal with substrates.

3.3 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

A. General: Install through-penetration firestop systems to comply with Part 1 "Performance Requirements" Article and with firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

C. Install fill materials for firestop systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Identify through-penetration firestop systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of edge of the firestop systems so that labels will be visible to anyone seeking to remove penetrating items or firestop systems. Use mechanical fasteners for metal labels. For plastic labels, use self-adhering type with adhesives capable of permanently bonding labels to surfaces on which labels are placed and, in combination with label material, will result in partial destruction of label if removal is attempted. Include the following information on labels:

1. The words "Warning - Through-Penetration Firestop System - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Through-penetration firestop system designation of applicable testing and inspecting agency.
4. Date of installation.
5. Through-penetration firestop system manufacturer's name.
6. Installer's name.

3.5 CLEANING AND PROTECTING

A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

3.6 THROUGH-PENETRATION FIRESTOP SYSTEM SCHEDULE

A. Where UL-classified systems are indicated, they refer to alpha-alpha-numeric designations listed in UL's "Fire Resistance Directory" under product Category XHEZ.

B. Available Firestop Systems for Metallic Pipes, Conduit, or Tubing:

1. UL-Classified Systems: C-AJ-, C-BJ-, C-BK-, F-A-, F-B-, F-C-, W-J-, W-K-, W-L-1001-1999.

    a. C-AJ-1080
    b. W-J-1055
    c. W-L-1172
    d. W-L-1205

C. Available Firestop Systems for Nonmetallic Pipe, Conduit, or Tubing:

1. UL-Classified Systems: C-AJ-, C-BJ-, F-A-, F-B-, F-C-, W-J-, W-L-, 2001-2999.

a. C-AJ-2031
b. W-J-2018
c. W-L-2508
d. F-C-2032

D. Available Firestop Systems for Electrical Cables:

1. Available UL-Classified Systems: C-AJ-, C-BJ-, F-A-, F-B-, F-C-, W-J-, W-L-, 3001-3999.

a. C-AJ-3128
b. W-J-3022
c. W-L-3214

E. Available Firestop Systems for Cable Trays:

1. Available UL-Classified Systems: C-AJ-, C-BJ-, F-A-, F-B-, F-C-, W-J-, W-K-, W-L, 4001-4999.

a. C-AJ-4060
b. W-J-4009
c. W-L-4005
d. W-L-4074

F. Firestop Systems for Insulated Pipes:

1. Available UL-Classified Systems: C-AJ-, C-BJ-, F-A-, F-C-, W-J-, W-L-, 5001-5999.

a. C-AJ-5112
b. C-AJ-5029
c. W-J-5038
d. W-J-5012
e. W-L-5014
f. F-C-5014
g. W-L-5240
h. W-L-5144

G. Firestop system for wall: Concrete to exterior wall panel above Waste Room (136)

1. U017

END OF SECTION 078413

CONFIDENTIAL DOCUMENT

079200

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

JOINT SEALANTS

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

079200

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
079200	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Latex joint sealants.

B. Related Sections:

1. Division 04 Section "Unit Masonry" for masonry control and expansion joint fillers and gaskets.
2. Division 07 Section "Fire-Resistive Joint Systems" for sealing joints in fire-resistance-rated construction.
3. Division 09 Section "Gypsum Board" for sealing perimeter joints.

1.3 PRECONSTRUCTION TESTING

A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
2. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
3. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
4. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:

1. Locate test joints where indicated on Project or, if not indicated, as directed by Owner.
2. Conduct field tests for each application indicated below:

a. Each kind of sealant and joint substrate indicated.

3. Notify Owner seven days in advance of dates and times when test joints will be erected.
4. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
5. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.4 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

C. Qualification Data: For qualified Installer.

D. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.

E. Sealant, Waterproofing, and Restoration Institute (SWRI) Validation Certificate: For each sealant specified to be validated by SWRI's Sealant Validation Program.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.

G. Preconstruction Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

H. Preconstruction Field-Adhesion Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.

I. Field-Adhesion Test Reports: For each sealant application tested.

J. Warranties: Sample of special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.

C. Product Testing: Test joint sealants using a qualified testing agency.

1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
2. Test according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.

1.6 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer[or are below 40 deg F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.7 WARRANTY

A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from natural causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

1. Suitability for Immersion in Liquids. Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.

C. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

D. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

E. Colors of Exposed Joint Sealants: As selected by Owner from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

A. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT.

B. Mildew-Resistant, Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.

2.3 LATEX JOINT SEALANTS

A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

2.4 JOINT SEALANT BACKING

A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.5 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

    a. Concrete.
    b. Masonry.

3. Remove laitance and form-release agents from concrete.
4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

    a. Metal.
    b. Glass.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
4. Provide flush joint profile where indicated per Figure 8B in ASTM C 1193.
5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in ASTM C 1193.

    a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.6 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

    a. Control and expansion joints in unit masonry.
    b. Joints between metal panels.
    c. Joints between different materials listed above.
    d. Perimeter joints between materials listed above and frames of doors and windows.
    e. Control and expansion joints in ceilings and other overhead surfaces.
    f. Other joints as indicated.

2. Silicone Joint Sealant: Single component, nonsag, neutral curing, Class 100/50.
3. Joint-Sealant Color: As selected by Owner from manufacturer's full range of colors.

B. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

    a. Control and expansion joints on exposed interior surfaces of exterior walls.
    b. Perimeter joints of exterior openings where indicated.
    c. Vertical joints on exposed surfaces of interior unit masonry, walls and partitions.

d. Perimeter joints between interior wall surfaces and frames of interior doors windows and elevator entrances.
e. Other joints as indicated.

2. Joint Sealant: Latex.
3. Joint-Sealant Color: As selected by Owner from manufacturer's full range of colors.

C. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Sealant Location:

a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
b. Tile control and expansion joints where indicated.
c. Other joints as indicated.

2. Joint Sealant: Mildew resistant, single component, nonsag, neutral curing, Silicone.
3. Joint-Sealant Color: As selected by Owner from manufacturer's full range of colors.

END OF SECTION 079200

CONFIDENTIAL DOCUMENT

081113

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

HOLLOW METAL DOORS AND FRAMES

ImmuCell
Portland, ME

Reviews / Approvals

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The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

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081113

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
081113	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Custom hollow metal doors and frames.

B. Related Sections:

1. Division 08 Section "Door Hardware" for door hardware for hollow metal doors.
2. Division 09 Sections "Interior Painting" for field painting hollow metal doors and frames.
3. Division 26 Sections for electrical connections including conduit and wiring for door controls and operators.
4. Division 08 Section “Glazing” for glass.

1.3 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings.

B. Custom Hollow Metal Work: Hollow metal work fabricated according to ANSI/NAAMM-HMMA 861.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, fire-resistance rating, and finishes.

B. Shop Drawings: Include the following:

1. Elevations of each door design.
2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.
9. Details of conduit and preparations for power, signal, and control systems.

C. Other Action Submittals:

1. Schedule: Provide a schedule of hollow metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of hollow metal door and frame assembly.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain hollow metal work from single source from single manufacturer.

B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10B.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

1. Provide additional protection to prevent damage to finish of factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch high wood blocking. Do not store in a manner that traps excess humidity.

1. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.8 COORDINATION

A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum A40 (ZF120) metallic coating.

C. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z (12G) coating designation; mill phosphatized.

D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

E. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow metal frames of type indicated.

F. Grout: ASTM C 476, except with a maximum slump of 4 inches (102 mm), as measured according to ASTM C 143/C 143M.

G. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. (96- to 192-kg/cu. m) density; with maximum flame-spread and smoke-development indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

H. Glazing: Comply with requirements in Division 08 Section "Glazing."

I. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.2 CUSTOM HOLLOW METAL DOORS

A. General: Provide doors not less than 1-3/4 inches thick, of seamless hollow construction unless otherwise indicated. Construct doors with smooth surfaces without visible joints or seams on exposed faces. Comply with ANSI/NAAMM-HMMA 861.

B. Interior Door Face Sheets: Fabricated from cold-rolled steel sheet unless metallic-coated sheet is indicated, minimum 0.042 inch thick.

C. Core Construction:

1. Steel-Stiffened Core: 0.026-inch thick, steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches apart, spot welded to face sheets a maximum of 5 inches o.c. Spaces filled between stiffeners with glass- or mineral-fiber insulation.

a. Fire Door Core: As required to provide fire-protection ratings indicated.

D. Vertical Edges for Single-Acting Doors: Beveled 1/8 inch in 2 inches.

E. Vertical Edges for Double-Acting Doors: Round vertical edges with 2-1/8-inch radius.

F. Top and Bottom Channels: Closed with continuous channels, minimum 0.053 inch thick, of same material as face sheets and spot welded to both face sheets.

G. Hardware Reinforcement: Fabricate according to ANSI/NAAMM-HMMA 861 with reinforcing plates from same material as door face sheets.

2.3 CUSTOM HOLLOW METAL FRAMES

A. General: Fabricate frames of construction indicated. Close contact edges of corner joints tight with faces mitered and stops butted or mitered. Continuously weld faces and soffits and finish faces smooth. Comply with ANSI/NAAMM-HMMA 861.

1. Door Frames for Openings 48 Inches (1219 mm) Wide or Less: Fabricated from 0.053-inch- (1.3-mm-) thick steel sheet.
2. Door Frames for Openings More Than 48 Inches (1219 mm) Wide: Fabricated from 0.067-inch- (1.7-mm-) thick steel sheet.
3. Frames: Fabricated from same thickness material as adjacent door frame.

B. Interior Frames: Fabricated from cold-rolled steel sheet.

C. Hardware Reinforcement: Fabricate according to ANSI/NAAMM-HMMA 861 with reinforcing plates from same material as frame.

D. Head Reinforcement: Provide minimum 0.093-inch- (2.3-mm-) thick, steel channel or angle stiffener for opening widths more than 48 inches (1219 mm).

2.4 FRAME ANCHORS

A. Jamb Anchors:

1. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.

B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch thick, and as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.

2.5 HOLLOW METAL PANELS

A. Provide hollow metal panels of same materials, construction, and finish as specified for adjoining hollow metal work.

2.6 STOPS AND MOLDINGS

A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch thick, fabricated from same material as door face sheet in which they are installed.

B. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch high unless otherwise indicated.

C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch thick, fabricated from same material as frames in which they are installed.

D. Terminated Stops: Where indicated on interior door frames, terminate stops 6 inches above finish floor with a 45-degree angle cut, and close open end of stop with steel sheet closure. Cover opening in extension of frame with welded-steel filler plate, with welds ground smooth and flush with frame.

1. Provide terminated stops where indicated.

2.7 ACCESSORIES

A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

B. Ceiling Struts: Minimum 1/4-inch-thick by 1-inch- wide steel.

C. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

2.8 FABRICATION

A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/NAAMM-HMMA 861.

C. Hollow Metal Doors:

1. Glazed Lites: Factory cut openings in doors.
2. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.

D. Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
2. Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
3. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
4. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
5. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
6. Jamb Anchors: Provide number and spacing of anchors as follows:

    a. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

        1) Three anchors per jamb up to 60 inches high.
        2) Four anchors per jamb from 60 to 90 inches high.
        3) Five anchors per jamb from 90 to 96 inches high.
        4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
        5) Two anchors per head for frames above 42 inches wide and mounted in metal-stud partitions.

    b. Compression Type: Not less than two anchors in each jamb.
    c. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.

7. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep holes clear during construction.

    a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

E. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.

F. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."

1. Locate hardware as indicated, or if not indicated, according to ANSI/NAAMM-HMMA 861.
2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.

3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

G. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.

1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow metal work.
2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
3. Provide loose stops and moldings on inside of hollow metal work.
4. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

2.9 STEEL FINISHES

A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

B. Color and Gloss: As selected by Owner from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness to the following tolerances:

1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.

C. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with HMMA 840.

1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

a. At fire-protection-rated openings, install frames according to NFPA 80.
b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
c. Install frames with removable glazing stops located on secure side of opening.
d. Install door silencers in frames before grouting.
e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
f. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
g. Field apply bituminous coating to backs of frames that are filled with grout containing antifreezing agents.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.

a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.

4. Ceiling Struts: Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction. Provide adjustable wedged or bolted anchorage to frame jamb members.
5. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:

    a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
    c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Standard Steel Doors:

    a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
    b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
    c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
    d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

D. Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.

1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow metal work immediately after installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

D. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 081113

CONFIDENTIAL DOCUMENT

081119

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

STAINLESS-STEEL DOORS AND FRAMES

ImmuCell
Portland, ME

Reviews / Approvals

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Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

081119

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
081119	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 081119 - STAINLESS-STEEL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following for highly corrosive applications:

1. Stainless-steel, doors and frames.

B. Related Sections include the following:

1. Division 08 Sections for door hardware for stainless-steel doors.
2. Division 08 Section "Glazing" for glazed lites in stainless-steel doors and frames.

1.3 DEFINITIONS

A. Stainless-Steel Sheet Thicknesses: Indicated as the specified thicknesses for which over- and under-thickness tolerances apply, according to ASTM A 480/A 480M.

1.4 SUBMITTALS

A. Product Data: Include construction details, material descriptions, core descriptions, label compliance, fire-resistance and temperature-rise ratings, and finishes for each type of stainless-steel door and frame specified.

B. Shop Drawings: In addition to requirements below, provide a schedule of stainless-steel doors and frames using same reference numbers for details and openings as those on Drawings:

1. Elevations of each door design.
2. Details of doors, including vertical and horizontal edge details.
3. Frame details for each frame type, including dimensioned profiles.
4. Details and locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, accessories, joints, and connections.
7. Details of glazing frames and stops showing glazing.
8. Details of conduit and preparations for electrified door hardware and controls.

C. Qualification Data: For Installer.

D. Product Test Reports: Based on evaluation of comprehensive fire tests performed by a qualified testing agency, for each type of stainless-steel door and frame.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Source Limitations: Obtain stainless-steel doors and frames through one source from a single manufacturer.

C. Fire-Rated Door Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated.

1. Test Pressure: Test at atmospheric (neutral) pressure according to NFPA 252 or UL 10B.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver doors and frames palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store doors and frames under cover at Project site. Place units in a vertical position with heads up, spaced by blocking, on minimum 4-inch- high, wood blocking. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber.

1. If wrappers on doors become wet, remove cartons immediately. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify openings by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating stainless-steel frames without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to established dimensions.

1.8 COORDINATION

A. Coordinate installation of anchorages for stainless-steel frames.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stainless-Steel Sheet: ASTM A 666, austenitic stainless steel, Type indicated.

2.2 STAINLESS-STEEL DOORS AND FRAMES

A. Doors are to be ASI Doors, Inc Cleanseal Fire doors or approved equal.

1. Single Swinging U.L. Rated Fire Door: Model 220SSF
2. Paired Swinging U.L. Rated Fire Door: Model 235SSF

B. Door size to fit door opening as shown on architectural drawings.

C. Door shall be hours of fire ratings as indicated on the drawigns.

D. All door components to be constructed from 304, #4 brush stainless steel, including internal components, reinforcements, and anchorages. All hardware reinforcements to be minimum 12 gauge stainless steel.

E. Door panel shall be 1-3/4" thick, made of 16 gauge type 304 stainless steel. Door shall be polished to a #4 finish with the grain running vertically. Finish to be covered by a protective plastic. Door shall have INVISIBLE EDGE SEAMS continuously welded, ground smooth, refinished, and repolished on all four sides and corners or panel. Door bevel shall be 1/8" bevel on 2".

F. Door shall have a U.L. rated honeycomb core completely filling the inside of the door and laminated to both face skins.

G. Stainless steel door frame shall be 16 gauge 304, #4 finish with industry standard 2" face with variable profile. Frame shall be continuously welded units. Corner joints shall have all contact edges closed tight. Faces to be mitered, welded, ground smooth and polished.

H. Standard hardware to include:

1. Stainless steel butt hinges applied with stainless steel fasteners.
2. Positive latching device constructed of stainless steel on exposed surfaces.
3. Standard closer with stainless steel covers.
4. Gasket at sides, head, and sill to be non-marking.

I. Manufactures standard window kit with 45 degree sloped stainless steel frame.

2.3 FABRICATION

A. General: Fabricate stainless-steel doors and frames to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Stainless-Steel Doors: Comply with ANSI A250.4, Level A.

1. Edges: Door face sheets joined at vertical edges by continuous weld extending full height of door; with edges ground and polished, providing smooth, flush surfaces with no visible seams.

C. Stainless-Steel Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated from same thickness metal as frames.

1. Jamb Anchors: Provide number and spacing of anchors as follows:

a. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

1) Three anchors per jamb up to 60 inches in height.
2) Four anchors per jamb from 60 to 90 inches in height.
3) Five anchors per jamb from 90 to 96 inches in height.
4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof more than 96 inches in height.
5) Two anchors per head for frames more than 42 inches wide and mounted in metal-stud partitions.

D. Hardware Preparation: Factory prepare stainless-steel doors and frames to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping, according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."

1. Reinforce doors and frames to receive nontemplated mortised and surface-mounted door hardware.
2. Locate door hardware as indicated, or if not indicated, according to HMMA 831, "Recommended Hardware Locations for Custom Hollow Metal Doors and Frames."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of stainless-steel doors and frames.

1. Examine roughing-in for embedded and built-in anchors to verify actual locations of stainless-steel door-frame connections before frame installation.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prior to installation and with installation spreaders in place, adjust and securely brace stainless-steel door frames for squareness, alignment, twist, and plumb to the following tolerances:

1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.

B. Drill and tap doors and frames to receive nontemplated mortised and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install stainless-steel doors and frames plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Stainless-Steel Frames: Install stainless-steel frames for doors and other openings, of size and profile indicated.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

    a. At fire-protection-rated openings, install frames according to NFPA 80.
    b. Where frames are fabricated in sections due to shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
    c. Check plumb, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor and secure with postinstalled expansion anchors.

    a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors, if so indicated and approved on Shop Drawings.

3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.

4. Installation Tolerances: Adjust stainless-steel door frames for squareness, alignment, twist, and plumb to the following tolerances:

    a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
    c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Stainless-Steel Doors: Fit non-fire-rated doors accurately in frames with the following clearances:

1. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work including stainless-steel doors or frames that are warped, bowed, or otherwise unacceptable.

B. Clean grout and other bonding material off stainless-steel doors and frames immediately after installation.

C. Stainless-Steel Touchup: Immediately after erection, smooth any abraded areas of stainless steel and polish to match undamaged finish.

END OF SECTION 081119

CONFIDENTIAL DOCUMENT

081300

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

FIBERGLASS REINFORCED PANEL (FRP) DOORS AND FRAMES

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
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ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

081300

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
081300	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 081300 – FIBERGLASS REINFORCED PANEL (FRP) DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. FRP Doors.
2. Stainless-steel frames.

1.3 DEFINITIONS

A. Stainless-Steel Sheet Thicknesses: Indicated as the specified thicknesses for which over- and under-thickness tolerances apply, according to ASTM A 480/A 480M.

1.4 SUBMITTALS

A. Product Data: Include construction details, material descriptions, core descriptions, label compliance and finishes for each type of door and frame specified.

B. Shop Drawings: In addition to requirements below, provide a schedule of doors and frames using same reference numbers for details and openings as those on drawings:

1. Elevations of each door design.
2. Details of doors, including vertical and horizontal edge details.
3. Frame details for each frame type, including dimensioned profiles.
4. Details and locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, accessories, joints, and connections.
7. Details of glazing frames and stops showing glazing.
8. Details of conduit and preparations for electrified door hardware and controls.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Source Limitations: Obtain doors and frames through one source from a single manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver doors and frames palletized, wrapped, or crated to provide protection during transit and Project-site storage.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store doors and frames under cover at Project site. Place units in a vertical position with heads up, spaced by blocking, on minimum 4-inch high, wood blocking.

1. If wrappers on doors become wet, remove cartons immediately. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify openings by field measurements before fabrication and indicate measurements on Shop Drawings.

1.8 COORDINATION

A. Coordinate installation of anchorages for stainless-steel frames.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stainless-Steel Sheet: ASTM A 666, austenitic stainless steel, Type indicated.

2.2 DOORS (SINGLE)

A. CleanSeal Model 220 Excel Single Swinging Seamless Molded Fiberglass Door System as manufactured by CLEANSEAL Division of ASI Technologies, Inc., Milwaukee, WI.

1. Door size to fit door opening as shown on drawings.
2. Door shall be Manual Single Swinging Seamless Molded Fiberglass Cleanroom Door System.
3. Door panel shall consist of two molded fiberglass reinforced polyester shells surfaced with white polyester gel-coat and bonded into a seamless unit. Corners and edges to be reinforced to a thickness of 5/8". Panel to be reinforced with an internal 16 gauge channel steel frame with 1/4" steel attachment plates for attaching panels. Also, a 20 gauge 304 stainless steel edge capping will be attached on all four sides of panel for added strength and protection.
4. 1-3/4" thick panel to be unitized and filled with pour-type polyurethane foam insulation (rated at -R-16) having a “K” factor of .12 at 75° F.

5. Frame shall be 16 gauge, 304 stainless steel with 2” face, mitered in the corners, welded, ground and polished, providing smooth, flush seamless surfaces. Additionally the mitered corners must be continuously welded through the throat (rabbet(s) and stop) eliminating any seams or the appearance of seams.
6. Hardware to include:

Door Hardware Set No. 2F		
Single – Side Hinged Door Presentation of valid card will release maglock and allow entry and then relock. Interlocked door. Each to have the following:		
No.	Item	Description
*	Hanging Devices	Stainless Steel Butt Hinges HAGER BB1191 SS Fully Mortised Hinges
2	Operating Trim	Stainless Steel - Fixed
1	Closing Devices	Stainless Steel Parallel Arm
2	Protection Plate	Stainless Steel 3’-0” W 24” H Kick Plate
1	Emergence Release Button	
1	Set of Contacts	
1	Card Reader	
* Number of hinges, as specified.		

7. Stainless steel push/pull handles, constructed of stainless steel on exposed surfaces.
8. Closer to manual open and spring assist close.
9. Frame mounted, three-sided bulb type perimeter gasket and bottom sweep gasket.

2.3 DOORS (DOUBLE)

A. CleanSeal Model 230 Excel Paired Swinging Seamless Molded Fiberglass Door Systems as manufactured by CLEANSEAL Division of ASI Technologies, Inc., Milwaukee, WI.

1. Door size to fit door opening as shown on drawings.
2. Doors shall be electric power operated, Paired Swinging Seamless Molded Fiberglass Cleanroom Door System.
3. Door panel shall consist of two molded fiberglass reinforced polyester shells surfaced with white polyester gel-coat and bonded into a seamless unit. Corners and edges to be reinforced to a thickness of 5/8". Panel to be reinforced with an internal 16 gauge channel steel frame with 1/4" steel attachment plates for attaching panels. Also, a 20 gauge 304 stainless steel edge capping will be attached on all four sides of panel for added strength and protection.
4. 1-3/4" thick panel to be unitized and filled with pour-type polyurethane foam insulation (rated at -R-16) having a “K” factor of .12 at 75° F.
5. Frame shall be 16 gauge, 304 stainless steel with 2” face, mitered in the corners, welded, ground and polished, providing smooth, flush seamless surfaces. Additionally the mitered corners must be continuously welded through the throat (rabbet(s) and stop) eliminating any seams or the appearance of seams.

6. Hardware to include:

Door Hardware Set No. 1F		
Double – Side Hinged Door Free ingress and egress from both sides at all times. Depressing exit hardware will retract bolt and allow egress. Each to have the following:		
No.	Item	Description
*	Hanging Devices	Stainless Steel Butt Hinges HAGER BB1191 SS Fully Mortised Hinges
2	Exit Device	Stainless Steel
2	Operating Trim	Stainless Steel
2	Latch Set	Stainless Steel Passage
2	Closing Devices	Stainless Steel Parallel Arm
4	Protection Plate	Stainless Steel 3’-0” W 24” H Kick Plate
* Number of hinges, as specified.		

a. Stainless steel butt hinges, applied with stainless steel fasteners
b. Push/pull handles, constructed of stainless steel on exposed surfaces.
c. Frame mounted, three-sided bulb type perimeter gasket and bottom sweep gasket.
d. Closer to manual open and spring assist close.
e. Frame mounted, three-sided bulb type perimeter gasket and bottom sweep gasket.
f. Push plate to open; time delay to close.
g. In case of power failure, door can be opened manually at any time.
h. Door actuation to be provided.
i. Swing side of door to be protected by a head mounted active reflecting infrared motion sensor

2.4 VISION PANEL

A. Vision panel option will include two 45 degree sloped stainless steel frames connected internally with no exposed fasteners on either side of the door panel. Also include factory installed 1/4" tempered glass.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of stainless-steel doors and frames.

1. Examine roughing-in for embedded and built-in anchors to verify actual locations of stainless-steel door-frame connections before frame installation.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory.

B. Prior to installation and with installation spreaders in place, adjust and securely brace door frames for squareness, alignment, twist, and plumb to the following tolerances:

1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.

C. Drill and tap doors and frames to receive nontemplated mortised and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install doors and frames plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Install the work in accordance with manufacturer instructions.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work including stainless-steel doors or frames that are warped, bowed, or otherwise unacceptable.

B. Clean grout and other bonding material off doors and frames immediately after installation.

C. Stainless-Steel Touchup: Immediately after erection, smooth any abraded areas of stainless steel and polish to match undamaged finish.

END OF SECTION 081300

CONFIDENTIAL DOCUMENT

083327

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

FABRIC DOOR

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
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ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

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083327

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
083327	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 083327 – FABRIC DOOR

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. High speed traffic doors.

1.2 RELATED SECTIONS

A. Section 087100 - Door Hardware.

B. Section 260519 - Low Voltage Electrical Power Conductors and Cables.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for each type of traffic door. Include both published data and any specific data prepared for this project.

B. Shop Drawings: Submit shop drawings for approval prior to fabrication. Include detailed plans, elevations, framing member details, required clearances, anchors, and accessories. Include relationship with adjacent materials.

1.4 QUALITY ASSURANCE

A. Manufacturer: High speed doors shall be manufactured by firm with minimum of five years experience in the fabrication and installation of upward acting doors. Manufacturers proposed for use, which are not named in these specifications, shall submit evidence of ability to meet performance and fabrication requirements specified.

B. Installer: Installation of traffic doors shall be performed by an authorized representative of the manufacturer.

C. Single-Source Responsibility: Provide secondary components from source acceptable to manufacturer of primary components.

D. Pre-Installation Conference: Schedule and convene a pre-installation conference at least five days prior to commencement of field operations, to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials and products in labeled protective packages. Store and handle in strict compliance with manufacturer's instructions and recommendations. Protect from damage from weather, excessive temperatures and construction operations.

PART 2 - PRODUCTS

2.1 HIGH SPEED TRAFFIC DOORS

A. Curtain: 2.0mm – 2.5mm thick Multi-ply PVC impregnated fabric, with positive tensioning system to resist windload effects during operation, with traveling tubular windbars.

B. Color: As selected from Manufacturer's Standard

C. Vision Panels: clear vision panels; can combined to create full-width vision.

D. Bottom Bar: Extruded aluminum profile breakaway bottom bar with integral microswitches at each end of bar to stop motor and activate alarm mode when breakout condition exists. Internal curtain attachment. Bottom bar to incorporate a four-wire, fail-safe electric sensing edge that is black/yellow safety striped.

E. Guides: Black anodized, extruded aluminum with integral vinyl weatherseals and steel U-shaped channels to protect the guide from damage. Complete assembly with factory assembled photoelectric sensors.

F. Operator: Modular chain drive, gear motor/brake assembly in hp per manufacturers recommendation, with upward door speed of 36"/sec, and downward door speed of 36"/sec. Operator, drive assembly and limit switches are factory preassembled and installed.

G. Door Roll: Sprocket drive, steel tube with integral shafts, keyed on both ends, and supported by self-aligning sealed bearings.

H. Hood Assembly: Black painted steel extending full width between support brackets with full width brush seals.

1. Area detection system: Extend beyond the immediate door opening on both sides, reversing the downward motion of the door when a person or object enters the protected area.
2. Photoelectric sensors: Cast an invisible beam across the door opening and reverse the downward motion of the door when an object enters the path of the beam.
3. A four wire, black/yellow striped, self-monitoring, fail-safe sensing edge reverses the downward motion of the door upon impact.
4. Motor cutout switches located in the breakaway bottom bar, stop the motor and activate alarm mode when breakaway occurs.

I. Actuation: Loop detectors, radio control, push buttons, motion detectors, pull cords or combinations.

J. Control Panels: Programmable logic controller with microprocessor self diagnostics. LED readouts indicate door action, alarm conditions and fault conditions. LED readouts to be visible through clear panel on controller box cover. Enclosure to be NEMA 12 rated.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examine conditions of substrates, supports, and other conditions under which this work is to be performed. Do not proceed with work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Strictly comply with manufacturer's installation instructions and recommendations. Coordinate installation with adjacent work to ensure proper clearances and allow for maintenance.

B. Instruct Owner's personnel in proper operating procedures and maintenance schedule.

3.3 ADJUSTING AND CLEANING

A. Test high speed traffic doors for proper operation and adjust as necessary to provide proper operation without binding or distortion.

B. Touch-up damage coatings and finishes and repair minor damage prior to substantial completion. Clean exposed surfaces using non-abrasive materials and methods recommended by manufacturer of material or product being cleaned.

END OF SECTION 083227

CONFIDENTIAL DOCUMENT

085113

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

ALUMINUM WINDOWS

ImmuCell
Portland, ME

Reviews / Approvals

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ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

085113

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
085113	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 085113 - ALUMINUM WINDOWS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes fixed and operable aluminum-framed windows for interior and exterior locations.

1.3 DEFINITIONS

A. Performance class designations according to AAMA/WDMA 101/I.S.2/NAFS:

1. HC: Heavy Commercial.

B. Performance grade number according to AAMA/WDMA 101/I.S.2/NAFS:

1. Design pressure number in pounds force per square foot used to determine the structural test pressure and water test pressure.

C. Structural Test Pressure: For uniform load structural test, is equivalent to 150 percent of the design pressure.

D. Minimum Test Size: Smallest size permitted for performance class (gateway test size). Products must be tested at minimum test size or at a size larger than minimum test size to comply with requirements for performance class.

1.4 PERFORMANCE REQUIREMENTS

A. General: Provide aluminum windows capable of complying with performance requirements indicated, based on testing manufacturer's windows that are representative of those specified, and that are of minimum test size indicated below:

1. Size required by AAMA/WDMA 101/I.S.2/NAFS for gateway performance for both gateway performance and optional performance grade.
2. Size indicated on Drawings.

B. Structural Performance: Provide aluminum windows capable of withstanding the effects of the following loads, based on testing units representative of those indicated for Project that pass AAMA/WDMA 101/I.S.2/NAFS, Uniform Load Structural Test:

1. Deflection: Design glass framing system to limit lateral deflections of glass edges to less than 1/175 of glass-edge length or 3/4 inch, whichever is less, at design pressure based on testing performed according to AAMA/WDMA 101/I.S.2/NAFS, Uniform Load Deflection Test or structural computations.

C. Thermal Movements: Provide aluminum windows, including anchorage, that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F material surfaces.

1.5 SUBMITTALS

A. Product Data: Include construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, and operating instructions for each type of aluminum window indicated.

B. Shop Drawings: Include plans, elevations, sections, details, hardware, attachments to other work, operational clearances, installation details, and the following:

1. Mullion details, including reinforcement and stiffeners.
2. Joinery details.
3. Expansion provisions.
4. Flashing and drainage details.
5. Weather-stripping details.
6. Thermal-break details.
7. Glazing details.

C. Warranty: Special warranty specified in this Section.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An installer acceptable to aluminum window manufacturer for installation of units required for this Project.

B. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting this performance by inclusion in lists and by labels, test reports, and calculations.

C. Source Limitations: Obtain aluminum windows through one source from a single manufacturer.

D. Glazing Publications: Comply with published recommendations of glass manufacturers and with GANA's "Glazing Manual" unless more stringent requirements are indicated.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify aluminum window openings by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating aluminum windows without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to established dimensions.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure to meet performance requirements.
b. Structural failures including excessive deflection, water leakage, air infiltration, or condensation.
c. Faulty operation of movable sash and hardware.
d. Deterioration of metals, other materials, and metal finishes beyond normal weathering.
e. Failure of insulating glass.

2. Warranty Period:

a. Window: Two years from date of Substantial Completion.
b. Glazing: Five years from date of Substantial Completion.
c. Metal Finish: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum Extrusions: Alloy and temper recommended by aluminum window manufacturer for strength, corrosion resistance, and application of required finish, but not less than 22,000-psi ultimate tensile strength, not less than 16,000-psi minimum yield strength, and not less than 0.062-inch thickness at any location for the main frame and sash members.

B. Fasteners: Aluminum, nonmagnetic stainless steel, epoxy adhesive, or other materials warranted by manufacturer to be noncorrosive and compatible with aluminum window members, trim, hardware, anchors, and other components.

1. Reinforcement: Where fasteners screw anchor into aluminum less than 0.125 inch thick, reinforce interior with aluminum or nonmagnetic stainless steel to receive screw threads, or provide standard, noncorrosive, pressed-in, splined grommet nuts.

2. Exposed Fasteners: Unless unavoidable for applying hardware, do not use exposed fasteners. For application of hardware, use fasteners that match finish of member or hardware being fastened, as appropriate.

C. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.

D. Reinforcing Members: Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.

E. Sealant: For sealants required within fabricated windows, provide window manufacturer's standard, permanently elastic, nonshrinking, and nonmigrating type recommended by sealant manufacturer for joint size and movement.

2.2 WINDOW

A. Window Type: Fixed.

B. AAMA/WDMA Performance Requirements: Provide aluminum windows of performance indicated that comply with AAMA/WDMA 101/I.S.2/NAFS unless more stringent performance requirements are indicated.

1. Performance Class and Grade: HC 45.

C. Life-Cycle Testing: Test according to AAMA 910 and comply with AAMA/WDMA 101/I.S.2/NAFS.

2.3 GLAZING

A. Glazing System: Manufacturer's standard tempered factory-glazing system that produces airtight seal.

2.4 FABRICATION

A. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.

B. Fabricate aluminum windows that are reglazable without dismantling sash or ventilator framing.

C. Factory-Glazed Fabrication: Glaze aluminum windows in the factory where practical and possible for applications indicated. Comply with requirements of AAMA/WDMA 101/I.S.2/NAFS.

D. Glazing Stops: Provide snap-on glazing stops and glazing system indicated. Provide glazing stops to match sash and ventilator frames.

2.5 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 611.

1. Color: As selected by Owner from full range of industry colors and color densities.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work. Verify rough opening dimensions, levelness of sill plate, and operational clearances. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure a coordinated, weathertight window installation.

1. Metal Surfaces: Dry; clean; free of grease, oil, dirt, rust, corrosion, and welding slag; without sharp edges or offsets at joints.

3.2 INSTALLATION

A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing windows, hardware, accessories, and other components.

B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.

C. Set sill members in bed of sealant or with gaskets, as indicated, for weathertight construction.

D. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.

E. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.3 ADJUSTING, CLEANING, AND PROTECTION

A. Adjust operating sashes and ventilators, screens, hardware, operators, and accessories for a tight fit at contact points and weather stripping for smooth operation and weathertight closure. Lubricate hardware and moving parts.

B. Clean aluminum surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

C. Clean factory-glazed glass immediately after installing windows. Comply with manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels, and clean surfaces.

D. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

E. Protect window surfaces from contact with contaminating substances resulting from construction operations. In addition, monitor window surfaces adjacent to and below exterior concrete and masonry surfaces during construction for presence of dirt, scum, alkaline deposits, stains, or other contaminants. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written recommendations.

END OF SECTION 085113

CONFIDENTIAL DOCUMENT

085123

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

STAIN ESS STEEL WINDOWS

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

085123

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
085123	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 085123 – STAINLESS STEEL WINDOWS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Stainless Steel Windows

1.3 PERFORMANCE REQUIREMENTS

A. Air Infiltration for Non-Weather-Stripped Ventilators: Not more than 0 cfm/ft. of ventilator crack length at an inward test pressure of 6.24 lbf/sq. ft. when tested according to ASTM E 283.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, and operating instructions.

B. Shop Drawings: Include plans, elevations, sections, details, hardware, attachments to other work, operational clearances, installation details, and the following:

1. Mullion details including reinforcement and stiffeners.
2. Joinery details.
3. Expansion provisions.
4. Flashing and drainage details.
5. Glazing details.
6. Window-cleaning provisions.
7. Accessories.

C. Field quality-control reports.

D. Warranties: Sample of special warranty.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer capable of fabricating steel windows that meet or exceed performance requirements indicated and of documenting this performance by inclusion in lists, and by labels, test reports, and calculations.

B. Installer Qualifications: An installer acceptable to window manufacturer for installation of units required for this Project.

1. Installer's responsibilities include providing professional engineering services needed to assume engineering responsibility including preparation of data for steel windows, including Shop Drawings and Designated Design Submittal based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

C. Source Limitations: Obtain steel windows from single source from single manufacturer.

D. SWI Publication: Comply with applicable requirements in SWI's "The Architect's Guide to Steel Windows and Doors" except where more stringent requirements are indicated.

E. Window units are to meet room cleanroom classifications.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of steel window openings by field measurements before fabrication.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of steel windows that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure to meet performance requirements.
b. Structural failures including excessive deflection.
c. Water leakage or air infiltration.
d. Faulty operation of operable sash and hardware.
e. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Period: Three years from date of Substantial Completion.
3. Warranty Period for Metal Finishes: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Fasteners: Provide fasteners of stainless steel, or other metal that are warranted by manufacturer to be noncorrosive and compatible with trim, hardware, anchors, and other components of steel windows.

B. Anchors, Clips, and Window Accessories: Provide units of stainless steel with ASTM A 123/A 123M. Provide units with sufficient strength to withstand design pressure indicated.

C. Glazing Stops: Stainless steel.

D. Sealant: For sealants required within fabricated windows, provide manufacturer's standard, permanently elastic, nonshrinking, and nonmigrating type recommended by sealant manufacturer for joint size and movement.

2.2 WINDOW

A. Window Type: Fixed.

B. Stainless steel window frames shall be 16 gauge 304, #4 finish with standard 2" face profile. Frame shall be continuously welded units. Corner joints shall have all contact edges closed tight. Faces to be mitered, welded, ground smooth and polished.

1. Frame Depth: Match Wall Thickness, Flush Glazing
2. Window Finish: Stainless Steel

2.3 GLAZING

A. Glass: Uncoated clear float glass.

2.4 ACCESSORIES

A. General: Provide manufacturer's standard accessories that comply with indicated standards.

B. Window Cleaner Anchor Bolts: Provide window cleaner anchor bolts of standard design, complying with requirements of authorities having jurisdiction. Fabricate bolts of nonmagnetic stainless steel.

1. Reinforce window units or mullions to receive bolts and provide additional anchorage of units at bolt locations.

2.5 FABRICATION

A. General: Fabricate steel windows of type and in sizes indicated to comply with SWI standards. Include a complete system for assembly of components and anchorage of window units.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Verify rough opening dimensions and levelness of sill.

1. Metal Surfaces: Dry, clean, and free of grease, oil, dirt, rust, corrosion, and welding slag; without sharp edges or offsets at joints.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing windows, hardware, operators, accessories, and other components.

B. Install windows level, plumb, square, true to line, without distortion or impediment to thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.

C. Set sill members in bed of sealant or with gaskets, as indicated, to provide weathertight construction.

D. Install windows and components to drain condensation, water-penetrating joints, and moisture migrating within windows to the exterior.

E. Separate corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials according to ASTM E 2112, Section 5.12 "Dissimilar Materials."

3.3 ADJUSTING, CLEANING, AND PROTECTION

A. Clean factory-finished steel surfaces immediately after installing windows. Comply with manufacturer's written recommendations for final cleaning and maintenance. Avoid damaging protective coatings and finishes.

B. Clean glass immediately after installing windows. Comply with manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels, and clean surfaces.

C. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

D. Protect window surfaces from contact with contaminating substances resulting from construction operations. Remove contaminants immediately according to manufacturer's written recommendations.

E. Refinish or replace windows with damaged finish.

END OF SECTION 085123

CONFIDENTIAL DOCUMENT

087100

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

DOOR HARDWARE

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

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CONFIDENTIAL DOCUMENT

087100

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
087100	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Commercial door hardware for the following:

a. Swinging doors.

2. Cylinders for doors specified in other Sections.
3. Electrified door hardware.

B. Related Sections include the following:

1. Division 08 Section "Hollow Metal Doors and Frames" for door silencers provided as part of hollow-metal frames.
2. Division 08 Section "Overhead Coiling Doors" for door hardware provided as part of overhead door assemblies.
3. Division 26 Sections for connections to electrical power system and for low-voltage wiring work.
4. Division 28 Section "Access Control" for access control devices installed at door openings and provided as part of a security access system.
5. Division 28 Section "Intrusion Detection" for detection devices installed at door openings and provided as part of an intrusion detection system.
6. Division 28 Section "Fire Detection and Alarm" for connections to building fire alarm system.

1.3 SUBMITTALS

A. Product Data: Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Details of electrified door hardware, indicating the following:

1. Wiring Diagrams: Power, signal, and control wiring. Include the following:

a. System schematic.
b. Point-to-point wiring diagram.

c. Riser diagram.
d. Elevation of each door.

2. Detail interface between electrified door hardware and fire alarm, access control, security and building control systems.
3. Operation Narrative: Describe the operation of doors controlled by electrified door hardware.
4. Templates: All required templates shall be furnished in accordance with the hardware schedule. Furnish templates to the door and frame manufacturer sufficiently in advance so as not to delay progress of the work. Do not issue templates or order materials until the schedule has been approved.

C. Product Certificates: For electrified door hardware, signed by product manufacturer.

1. Certify that door hardware approved for use on types and sizes of labeled fire doors complies with listed fire door assemblies.

D. Qualification Data: For Installer.

E. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware and keying schedule.

F. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by lock manufacturer.

1. Installer's responsibilities include supplying and installing door hardware and providing a qualified Architectural Hardware Consultant available during the course of the Work to consult with Contractor and Owner about door hardware and keying.
2. Installer shall have warehousing facilities in Project's vicinity.
3. Scheduling Responsibility: Preparation of door hardware and keying schedules.

B. Source Limitations: Obtain each type and variety of door hardware from a single manufacturer, unless otherwise indicated.

1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.

D. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.

B. Tag each item or package separately with identification related to the final door hardware sets, and include basic installation instructions, templates, and necessary fasteners with each item or package.

C. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

1.6 COORDINATION

A. Coordinate layout and installation of recessed closers with floor construction. Cast anchoring inserts into concrete. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Templates: Distribute door hardware templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Electrical System Roughing-in: Coordinate layout and installation of electrified door hardware with connections to power supplies, fire alarm system and detection devices, access control system, security system and building control system.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Structural failures including excessive deflection, cracking, or breakage.
    b. Faulty operation of operators and door hardware.
    c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: Three years from date of Substantial Completion, except as follows:

    a. Locks: Five years from date of Substantial Completion.
    b. Exit Devices: Two years from date of Substantial Completion.
    c. Manual Closers: 10 years from date of Substantial Completion.

1.8 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

B. Maintenance Service: Beginning at Substantial Completion, provide six months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door hardware operation. Provide parts and supplies same as those used in the manufacture and installation of original products.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in this Section and door hardware sets indicated in door and frame schedule and door hardware sets indicated in Part 3 "Door Hardware Sets" Article.

1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products equivalent in function and comparable in quality to named products and products complying with BHMA standard referenced.
2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.

B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Sets" Article. Products are identified by using door hardware designations, as follows:

1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in Part 3 "Door Hardware Sets" Article.
2. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.

2.2 HINGES, GENERAL

A. Quantity: Provide the following, unless otherwise indicated:

1. Two Hinges: For doors with heights up to 60 inches (1524 mm).
2. Three Hinges: For doors with heights 61 to 90 inches (1549 to 2286 mm).
3. Four Hinges: For doors with heights 91 to 120 inches (2311 to 3048 mm).
4. For doors with heights more than 120 inches (3048 mm), provide 4 hinges, plus 1 hinge for every 30 inches (750 mm) of door height greater than 120 inches (3048 mm).

B. Template Requirements: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.

C. Hinge Weight: Unless otherwise indicated, provide the following:

1. Entrance Doors: Heavy-weight hinges.
2. Doors with Closers: Antifriction-bearing hinges.
3. Interior Doors: Standard-weight hinges.

D. Hinge Base Metal: Unless otherwise indicated, provide the following:

1. Exterior Hinges: Stainless steel, with stainless-steel pin.
2. Interior Hinges: Stainless steel, with stainless-steel pin.
3. Hinges for Fire-Rated Assemblies: Stainless steel, with stainless-steel pin.

E. Hinge Options: Where indicated in door hardware sets or on Drawings:

1. Hospital Tips: Slope ends of hinge barrel.
2. Safety Stud: Designed for stud in one leaf to engage hole in opposing leaf.
3. Maximum Security Pin: Fix pin in hinge barrel after it is inserted.
4. Nonremovable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for outswinging exterior doors and outswinging corridor doors with locks.
5. Corners: 5/8-inch (16-mm) radius.

F. Electrified Functions for Hinges: Comply with the following:

1. Power Transfer: Concealed PTFE-jacketed wires, secured at each leaf and continuous through hinge knuckle.
2. Monitoring: Concealed electrical monitoring switch.
3. Power Transfer and Monitoring: Concealed PTFE-jacketed wires, secured at each leaf and continuous through hinge knuckle, and with concealed electrical monitoring switch.

G. Fasteners: Comply with the following:

1. Machine Screws: For metal doors and frames. Install into drilled and tapped holes.
2. Wood Screws: For wood doors and frames.
3. Threaded-to-the-Head Wood Screws: For fire-rated wood doors.
4. Screws: Phillips flat-head; machine screws (drilled and tapped holes) for metal doors. Finish screw heads to match surface of hinges.

2.3 HINGES

A. Butts and Hinges: BHMA A156.1. Listed under Category A in BHMA's "Certified Product Directory."

B. Template Hinge Dimensions: BHMA A156.7.

2.4 CONTINUOUS HINGES

A. Standard: BHMA A156.26, Grade 1-150.

1. Listed under Category N in BHMA's "Certified Product Directory."

B. General: Minimum 0.120-inch- (3.0-mm-) thick, hinge leaves with minimum overall width of 4 inches (102 mm); fabricated to full height of door and frame and to template screw locations; with components finished after milling and drilling are complete.

1. Fire Pins: Steel pins to hold labeled fire doors in place if required by tested listing.

C. Continuous, Barrel-Type Hinges: Hinge with knuckles formed around a pin that extends entire length of hinge.

1. Base Metal for Exterior Hinges: Stainless steel.
2. Base Metal for Interior Hinges: Stainless steel.
3. Base Metal for Hinges for Fire-Rated Assemblies: Stainless steel.

2.5 LOCKS AND LATCHES, GENERAL

A. Accessibility Requirements: Where indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)." ANSI A117.1.

1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22 N).

B. Latches and Locks for Means of Egress Doors: Comply with NFPA 101. Latches shall not require more than 15 lbf (67 N) to release the latch. Locks shall not require use of a key, tool, or special knowledge for operation.

C. Electrified Locking Devices: BHMA A156.25.

D. Lock Trim:

1. Levers: Cast.
2. Knobs: Cast.
3. Escutcheons (Roses): Cast.
4. Dummy Trim: Match knobs or lever lock trim and escutcheons.

E. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:

1. Mortise Locks: Minimum 3/4-inch (19-mm) latchbolt throw.

F. Rabbeted Meeting Doors: Provide special rabbeted front and strike on locksets for rabbeted meeting stiles.

G. Backset: 2-3/4 inches (70 mm), unless otherwise indicated.

H. Strikes: Manufacturer's standard strike with strike box for each latchbolt or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, and as follows:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.

2.6 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: Function numbers and descriptions indicated in door hardware sets comply with the following:

1. Mortise Locks: BHMA A156.13.

B. Mortise Locks: Stamped steel case with steel or brass parts; BHMA A156.13, Grade 1; Series 1000. Listed under Category F in BHMA's "Certified Product Directory."

2.7 AUXILIARY LOCKS AND LATCHES

A. Auxiliary Locks: BHMA A156.5, Grade 1. Listed under Category E in BHMA's "Certified Product Directory."

2.8 EXIT LOCKS AND EXIT ALARMS

A. Exit Locks: BHMA A156.29, Grade 1, surface mounted, battery powered, housed in metal case; with red-and-white lettering reading "EMERGENCY EXIT PUSH TO OPEN--ALARM WILL SOUND." Include the following features:

1. Low-battery alert.
2. Outside key control.
3. Audible alarm that sounds when unauthorized use of door occurs.
4. Silent alarm with remote signal capability for connection to remote indicating panel.

2.9 EXIT DEVICES

A. Exit Devices: BHMA A156.3, Grade 1. Listed under Category G in BHMA's "Certified Product Directory."

B. Accessibility Requirements: Where handles, pulls, latches, locks, and other operating devices are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)." ANSI A117.1.

1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22 N).

C. Exit Devices for Means of Egress Doors: Comply with NFPA 101. Exit devices shall not require more than 15 lbf (67 N) to release the latch. Locks shall not require use of a key, tool, or special knowledge for operation.

D. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.

E. Fire Exit Devices: Devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252.

F. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.

1. Operation: Movable.

G. Outside Trim: Lever ; material and finish to match locksets, unless otherwise indicated.

1. Match design for locksets and latchsets, unless otherwise indicated.

H. Electronic Exit Bars: Nonlatching electronic releasing device, activated by an adjustable capacitance sensor, with no moving parts; listed and labeled as panic exit hardware. Fabricate bar from extruded aluminum, and provide door and frame transfer device and 16 feet (4.9 m) of cord to route wiring off the door frame.

2.10 LOCK CYLINDERS

A. High-Security Lock Cylinders: BHMA A156.30, Grade 1.

1. Key Control Level: Category A.
2. Destructive Test Level: Category A.
3. Surreptitious Entry Resistance Level: Category A.

B. Cylinders: Manufacturer's standard tumbler type, constructed from brass or bronze, stainless steel, or nickel silver, and complying with the following:

1. Number of Pins: Six.
2. Mortise Type: Threaded cylinders with rings and straight- or clover-type cam.

a. High-Security Grade: BHMA A156.5, Grade 1A, listed and labeled as complying with pick- and drill-resistant testing requirements in UL 437 (Suffix A).

C. Permanent Cores: Manufacturer's standard; finish face to match lockset; complying with the following:

1. Interchangeable Cores: Core insert, removable by use of a special key; usable with other manufacturers' cylinders.
2. Removable Cores: Core insert, removable by use of a special key; for use only with core manufacturer's cylinder and door hardware.

D. Construction Keying: Comply with the following:

1. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.
2. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

a. Replace construction cores with permanent cores as directed by Owner.
b. Furnish permanent cores to Owner for installation.

E. Manufacturer: Same manufacturer as for locks and latches.

2.11 KEYING

A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference, and as follows:

1. Master Key System: Cylinders are operated by a change key and a master key.
2. Existing System: Master key or grand master key locks to Owner's existing system.
3. Keyed Alike: Key all cylinders to same change key.

B. Keys: Nickel silver.

1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:

a. Notation: "DO NOT DUPLICATE."

2. Quantity: In addition to one extra key blank for each lock, provide the following:

a. Cylinder Change Keys: Three.
b. Master Keys: Five.
c. Grand Master Keys: Five.
d. Great-Grand Master Keys: Five.

2.12 ELECTRIC STRIKES

A. Standard: BHMA A156.31, Grade 1.

B. General: Use fail-secure electric strikes with fire-rated devices.

C. OPERATING TRIM

D. Standard: BHMA A156.6.

E. Materials: Fabricate from stainless steel, unless otherwise indicated.

2.13 ACCESSORIES FOR PAIRS OF DOORS

A. Carry-Open Bars: Provide carry-open bars for inactive leaves of pairs of doors unless automatic or self-latching bolts are used.

1. Material: Polished brass or bronze, with strike plate.

2.14 CLOSERS

A. Accessibility Requirements: Where handles, pulls, latches, locks, and other operating devices are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)." ANSI A117.1.

1. Comply with the following maximum opening-force requirements:

a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
b. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

B. Door Closers for Means of Egress Doors: Comply with NFPA 101. Door closers shall not require more than 30 lbf (133 N) to set door in motion and not more than 15 lbf (67 N) to open door to minimum required width.

C. Hold-Open Closers/Detectors: Coordinate and interface integral smoke detector and closer device with fire alarm system.

D. Power-Assist Closers: As specified in Division 08 Section "Automatic Door Operators" for access doors for people with disabilities or where listed in the door hardware sets.

E. Size of Units: Unless otherwise indicated, comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

F. Surface Closers: BHMA A156.4, Grade 1. Listed under Category C in BHMA's "Certified Product Directory." Provide type of arm required for closer to be located on non-public side of door, unless otherwise indicated.

G. Concealed Closers: BHMA A156.4, Grade 1. Listed under Category C in BHMA's "Certified Product Directory."

H. Coordinators: BHMA A156.3.

2.15 PROTECTIVE TRIM UNITS

A. Size: 1-1/2 inches (38 mm) less than door width on push side and 1/2 inch (13 mm) less than door width on pull side, by height specified in door hardware sets.

B. Fasteners: Manufacturer's standard machine or self-tapping screws.

C. Metal Protective Trim Units: BHMA A156.6; beveled top and 2 sides; fabricated from the following material:

1. Material: 0.050-inch- (1.3-mm-) thick stainless steel.

2.16 STOPS AND HOLDERS

A. Stops and Bumpers: BHMA A156.16, Grade 1.

1. Provide floor stops for doors unless wall or other type stops are scheduled or indicated. Do not mount floor stops where they will impede traffic. Where floor or wall stops are not appropriate, provide overhead holders.

B. Mechanical Door Holders: BHMA A156.16, Grade 1.

C. Combination Overhead Stops and Holders: BHMA A156.8, Grade 1.

D. Silencers for Metal Door Frames: BHMA A156.16, Grade 1; neoprene or rubber, minimum diameter 1/2 inch (13 mm); fabricated for drilled-in application to frame.

2.17 DOOR GASKETING

A. Standard: BHMA A156.22. Listed under Category J in BHMA's "Certified Product Directory."

B. General: Provide continuous weather-strip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated or scheduled. Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

1. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
2. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
3. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

C. Air Leakage: Not to exceed 0.50 cfm per foot (0.000774 cu. m/s per m) of crack length for gasketing other than for smoke control, as tested according to ASTM E 283.

D. Smoke-Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke-control ratings indicated, based on testing according to UL 1784.

1. Provide smoke-labeled gasketing on 20-minute-rated doors and on smoke-labeled doors.

E. Fire-Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.

F. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated, based on testing according to ASTM E 1408.

G. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

H. Gasketing Materials: ASTM D 2000 and AAMA 701/702.

2.18 THRESHOLDS

A. Standard: BHMA A156.21. Listed under Category J in BHMA's "Certified Product Directory."

B. Accessibility Requirements: Where thresholds are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)." ANSI A117.1.

1. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.

C. Thresholds for Means of Egress Doors: Comply with NFPA 101. Maximum 1/2 inch (13 mm) high.

2.19 FABRICATION

A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rated labels and as otherwise approved by Owner.

1. Manufacturer's identification is permitted on rim of lock cylinders only.

B. Base Metals: Produce door hardware units of base metal, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18. Do not furnish manufacturer's standard materials or forming methods if different from specified standard.

C. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.

1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
2. Steel Machine or Wood Screws: For the following fire-rated applications:

a. Mortise hinges to doors.
b. Strike plates to frames.
c. Closers to doors and frames.

3. Steel Through Bolts: For the following fire-rated applications unless door blocking is provided:

a. Surface hinges to doors.

b. Closers to doors and frames.
c. Surface-mounted exit devices.

4. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
5. Fasteners for Wood Doors: Comply with requirements in DHI WDHS.2, "Recommended Fasteners for Wood Doors."

2.20 FINISHES

A. Standard: BHMA A156.18, as indicated in door hardware sets.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Steel Doors and Frames: Comply with DHI A115 Series.

1. Surface-Applied Door Hardware: Drill and tap doors and frames according to ANSI A250.6.

B. Wood Doors: Comply with DHI A115-W Series.

3.3 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights indicated as follows unless otherwise indicated or required to comply with governing regulations.

1. Custom Steel Doors and Frames: DHI's "Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames."

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 09 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

C. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

D. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated. Verify location with Owner.

1. Configuration: Provide one power supply for each door opening.
2. Configuration: Provide the least number of power supplies required to adequately serve doors with electrified door hardware.

E. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

3.4 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 30 degrees.
2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
3. Door Closers: Unless otherwise required by authorities having jurisdiction, adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches (75 mm) from the latch, measured to the leading edge of the door.

B. Occupancy Adjustment: Approximately three months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust, including adjusting operating forces, each item of door hardware as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.5 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes. Refer to Division 01 Section "Demonstration and Training."

3.7 DOOR HARDWARE SETS

Door Hardware Set No. 1		
Single – Fire Rated – Side Hinged Door Presentation of valid card will release electrified strike and allow entry and then relock. Free egress from the interior at all times. Depressing exit hardware will retract bolt and allow egress. Each to have the following:		
No.	Item	Description
*	Hanging Devices	Full Mortis
1	Exit Device	Fire Egress Device
1	Operating Trim	Lever (Fixed)
1	Closing Devices	Parallel Arm
1	Set of Weather Strips	Jamb, Head and Threshold Weather Strips
1	Protection Plate	3’-0” W 2’-0” H Kick Plate
1	Card Reader	
1	Contact	Head Door Contact
1	Set of Fire Labeled Gaskets	Jamb and Head Fire Labeled Gaskets
* Number of hinges, as specified.		

Door Hardware Set No. 2		
Single – Side Hinged Door Free Passage at all times. Each to have the following:		
No.	Item	Description
*	Hanging Devices	Full Mortis
1	Operating Trim	Lever
1	Latch Set	Passage Latch Set
1	Closing Devices	Parallel Arm
1	Protection Plate	3’-0” W 2’-0” H Kick Plate
* Number of hinges, as specified.		

Door Hardware Set No. 3		
Single – Side Hinged Door Free Passage at all times. Each to have the following:		
No.	Item	Description
*	Hanging Devices	Full Mortis
1	Operating Trim	Lever
1	Latch Set	Passage Latch Set
1	Closing Devices	Parallel Arm
1	Protection Plate	4’-0” W 2’-0” H Kick Plate
* Number of hinges, as specified.		

Door Hardware Set No. 4		
Overhead High Speed Coiling Door Each to have the following:		
No.	Item	Description
1	Key Cylinder	Cylinder for keying overhead door

Door Hardware Set No. 5		
Single – Side Hinged Door Presentation of valid card will release electrified strike and allow entry and then relock. Free egress from the interior at all times. Depressing exit hardware will retract bolt and allow egress. Each to have the following:		
No.	Item	Description
*	Hanging Devices	Full Mortis
1	Exit Device	Panic Egress Device
1	Operating Trim	Lever (Fixed)
1	Closing Devices	Parallel Arm
1	Set of Weather Strips	Jamb, Head and Threshold Weather Strips
1	Protection Plate	3’-0” W 2’-0” H Kick Plate
1	Card Reader	
1	Contact	Head Door Contact
* Number of hinges, as specified.		

Door Hardware Set No. 6		
Single – Side Hinged Door Privacy Lock. Locking lever from inside. Operation of lever from inside will release lock and allow egress at all times. Each to have the following:		
No.	Item	Description
*	Hanging Devices	Full Mortis
1	Operating Trim	Lever
1	Lock Set	Privacy Lock Set
1	Closing Devices	Parallel Arm
* Number of hinges, as specified.		

Door Hardware Set No. 7		
Double – Side Hinged Door Interlocked Each to have the following:		
No.	Item	Description
*	Hanging Devices	Stainless Steel Full Mortis
2	Sets Push / Pull	Stainless Steel Push / Pull Sets
2	Magnetic Locks	Stainless Steel Overhead (Push Side)
2	Closing Devices	Stainless Steel Parallel Arm
2	Set of Seals	Jamb, Head and Threshold Air Strip Seals
4	Protection Plate	Stainless Steel 3’-0” W 2’-0” H Kick Plate
1	Emergency Release Button	Pull Side of Door
2	Door Buttons	One on Each Side of Door
2	Contact	Head Door Contact
* Number of hinges, as specified.		

Door Hardware Set No. 8		
Single – Side Hinged Door Interlocked Each to have the following:		
No.	Item	Description
*	Hanging Devices	Stainless Steel Full Mortis
1	Set Push / Pull	Stainless Steel Push / Pull Sets
1	Magnetic Locks	Stainless Steel Overhead (Push Side)
1	Closing Devices	Stainless Steel Parallel Arm
1	Set of Seals	Jamb, Head and Threshold Air Strip Seals
2	Protection Plate	Stainless Steel 4’-0” W 2’-0” H Kick Plate
1	Emergency Release Button	Pull Side of Door
2	Door Buttons	One on Each Side of Door
1	Contact	Head Door Contact
* Number of hinges, as specified.		

Door Hardware Set No. 9		
Double – Side Hinged Door Interlocked Each to have the following:		
No.	Item	Description
*	Hanging Devices	Stainless Steel Full Mortis
2	Sets Push / Pull	Stainless Steel Push / Pull Sets
2	Magnetic Locks	Stainless Steel Overhead (Pull Side)
2	Closing Devices	Stainless Steel Parallel Arm
2	Set of Seals	Jamb, Head and Threshold Air Strip Seals
4	Protection Plate	Stainless Steel 3’-0” W 2’-0” H Kick Plate
1	Emergency Release Button	Pull Side of Door
2	Door Buttons	One on Each Side of Door
1	Door Opener	Stainless Steel Double Door Opener (Pull Side)
2	Contact	Head Door Contact
* Number of hinges, as specified.		

Door Hardware Set No. 10		
Double – Side Hinged Door Interlocked Each to have the following:		
No.	Item	Description
*	Hanging Devices	Stainless Steel Full Mortis
2	Sets Push / Pull	Stainless Steel Push / Pull Sets
2	Magnetic Locks	Stainless Steel Overhead (Push Side)
2	Closing Devices	Stainless Steel Parallel Arm
2	Set of Seals	Jamb, Head and Threshold Air Strip Seals
4	Protection Plate	Stainless Steel 3’-0” W 2’-0” H Kick Plate
1	Emergency Release Button	Pull Side of Door
2	Door Buttons	One on Each Side of Door
1	Door Opener	Stainless Steel Double Door Opener (Push Side)
2	Contact	Head Door Contact
* Number of hinges, as specified.		

Door Hardware Set No. 11		
Double – Electrically Classified Class 1 Div. 1 – Side Hinged Door Interlocked Each to have the following:		
No.	Item	Description
*	Hanging Devices	Stainless Steel Full Mortis
2	Sets Push / Pull	Stainless Steel Push / Pull Sets
2	Magnetic Locks	Stainless Steel Overhead (Pull Side)
2	Closing Devices	Stainless Steel Parallel Arm
2	Set of Seals	Jamb, Head and Threshold Air Strip Seals
4	Protection Plate	Stainless Steel 3’-0” W 2’-0” H Kick Plate
1	Emergency Release Button	Pull Side of Door
2	Door Buttons	One on Each Side of Door
2	Contact	Head Door Contact
* Number of hinges, as specified.		

Door Hardware Set No. 12		
Single – Side Hinged Door Passage Each to have the following:		
No.	Item	Description
*	Hanging Devices	Stainless Steel Full Mortis
1	Latch Set	Stainless Steel Passage Latch Set
1	Closing Devices	Stainless Steel Parallel Arm
1	Set of Seals	Jamb, Head and Threshold Air Strip Seals
2	Protection Plate	Stainless Steel 3’-0” W 2’-0” H Kick Plate
* Number of hinges, as specified.		

Door Hardware Set No. 13		
Single – Side Hinged Door Free Passage at all times. Each to have the following:		
No.	Item	Description
*	Hanging Devices	Full Mortis
1	Operating Trim	Lever
1	Latch Set	Passage Latch Set
1	Closing Devices	Parallel Arm
1	Protection Plate	4’-0” W 2’-0” H Kick Plate
* Number of hinges, as specified.		

Door Hardware Set No. 14		
Single – Side Hinged Door Closet Lock. Lock set remains locked at all time. Key usage on outside trim allows entry. Egress by operating trim from inside allows egress at all times. Each to have the following:		
No.	Item	Description
*	Hanging Devices	Full Mortis
1	Operating Trim	Lever
1	Lock Set	Closet Lock Set
1	Closing Devices	Parallel Arm
1	Protection Plate	3’-0” W 2’-0” H Kick Plate
* Number of hinges, as specified.		

Door Hardware Set No. 14		
Single – Side Hinged Door Closet Lock. Lock set remains locked at all time. Key usage on outside trim allows entry. Depressing exit hardware will retract bolt and allow egress. Each to have the following:		
No.	Item	Description
*	Hanging Devices	Full Mortis
1	Operating Trim	Lever
1	Exit Device	Panic Device
1	Lock Set	Closet Lock Set
1	Closing Devices	Parallel Arm
1	Protection Plate	3’-0” W 2’-0” H Kick Plate
* Number of hinges, as specified.		

END OF SECTION 087100

CONFIDENTIAL DOCUMENT

088000

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

GLAZING

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
088000	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:

1. Interior Windows.
2. Interior Doors.
3. Fire Rated Doors.

1.3 DEFINITIONS

A. Manufacturers of Glass Products: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

C. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.

1.4 PERFORMANCE REQUIREMENTS

A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

1.5 SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. Glazing Schedule: Use same designations indicated on Drawings for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.

C. Qualification Data: For installers.

D. Warranties: Special warranties specified in this Section.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance; and who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

B. Source Limitations for Glazing Accessories: Obtain glazing accessories through one source from a single manufacturer for each product and installation method indicated.

C. Glazing for Fire-Rated Door Assemblies: Glazing for assemblies that comply with NFPA 80 and that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252 for door assemblies and NFPA 257 for window assemblies.

D. Safety Glazing Products: Comply with testing requirements in 16 CFR 1201.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 40 deg F.

1.9 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form, made out to Owner and signed by coated-glass manufacturer agreeing to replace coated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form, made out to Owner and signed by laminated-glass manufacturer agreeing to replace laminated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: Five years from date of Substantial Completion.

C. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form, made out to Owner and signed by insulating-glass manufacturer agreeing to replace insulating-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS

A. Heat-Treated Float Glass: ASTM C 1048; Type I (transparent flat glass); Quality-Q3; of class, kind, and condition indicated.

1. Provide Kind FT (fully tempered) float glass in place of annealed or Kind HS (heat-strengthened) float glass where safety glass is indicated.

2.2 FIRE-RATED GLAZING PRODUCTS

A. Laminated Ceramic Glazing Material: Proprietary Category II safety glazing product in the form of 2 lites of clear ceramic glazing material laminated together to produce a laminated lite of 5/16-inch nominal thickness; polished on both surfaces; weighing 4 lb/sq. ft.; and as follows:

1. Fire-Protection Rating: As indicated for the assembly in which glazing material is installed, and permanently labeled by a testing and inspecting agency acceptable to authorities having jurisdiction.
2. Polished on both surfaces, transparent.
3. Product: "FireLite Plus" by Nippon Electric Glass Co., Ltd., and distributed by Technical Glass Products.

2.3 GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of material indicated below, complying with standards referenced with name of elastomer indicated below, and of profile and hardness required to maintain watertight seal:

1. Neoprene, ASTM C 864.
2. EPDM, ASTM C 864.
3. Silicone, ASTM C 1115.
4. Thermoplastic polyolefin rubber, ASTM C 1115.
5. Any material indicated above.

2.4 GLAZING SEALANTS

A. General: Provide products of type indicated, complying with the following requirements:

1. Compatibility: Select glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Colors of Exposed Glazing Sealants: As selected by Owner from manufacturer's full range.

B. Elastomeric Glazing Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

1. Single-Component Neutral- and Basic-Curing Silicone Glazing Sealants:

2.5 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions with a Shore, Type A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

G. Perimeter Insulation for Fire-Resistive Glazing: Identical to product used in test assembly to obtain fire-resistance rating.

2.6 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites in a manner that produces square edges with slight kerfs at junctions with outdoor and indoor faces.

C. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing glazing, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep system.
3. Minimum required face or edge clearances.
4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches as follows:

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

3.4 GASKET GLAZING (DRY)

A. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Install gaskets so they protrude past face of glazing stops.

3.5 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 088000

CONFIDENTIAL DOCUMENT

092216

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

NON-STRUCTURAL METAL FRAMING

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

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Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
092216	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes non-load-bearing steel framing members for the following applications:

1. Interior framing systems (e.g., supports for partition walls, framed soffits, furring, etc.).
2. Interior suspension systems (e.g., supports for ceilings, suspended soffits, etc.).

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

PART 2 - PRODUCTS

2.1 NON-LOAD-BEARING STEEL FRAMING, GENERAL

A. Recycled Content of Steel Products: Provide products with average recycled content of steel products such that postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

B. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal, unless otherwise indicated.
2. Protective Coating: ASTM A 653/A 653M, G40, hot-dip galvanized, unless otherwise indicated.

2.2 SUSPENSION SYSTEM COMPONENTS

A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch diameter wire, or double strand of 0.0475-inch diameter wire.

B. Hanger Attachments to Concrete:

1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.

a. Type: Postinstalled, expansion anchor.

2. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.

C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162-inch diameter.

D. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch and minimum 1/2-inch- wide flanges.

1. Depth: 2-1/2 inches.

E. Furring Channels (Furring Members):

1. Cold-Rolled Channels: 0.0538-inch bare-steel thickness, with minimum 1/2-inch- wide flanges, 3/4 inch deep.
2. Steel Studs: ASTM C 645.

a. Minimum Base-Metal Thickness: 0.0312 inch.
b. Depth: 3-5/8 inches.

3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.

a. Minimum Base Metal Thickness: 0.0312 inch.

4. Resilient Furring Channels: 1/2-inch deep members designed to reduce sound transmission.

a. Configuration: Asymmetrical or hat shaped.

F. Grid Suspension System for Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Armstrong World Industries, Inc.; Drywall Grid Systems.
b. USG Corporation; Drywall Suspension System.

2.3 STEEL FRAMING FOR FRAMED ASSEMBLIES

A. Steel Studs and Runners: ASTM C 645.

1. Minimum Base-Metal Thickness: 0.0516.
2. Depth: As indicated on Drawings.

B. Slip-Type Head Joints: Where indicated, provide one of the following:

1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch- (50.8-mm-) deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches (305 mm) of the top of studs to provide lateral bracing.
2. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

C. Cold-Rolled Channel Bridging: 0.0538-inch bare-steel thickness, with minimum 1/2-inch wide flanges.

1. Depth: 1-1/2 inches.
2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch- thick, galvanized steel.

2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754, except comply with framing sizes and spacing indicated.

1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

C. Install bracing at terminations in assemblies.

D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING SUSPENSION SYSTEMS

A. Install suspension system components in sizes and spacings indicated on Drawings, but not less than those required by referenced installation standards for assembly types and other assembly components indicated.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.

3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Do not attach hangers to steel roof deck.
5. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
6. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
7. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

E. Seismic Bracing: Sway-brace suspension systems with hangers used for support.

F. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

G. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

3.5 INSTALLING FRAMED ASSEMBLIES

A. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

B. Install studs so flanges within framing system point in same direction.

1. Space studs as follows:

a. Single-Layer Application: 16 inches o.c., unless otherwise indicated.
b. Multilayer Application: 16 inches o.c., unless otherwise indicated.

C. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

a. Install two studs at each jamb, unless otherwise indicated.

b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

D. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

END OF SECTION 092216

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096519

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Design Specification

RESILIENT TILE FLOORING

ImmuCell
Portland, ME

Reviews / Approvals

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CONFIDENTIAL DOCUMENT

096519

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
096519	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Vinyl composition floor tile.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Initial Selection: For each type of floor tile indicated.

C. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.

B. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store floor tiles on flat surfaces.

1.6 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive floor tile during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Close spaces to traffic during floor tile installation.

D. Close spaces to traffic for 48 hours after floor tile installation.

E. Install floor tile after other finishing operations, including painting, have been completed.

1.7 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Tile: Furnish 1 box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

PART 2 - PRODUCTS

2.1 VINYL COMPOSITION FLOOR TILE

A. Tile Standard: ASTM F 1066, Class 1, solid-color tile and Class 2 through-pattern tile or.

B. Wearing Surface: Smooth.

C. Thickness: 0.125 inch.

D. Size: 12 by 12 inches.

E. Colors and Patterns: As selected by Owner from full range of industry colors.

2.2 Rubber Base

A. Rubber base will be standard base.

B. Profile: Bull Toe

C. Gauge: 1/8"

D. Height: 4"

E. ASTM F 1816, Type TS, Group 1 Style B

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit floor tile and substrate conditions indicated.

C. Seamless-Installation Accessories:

1. Chemical-Bonding Compound: Manufacturer's product for chemically bonding seams.

D. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
4. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.

    a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.

b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75% relative humidity level measurement.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install floor tiles until they are same temperature as space where they are to be installed.

1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay tiles square with room axis.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

1. Lay tiles with grain running in one direction.

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.

G. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

H. Seamless Installation:

1. Chemically Bonded Seams: Bond seams with chemical-bonding compound to permanently fuse sections into a seamless floor covering. Prepare seams and apply compound to produce tightly fitted seams without gaps, overlays, or excess bonding compound on floor covering surfaces.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of floor tile.

B. Perform the following operations immediately after completing floor tile installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect floor tile products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Floor Polish: Remove soil, visible adhesive, and surface blemishes from floor tile surfaces before applying liquid floor polish.

1. Apply two coat(s).

E. Sealers and Finish Coats: Remove soil, visible adhesive, and surface blemishes from resilient terrazzo floor tile surfaces before applying liquid cleaners, sealers, and finish products.

1. Sealer: Apply two base coats of liquid sealer.
2. Finish: Apply two coats of liquid floor finish.

F. Cover floor tile until Substantial Completion.

END OF SECTION 096519

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096723

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

RESINOUS FLOORING

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
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Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
096723	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 096723 - RESINOUS FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes resinous flooring systems with epoxy body coat(s).

1. Application Method: Self-leveling slurry with broadcast aggregates.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.

B. Samples for Initial Selection: For each type of exposed finish required.

C. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.

D. Material Test Reports: For each resinous flooring component.

E. Material Certificates: For each resinous flooring component, signed by manufacturer.

F. Maintenance Data: For resinous flooring to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer (applicator) who is experienced in applying resinous flooring systems similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance, and who is acceptable to resinous flooring manufacturer.

1. Engage an installer who employs only persons trained and approved by resinous flooring manufacturer for applying resinous flooring systems indicated.

B. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, through one source from a single manufacturer. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.

C. Mockups: Apply mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Apply full-thickness mockups on 48-inch square floor area selected by Owner.

a. Include 48-inch length of integral cove base.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.

B. Store materials to prevent deterioration from moisture, heat, cold, direct sunlight, or other detrimental effects.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.

B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.

C. Close spaces to traffic during resinous flooring application and for not less than 24 hours after application, unless manufacturer recommends a longer period.

PART 2 - PRODUCTS

2.1 RESINOUS FLOORING EPX CLEANROOM

A. Resinous flooring built up system for ISO classified cleanroom spaces.

1. Multi-Layer High Build Troweled
2. Abrasion Resistant
3. Chemical Resistant
4. High Impact Resistant
5. High Strength
6. High Traffic
7. Water Resistant
8. Wear Resistant
9. Seamless
10. Slip Resistant
11. High Gloss
12. Antimicrobial
13. Stain Resistant, Impact

B. System Characteristics:

1. Color and Pattern: As selected by Owner from manufacturer's full range.
2. Wearing Surface: Manufacturer's standard orange-peel texture.
3. Integral Cove Base: 4 inches high.
4. Overall System Thickness: 1/2 inch.
5. Federal Agency Approvals: USDA, ISO FED REG, EU and FDA approved for cleanroom processing environments.

C. System Components: Manufacturer's standard components that are compatible with each other and as follows:

1. Body Coat(s):

a. Resin: Epoxy.
b. Formulation Description: 100 percent solids.
c. Application Method: Troweled or screeded.

1) Thickness of Coats: 1/4 inch.
2) Number of Coats: Two.

d. Aggregates: Manufacturer's standard.

2. Primer: Type recommended by manufacturer for substrate and body coat(s) indicated.

a. Formulation Description: 100 percent solids.

3. Waterproofing Membrane: Type recommended by manufacturer for substrate and primer and body coat(s) indicated.

a. Formulation Description: 100 percent solids.

4. Reinforcing Membrane: Flexible resin formulation that is recommended by manufacturer for substrate and primer and body coat(s) indicated and that prevents substrate cracks from reflecting through resinous flooring.

a. Formulation Description: 100 percent solids.
b. Provide fiberglass scrim embedded in reinforcing membrane.

5. Topcoat: Chemical-resistant sealing or finish coat(s).

a. Resin: Epoxy.
b. Formulation Description: 100 percent solids.
c. Type: Clear.
d. Finish: Gloss.
e. Number of Coats: Two.

D. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:

1. Compressive Strength: 10,000 psi per ASTM C 579.

2. Tensile Strength: 1750 psi per ASTM C 307.
3. Flexural Modulus of Elasticity: 2.0 x 10^6 psi per ASTM C 580.
4. Water Absorption: 2% per ASTM C 413.
5. Impact Resistance: >160 in./lbs. No chipping, cracking, or delamination and not more than 1/16-inch permanent indentation per MIL-D-3134.
6. Resistance to Elevated Temperature: No slip or flow of more than 1/16 inch per MIL-D-3134.
7. Abrasion Resistance: .0.1 gm maximum weight loss per ASTM D 4060.
8. Flammability: Class 1 ASTM E-648 Self-extinguishing per ASTM D 635.
9. Hardness: .85 to 90, Shore D per ASTM D 2240.

E. System Chemical Resistance: Test specimens of cured resinous flooring system are unaffected when tested according to ASTM D 543, Procedure A, for immersion in the following reagents for not less than 7 days.

2.2 RESINOUS FLOORING EPX NOT CLASSIFIED

A. Resinous flooring system for Not Classified and Controlled Non-Classified spaces. Manufacturer's system resistant to fork truck traffic.

1. High Abrasion Resistant
2. Chemical Resistant
3. High Impact Resistant
4. High Strength
5. High Traffic
6. Water Resistant
7. High Wear Resistant
8. Seamless
9. Slip Resistant
10. High Gloss
11. Antimicrobial
12. Stain Resistant, Impact

B. System Characteristics:

1. Color and Pattern: As selected by Owner from manufacturer's full range.
2. Wearing Surface: Manufacturer's standard orange-peel texture.
3. Integral Cove Base: 4 inches high.
4. Overall System Thickness: 1/4 inch.
5. Federal Agency Approvals: USDA, ISO FED REG, EU and FDA approved for cleanroom processing environments.

C. System Components: Manufacturer's standard components that are compatible with each other and as follows:

1. Body Coat(s):

a. Resin: Epoxy.
b. Formulation Description: 100 percent solids>.
c. Application Method: Self-leveling slurry.

1) Thickness of Coats: 1/16 inch.
2) Number of Coats: Two.

d. Aggregates: Manufacturer's standard.

2. Primer: Type recommended by manufacturer for substrate and body coat(s) indicated.

a. Formulation Description: 100 percent solids.

3. Waterproofing Membrane: Type recommended by manufacturer for substrate and primer and body coat(s) indicated.

a. Formulation Description: 100 percent solids.

4. Reinforcing Membrane: Flexible resin formulation that is recommended by manufacturer for substrate and primer and body coat(s) indicated and that prevents substrate cracks from reflecting through resinous flooring.

a. Formulation Description: 100 percent solids.
b. Provide fiberglass scrim embedded in reinforcing membrane.

5. Topcoat: Chemical-resistant sealing or finish coat(s).

a. Resin: Epoxy.
b. Formulation Description: 100 percent solids.
c. Type: Clear.
d. Finish: Gloss.
e. Number of Coats: Two.

D. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:

1. Compressive Strength: 10,000 psi per ASTM C 579.
2. Tensile Strength: 1750 psi per ASTM C 307.
3. Flexural Modulus of Elasticity: 2.0 x 10^6 psi per ASTM C 580.
4. Water Absorption: 2% per ASTM C 413.
5. Impact Resistance: >160 in./lbs. No chipping, cracking, or delamination and not more than 1/16-inch permanent indentation per MIL-D-3134.
6. Resistance to Elevated Temperature: No slip or flow of more than 1/16 inch per MIL-D-3134.
7. Abrasion Resistance: .0.1 gm maximum weight loss per ASTM D 4060.
8. Flammability: Class 1 ASTM E-648 Self-extinguishing per ASTM D 635.
9. Hardness: .85 to 90, Shore D per ASTM D 2240.

E. System Chemical Resistance: Test specimens of cured resinous flooring system are unaffected when tested according to ASTM D 543, Procedure A, for immersion in the following reagents for not less than 7 days.

2.3 ACCESSORY MATERIALS

A. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.

B. Joint Sealant: Type recommended or produced by resinous flooring manufacturer for type of service and joint condition indicated.

PART 3 - EXECUTION

3.1 PREPARATION

A. General: Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry, and neutral Ph substrate for resinous flooring application.

B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.

1. Roughen concrete substrates.
2. Verify that concrete substrates have neutral Ph and that resinous flooring will adhere to them. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.

C. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.

D. Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.

E. Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written recommendations.

3.2 APPLICATION

A. General: Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.

1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
3. At substrate expansion and isolation joints, provide joint in resinous flooring to comply with resinous flooring manufacturer's written recommendations.

    a. Apply joint sealant to comply with manufacturer's written recommendations.

B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.

C. Apply waterproofing membrane, where indicated, in manufacturer's recommended thickness.

1. Apply waterproofing membrane to integral cove base substrates.

D. Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details including those for taping, mixing, priming, troweling, sanding, and topcoating of cove base. Round internal and external corners.

E. Apply self-leveling slurry body coat(s) in thickness indicated for flooring system.

1. Broadcast aggregates and, after resin is cured, remove excess aggregates to provide surface texture indicated.

3.3 CLEANING AND PROTECTING

A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

END OF SECTION 096723

CONFIDENTIAL DOCUMENT

096813

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

TILE CARPETING

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

096813

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
096813	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes modular carpet tile.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance. Include installation recommendations for each type of substrate.

B. Shop Drawings: Show the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
2. Existing flooring materials to be removed.
3. Existing flooring materials to remain.
4. Carpet tile type, color, and dye lot.
5. Type of subfloor.
6. Type of installation.
7. Pattern of installation.
8. Pattern type, location, and direction.
9. Pile direction.
10. Type, color, and location of insets and borders.
11. Type, color, and location of edge, transition, and other accessory strips.
12. Transition details to other flooring materials.

C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet Tile: Full-size Sample.
2. Exposed Edge, Transition, and other Accessory Stripping: 12-inch-long Samples.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.

B. Fire-Test-Response Characteristics: Provide products with the critical radiant flux classification indicated in Part 2, as determined by testing identical products per ASTM E 648 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRI 104, Section 5, "Storage and Handling."

1.6 PROJECT CONDITIONS

A. Comply with CRI 104, Section 7.2, "Site Conditions; Temperature and Humidity" and Section 7.12, "Ventilation."

B. Environmental Limitations: Do not install carpet tiles until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.7 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer's standard form in which manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
2. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, loss of tuft bind strength, dimensional stability, excess static discharge, and delamination.
3. Warranty Period: 10 years from date of Substantial Completion.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd.

PART 2 - PRODUCTS

2.1 CARPET TILE

A. Fiber Content: 100 percent nylon 6, 6.

B. Pile Characteristic: Level-loop pile.

C. Primary Backing/Backcoating: Manufacturer's standard composite materials.

D. Secondary Backing: Manufacturer's standard material.

E. Size: 24 by 24 inches.

F. Applied Soil-Resistance Treatment: Manufacturer's standard material.

G. Performance Characteristics: As follows:.

1. Critical Radiant Flux Classification: Not less than 0.22 W/sq. cm.
2. Dry Breaking Strength: Not less than 100 lbf per ASTM D 2646.
3. Tuft Bind: Not less than 6.2 lbf per ASTM D 1335.
4. Delamination: Not less than 3.5 lbf/in. per ASTM D 3936.
5. Dimensional Tolerance: Within 1/32 inch (0.8 mm) of specified size dimensions, as determined by physical measurement.
6. Dimensional Stability: 0.2 percent or less per ISO 2551 (Aachen Test).
7. Resistance to Insects: Comply with AATCC 24.

2.1 RUBBER BASE

A. Rubber base will be standard base.

B. Profile: Bull Toe

C. Gauge: 1/8"

D. Height: 4"

E. ASTM F 1816, Type TS, Group 1 Style B

2.2 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.

B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:

1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
2. Subfloor finishes comply with requirements specified in Division 03 Section "Cast-in-Place Concrete" for slabs receiving carpet tile.
3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider and protrusions more than 1/32 inch, unless more stringent requirements are required by manufacturer's written instructions.

C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.

D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

A. General: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.

B. Installation Method: As recommended in writing by carpet tile manufacturer.

C. Maintain dye lot integrity. Do not mix dye lots in same area.

D. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

E. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.

G. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet tile:

1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
2. Remove yarns that protrude from carpet tile surface.
3. Vacuum carpet tile using commercial machine with face-beater element.

B. Protect installed carpet tile to comply with CRI 104, Section 16, "Protection of Indoor Installations."

C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 096813

CONFIDENTIAL DOCUMENT

099123

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

INTERIOR PAINTING

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
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ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

099123

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
099123	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes surface preparation and the application of paint systems on the following interior substrates:

1. Concrete masonry units (CMU).
2. Steel.
3. Gypsum board.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Initial Selection: For each type of topcoat product indicated.

C. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.

1.4 QUALITY ASSURANCE

A. MPI Standards:

1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.6 PROJECT CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.

1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. of each material and color applied.

PART 2 - PRODUCTS

2.1 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. Chemical Components of Field-Applied Interior Paints and Coatings: Provide topcoat paints and anti-corrosive and anti-rust paints applied to ferrous metals that comply with the following chemical restrictions; these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:

1. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
2. Restricted Components: Paints and coatings shall not contain any of the following:

a. Acrolein.
b. Acrylonitrile.
c. Antimony.
d. Benzene.
e. Butyl benzyl phthalate.
f. Cadmium.
g. Di (2-ethylhexyl) phthalate.
h. Di-n-butyl phthalate.
i. Di-n-octyl phthalate.

j. 1,2-dichlorobenzene.
k. Diethyl phthalate.
l. Dimethyl phthalate.
m. Ethylbenzene.
n. Formaldehyde.
o. Hexavalent chromium.
p. Isophorone.
q. Lead.
r. Mercury.
s. Methyl ethyl ketone.
t. Methyl isobutyl ketone.
u. Methylene chloride.
v. Naphthalene.
w. Toluene (methylbenzene).
x. 1,1,1-trichloroethane.
y. Vinyl chloride.

C. Colors: As selected by Owner or Owner's Representative from manufacturer's full range.

2.2 BLOCK FILLERS

A. Interior/Exterior Latex High Build Block Filler: MPI #4.

1. VOC Content: E Range of E2.

2.3 PRIMERS/SEALERS

A. Interior Latex Primer/Sealer: MPI #50.

1. VOC Content: E Range of E1.
2. Environmental Performance Rating: EPR 1.

B. Quick-Drying Alkyd Metal Primer: MPI #76.

1. VOC Content: E Range of E1.

2.4 LATEX PAINTS

A. Interior Latex (Semigloss): MPI #54 (Gloss Level 5).

1. VOC Content: E Range of E1.
2. Environmental Performance Rating: EPR 2.

2.5 HIGH PERFORMANCE PAINT

A. High-Performance Architectural Epoxy, MPI INT 4.2 G

B. High-Performance Architectural Latex (Semigloss): MPI #141 (Gloss Level 5).

1. VOC Content: E Range of E1.
2. Environmental Performance Rating: EPR 5.

2.6 ALKYD PAINTS

A. Interior Alkyd (Semigloss): MPI #47 (Gloss Level 5).

1. VOC Content: E Range of E1.
2. Environmental Performance Rating: EPR 1.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Masonry (Clay and CMU): 12 percent.
2. Gypsum Board: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.

D. Concrete Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions.

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Owner or Owner’s Representative, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 INTERIOR PAINTING SCHEDULE

A. CMU Substrates:

1. Latex System (NC spaces): MPI INT 4.2A.

a. Prime Coat: Interior/exterior latex high build block filler.
b. Intermediate Coat: Interior latex matching topcoat.
c. Topcoat: Interior latex semigloss.

2. Alkyd Over Latex Sealer System: MPI INT 4.2N.

a. Prime Coat: Interior/exterior latex high build block filler.
b. Sealer Coat: Interior latex primer/sealer.
c. Intermediate Coat: Interior alkyd matching topcoat.
d. Topcoat: Interior alkyd semigloss.

B. Steel Substrates:

1. Latex Over Alkyd Primer System (NC spaces): MPI INT 5.1Q.

a. Prime Coat: Quick-drying alkyd metal primer.
b. Intermediate Coat: Interior latex matching topcoat.
c. Topcoat: Interior latex semigloss.

C. Gypsum Board Substrates:

1. Latex System (NC spaces): MPI INT 9.2A.

a. Prime Coat: Interior latex primer/sealer.
b. Intermediate Coat: Interior latex matching topcoat.
c. Topcoat: Interior latex semigloss.

END OF SECTION 099123

CONFIDENTIAL DOCUMENT

099600

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

HIGH-PERFORMANCE COATINGS

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
099600	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 099600 - HIGH-PERFORMANCE COATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes surface preparation and application of high-performance coating systems on the following substrates:

1. Interior Substrates:

a. Concrete masonry units (CMU).
b. Steel.
c. Gypsum board.

B. Related Sections include the following:

1. Division 05 Sections for shop priming of metal substrates with primers specified in this Section.
2. Division 09 painting Sections for special-use coatings and general field painting.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Initial Selection: For each type of finish-coat product indicated.

C. Product List: For each product indicated. Cross-reference products to coating system and locations of application areas. Use same designations indicated on Drawings and in schedules.

1.4 QUALITY ASSURANCE

A. Master Painters Institute (MPI) Standards:

1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.6 PROJECT CONDITIONS

A. Apply coatings only when temperature of surfaces to be coated and surrounding air temperatures are between 50 and 95 deg F.

B. Do not apply coatings in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.

1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. of each material and color applied.

PART 2 - PRODUCTS

2.1 HIGH-PERFORMANCE COATINGS, GENERAL

A. Material Compatibility:

1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. Provide products of same manufacturer for each coat in a coating system.

B. Chemical Components of Field-Applied Interior Paints and Coatings: Provide topcoat paints and anti-corrosive and anti-rust paints applied to ferrous metals that comply with the following chemical restrictions; these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:

1. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing 1 or more benzene rings).
2. Restricted Components: Paints and coatings shall not contain any of the following:

a. Acrolein.
b. Acrylonitrile.

c. Antimony.
d. Benzene.
e. Butyl benzyl phthalate.
f. Cadmium.
g. Di (2-ethylhexyl) phthalate.
h. Di-n-butyl phthalate.
i. Di-n-octyl phthalate.
j. 1,2-dichlorobenzene.
k. Diethyl phthalate.
l. Dimethyl phthalate.
m. Ethylbenzene.
n. Formaldehyde.
o. Hexavalent chromium.
p. Isophorone.
q. Lead.
r. Mercury.
s. Methyl ethyl ketone.
t. Methyl isobutyl ketone.
u. Methylene chloride.
v. Naphthalene.
w. Toluene (methylbenzene).
x. 1,1,1-trichloroethane.
y. Vinyl chloride.

C. Colors: As selected by Owner from manufacturer's full range.

2.2 BLOCK FILLERS

A. High-Build Epoxy Block Filler: Heavy duty block filler MPI #116.

2.3 INTERIOR PRIMERS/SEALERS

A. Interior Latex Primer/Sealer: MPI #50.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Sherwin-Williams Company; PrepRite, 200 Latex Primer, B28W200.

B. Interior Alkyd Primer/Sealer: MPI #45.

C. Epoxy Zinc Primer: MPI #20.

1. VOC Content: Minimum E Range of E1.

D. Cold-Curing Epoxy Primer: MPI #101.

2.4 EPOXY COATINGS

A. Water-Based Epoxy: MPI #115.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Sherwin-Williams Company; Tile-Clad Epoxy High Gloss B73-100

B. High-Build Epoxy Marine Coating, Low Gloss: MPI #108.

1. VOC Content: Minimum E Range of E1.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

a. Masonry (Clay and CMU): 12 percent.
b. Gypsum Board: 12 percent.

2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
3. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
4. Coating application indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Clean substrates of substances that could impair bond of coatings, including dirt, oil, grease, and incompatible paints and encapsulants.

C. CMU Substrates: Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.

D. Steel Substrates: Remove rust and loose mill scale.

1. Clean using methods recommended in writing by coating manufacturer.

3.3 APPLICATION

A. Apply high-performance coatings according to manufacturer's written instructions.

1. Use applicators and techniques suited for coating and substrate indicated.
2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Coat back sides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.

D. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

3.4 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by Owner, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.5 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. CMU Substrates:

1. High-Build Epoxy Coating System (CNC, Material Storage Spaces and ISO Spaces):

a. Prime Coat: High-build Epoxy block filler, MPI #116.
b. Intermediate Coat: High-build epoxy marine coating, low gloss, MPI #108.
c. Topcoat: High-build epoxy marine coating, low gloss, MPI #108.

B. Steel Substrates:

1. High-Build Epoxy Coating System (CNC, Material Storage Spaces and ISO Spaces):

a. Prime Coat: Epoxy zinc primer, MPI#20.
b. Intermediate Coat: High-build epoxy marine coating, low gloss, MPI #108.
c. Topcoat: High-build epoxy marine coating, low gloss, MPI #108.

C. Gypsum Board Substrates:

1. High-Build Epoxy Coating System (ISO Classified Spaces):

a. Prime Coat: High-build Epoxy block filler, MPI #116.
b. Intermediate Coat: High-build epoxy marine coating, low gloss, MPI #108.
c. Topcoat: High-build epoxy marine coating, low gloss, MPI #108.

END OF SECTION 099600

CONFIDENTIAL DOCUMENT

102113

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

TOILET COMPARTMENTS

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

102113

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
102113	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 102113 - TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Solid-polymer toilet compartments configured as toilet enclosures.

B. Related Sections:

1. Division 10 Section "Toilet Accessories" for toilet tissue dispensers, grab bars, purse shelves, and similar accessories.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachments to other work.

1. Show locations of cutouts for compartment-mounted toilet accessories.
2. Show locations of reinforcements for compartment-mounted grab bars.
3. Show locations of centerlines of toilet fixtures.
4. Show overhead support or bracing locations.

C. Samples for Initial Selection: For each type of unit indicated. Include Samples of hardware and accessories involving material and color selection.

D. Product Certificates: For each type of toilet compartment, from manufacturer.

E. Maintenance Data: For toilet compartments to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Comply with requirements in GSA's CID-A-A-60003, "Partitions, Toilets, Complete."

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84, or another standard acceptable to authorities having jurisdiction, by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

C. Regulatory Requirements: Comply with applicable provisions in Americans with Disabilities Act (ADA) and ICC/ANSI A117.1 for toilet compartments designated as accessible.

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum Castings: ASTM B 26/B 26M.

B. Aluminum Extrusions: ASTM B 221.

C. Zamac: ASTM B 86, commercial zinc-alloy die castings.

D. Particleboard: ANSI A208.1, Grade M-2 with 45-lb density, made with binder containing no urea formaldehyde.

E. Plastic Laminate: NEMA LD 3, general-purpose HGS grade, 0.048-inch nominal thickness.

2.2 SOLID-POLYMER UNITS

A. Toilet-Enclosure Style: Floor and ceiling anchored.

B. Door, Panel, and Pilaster Construction: Solid, high-density polyethylene (HDPE) panel material, not less than 1 inch thick, seamless, with eased edges, no-sightline system, and with homogenous color and pattern throughout thickness of material.

1. Integral Hinges: Configure doors and pilasters to receive integral hinges.
2. Color and Pattern: One color and pattern in each room as selected by Owner from manufacturer's full range.

C. Pilaster Shoes and Sleeves (Caps): Manufacturer's standard design; polymer.

1. Polymer Color and Pattern: Matching pilaster.

D. Brackets (Fittings):

1. Full-Height (Continuous) Type: Manufacturer's standard design polymer .

a. Polymer Color and Pattern: Matching panel.

E. Overhead Cross Bracing for Ceiling-Hung Units: As recommended by manufacturer and fabricated from solid polymer.

2.3 ACCESSORIES

A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.

1. Hinges: Manufacturer's standard continuous, cam type that swings to a closed or partially open position.
2. Latch and Keeper: Manufacturer's standard recessed latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
3. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.
4. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
5. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.

B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.

C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel.

2.4 FABRICATION

A. Floor-and-Ceiling-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment at tops and bottoms of pilasters. Provide shoes and sleeves (caps) at pilasters to conceal anchorage.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

1. Maximum Clearances:

    a. Pilasters and Panels: 1/2 inch.
    b. Panels and Walls: 1 inch.

B. Floor-and-Ceiling-Anchored Units: Secure pilasters to supporting construction and level, plumb, and tighten. Hang doors and adjust so doors are level and aligned with panels when doors are in closed position.

3.2 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 102113

CONFIDENTIAL DOCUMENT

102600

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

WALL PROTECTION

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
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ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

102600

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
102600	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 102600 - WALL PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Wall guards.
2. Corner guards.
3. Interior Bollards

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions, impact strength dimensions of individual components and profiles, and finishes for each impact-resistant wall-protection unit.

B. Shop Drawings: For each impact-resistant wall-protection unit showing locations and extent. Include sections, details, and attachments to other work.

1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Qualification Data: For Installer.

D. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store impact-resistant wall-protection units in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1. Maintain room temperature within storage area at not less than 70 deg F during the period plastic materials are stored.

2. Keep plastic sheet material out of direct sunlight.
3. Store plastic wall-protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F.

    a. Store corner-guard covers in a vertical position.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install impact-resistant wall-protection units until building is enclosed and weatherproof, wet work is complete and dry, and HVAC system is operating and maintaining temperature at 70 deg F (21 deg C) for not less than 72 hours before beginning installation and for the remainder of the construction period.

B. Field Measurements: Verify actual locations of walls, columns, and other construction contiguous with impact-resistant wall-protection units by field measurements before fabrication and indicate measurements on Shop Drawings.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of impact-resistant wall-protection units that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Structural failures.
    b. Deterioration of plastic and other materials beyond normal use.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stainless-Steel Sheet: ASTM A 240/A 240M.

B. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.

2.2 WALL GUARDS

A. Crash Rail WG-B: Heavy-duty assembly consisting of continuous flat rail with bent inside and outside corners designed to withstand impacts.

1. Basis-of-Design Product: Wallguard 2181 Stainless Steel Crash Rail or a comparable product by one of the following:

2. Type 304 stainless steel standard
3. Rail: 1/4" thick x 4" high
4. Brackets: I-Beam brackets
5. Fasteners: Hidden Fasteners
6. Corners: Continuous inside and outside corners

2.3 CORNER GUARDS

A. Surface-Mounted, Stainless Steel Corner Guards WG-A: Assembly consisting of fabricated with 90-degree turn to match wall condition.

1. Angle: 3"x3"x1/8" 316 Stainless Steel Angles
2. Top Finish: Rounded Top
3. Fasten: Flat Head Wall Anchors

2.4 FABRICATION

A. Fabricate impact-resistant wall-protection units to comply with requirements indicated for design, dimensions, and member sizes, including thicknesses of components.

B. Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.

C. Fabricate components with tight seams and joints with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

2.5 METAL FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

C. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

1. Examine walls to which impact-resistant wall protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
2. For impact-resistant wall-protection units attached with adhesive or foam tape, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Complete finishing operations, including painting, before installing impact-resistant wall-protection system components.

B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

A. General: Install impact-resistant wall-protection units level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

3.4 CLEANING

A. Immediately after completion of installation, clean plastic covers and accessories using a standard, ammonia-based, household cleaning agent.

B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION 102600

CONFIDENTIAL DOCUMENT

102800

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

TOILET ACCESSORIES

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
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ImmuCell Project Manager ImmuCell	Elizabeth Williams		
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CONFIDENTIAL DOCUMENT

102800

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
102800	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 102800 - TOILET ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Washroom Accessories.
2. Air dryers.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include the following:

1. Construction details and dimensions.
2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
3. Material and finish descriptions.
4. Features that will be included for Project.
5. Manufacturer's warranty.

B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated on Drawings.

1.4 QUALITY ASSURANCE

A. Source Limitations: For products listed together in the same articles in Part 2, provide products of same manufacturer unless otherwise approved by Owner.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.5 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.6 WARRANTY

A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, 0.0312-inch minimum nominal thickness, unless otherwise indicated.

B. Brass: ASTM B 19 flat products; ASTM B 16 , rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.

C. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.0359-inch minimum nominal thickness.

D. Galvanized Steel Sheet: ASTM A 653/A 653M, with G60 hot-dip zinc coating.

E. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

F. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

G. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).

H. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

I. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

2.2 WASHROOM ACCESSORIES

A. Toilet Tissue (Roll) Dispenser (TTD-1):
1. Description: Double-roll dispenser with shelf.

2. Mounting: Partition mounted serving two adjacent toilet compartments and surface mounted.
3. Capacity: Designed for 4-1/2- or 5-inch- diameter tissue rolls.
4. Material and Finish: Stainless steel, No. 4 finish (satin).

B. Combination Towel (Folded) Dispenser/Waste Receptacle (TDW-1):
1. Description: Combination unit for dispensing C-fold or multifold towels, with removable waste receptacle.
2. Mounting: Semi recessed.
   a. Designed for nominal 6-inch wall depth.
3. Minimum Towel-Dispenser Capacity: 600 C-fold or 800 multifold paper towels.
4. Minimum Waste-Receptacle Capacity: 4 gal. .
5. Material and Finish: Stainless steel, No. 4 finish (satin).
6. Lockset: Tumbler type for towel-dispenser compartment[and waste receptacle].

C. Liquid-Soap Dispenser (LSD-1):
1. Description: Designed for dispensing soap in liquid or lotion.
2. Mounting: Vertically oriented, surface mounted.
3. Lockset: Tumbler type.
4. Refill Indicator: Window type.

D. Grab Bar:
1. Mounting: Flanges with concealed fasteners.
2. Material: Stainless steel, 0.05 inch thick.

3. Outside Diameter: 1-1/2 inches.
4. Configuration and Length: [As indicated on Drawings.

E. Sanitary-Napkin Disposal Unit (SND-1):
1. Mounting: Partition mounted, dual access.
2. Door or Cover: Self-closing disposal-opening cover and hinged face panel with tumbler lockset.
3. Receptacle: Removable.
4. Material and Finish: Stainless steel, No. 4 finish (satin).

F. Shower Curtain Rod:
1. Description: 1-1/4-inch; fabricated from nominal 0.05-inch- thick stainless steel.
2. Mounting Flanges: Stainless-steel flanges designed for exposed fasteners.
3. Finish: No. 4 (satin).

G. Shower Curtain:
1. Size: Minimum 12 inches wider than opening by 72 inches high.
2. Material: Vinyl, minimum 0.006-inch- thick, opaque, matte.
3. Color: White.
4. Grommets: Corrosion resistant at minimum 6 inches o.c. through top hem.
5. Shower Curtain Hooks: Chrome-plated or stainless-steel, spring wire curtain hooks with snap fasteners, sized to accommodate specified curtain rod. Provide one hook per curtain grommet.

H. Folding Shower Seat:
1. Configuration: [L-shaped seat, designed for wheelchair access.

2. Seat: Phenolic or polymeric composite of slat-type or one-piece construction in color as selected by Owner.
3. Mounting Mechanism: Stainless steel, No. 4 finish (satin).

I. Mirror (MIR-1):

1. Description: 24” X 36” Tempered Glass Mirror with Stainless Steel Frame Bobrick Model B-165 2436

2.3 AIR DRYERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Excel Dryer Corporation.

B. Warm-Air Dryer (WAD): Xlerator (XL-SB)

1. Mounting: Surface mounted.
2. Electrical Requirements: 110/120 V, 13 A, 1500 W.

2.4 UNDERLAVATORY GUARDS

A. Underlavatory Guard Provide at all assessable sinks:

1. Description: Insulating pipe covering for supply and drain piping assemblies that prevent direct contact with and burns from piping, and allow service access without removing coverings.
2. Material and Finish: Antimicrobial, molded-plastic, white.

2.5 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to method in ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 102800

CONFIDENTIAL DOCUMENT

104413

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

FIRE EXTINGUISHER CABINETS

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
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CONFIDENTIAL DOCUMENT

104413

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
104413	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 104413 - FIRE EXTINGUISHER CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fire protection cabinets for the following:

a. Portable fire extinguishers.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire protection cabinets.

1. Fire Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.

B. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.

C. Product Schedule: For fire protection cabinets. Coordinate final fire protection cabinet schedule with fire extinguisher schedule to ensure proper fit and function.

1.4 QUALITY ASSURANCE

A. Fire-Rated, Fire Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.5 COORDINATION

A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate sizes and locations of fire protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.

B. Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:

1. Sheet: ASTM B 209.
2. Extruded Shapes: ASTM B 221.

C. Stainless-Steel Sheet: ASTM A 666, Type 304.

D. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

2.2 FIRE PROTECTION CABINET

A. Cabinet Type: Suitable for fire extinguisher.

1. Products: Subject to compliance with requirements, provide the following:

a. Larsen's Manufacturing Company; 2409-6R with full clear tempered door

B. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Lettered Door Handle: One-piece, cast-iron door handle with the word "FIRE" embossed into face.
3. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.

a. Identify fire extinguisher in fire protection cabinet with the words "FIRE EXTINGUISHER."

1) Location: Applied to cabinet door.
2) Lettering Color: Red.
3) Orientation: Vertical.

2.3 FABRICATION

A. Fire Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

1. Weld joints and grind smooth.
2. Provide factory-drilled mounting holes.
3. Prepare doors and frames to receive locks.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.

2.4 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces of fire protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire protection cabinets after assembly.

D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where recessed semi recessed cabinets will be installed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare recesses for semi recessed fire protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

A. General: Install fire protection cabinets in locations and at mounting heights indicated at heights indicated below:

1. Fire Protection Cabinets: 54 inches above finished floor to top of cabinet.

B. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.

3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire protection cabinet and mounting bracket manufacturers.

E. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 104413

CONFIDENTIAL DOCUMENT

104416

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

FIRE EXTINGUISHERS

ImmuCell
Portland, ME

Reviews / Approvals

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ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

104416

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
104416	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes portable, hand-carried fire extinguishers.

B. Related Sections:

1. Division 10 Section "Fire Extinguisher Cabinets."

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher.

B. Product Schedule: For fire extinguishers. Coordinate final fire extinguisher schedule with fire protection cabinet schedule to ensure proper fit and function.

C. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

D. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1. Provide fire extinguishers approved, listed, and labeled by FMG.

1.5 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

PART 2 - PRODUCTS

2.1 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Multipurpose Dry-Chemical Type in Aluminum Container 4-A:60-B:C, 10-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-aluminum container.

1. Valves: Manufacturer's standard.
2. Handles and Levers: Manufacturer's standard.
3. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install fire extinguishers in locations indicated and in compliance with requirements of authorities having jurisdiction.

END OF SECTION 104416

CONFIDENTIAL DOCUMENT

105113

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

METAL LOCKERS

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
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CONFIDENTIAL DOCUMENT

105113

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
105113	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 105113 - METAL LOCKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Heavy-duty metal lockers.
2. Locker benches.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal locker and bench.

B. Shop Drawings: For metal lockers. Include plans, elevations, sections, details, and attachments to other work.

1. Show locker trim and accessories.
2. Include locker identification system and numbering sequence.

C. Qualification Data: For qualified Installer.

D. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.

E. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain metal lockers, locker benches, and accessories from single source from single manufacturer.

C. Regulatory Requirements: Where metal lockers and benches are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities" and ICC/ANSI A117.1.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver metal lockers until spaces to receive them are clean, dry, and ready for their installation.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of recessed openings by field measurements before fabrication.

1.7 COORDINATION

A. Coordinate sizes and locations of bases for metal lockers.

B. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that metal lockers can be supported and installed as indicated.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Structural failures.
    b. Faulty operation of latches and other door hardware.

2. Damage from deliberate destruction and vandalism is excluded.
3. Warranty Period for All-Welded Metal Lockers: 10 years from date of Substantial Completion.

1.9 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Full-size units of the following metal locker hardware items equal to 10 percent of amount installed for each type and finish installed, but no fewer than two units:

a. Identification plates.
b. Hooks.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B, suitable for exposed applications.

B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with A60 (ZF180) zinc-iron, alloy (galvannealed) coating designation.

C. Expanded Metal: ASTM F 1267, Type II (flattened), Class I, 3/4-inch (19-mm) steel mesh, with at least 70 percent open area.

D. Plastic Laminate: NEMA LD 3, Grade HGP.

E. Extruded Aluminum: ASTM B 221 (ASTM B 221M), alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated.

F. Steel Tube: ASTM A 500, cold rolled.

G. Particleboard: ANSI A208.1, Grade M-2.

H. Fasteners: Zinc- or nickel-plated steel, slotless-type, exposed bolt heads; with self-locking nuts or lock washers for nuts on moving parts.

I. Anchors: Material, type, and size required for secure anchorage to each substrate.

1. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls[, and elsewhere as indicated,] for corrosion resistance.
2. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

2.2 HEAVY-DUTY METAL LOCKERS

A. Material: Cold-rolled steel sheet.

B. Body: Assembled by welding body components together. Fabricate from unperforated steel sheet with thicknesses as follows:

1. Tops, Bottoms, and Sides: 0.060-inch nominal thickness.
2. Backs: 0.048-inch nominal thickness.
3. Shelves: 0.060-inch nominal thickness, with double bend at front and single bend at sides and back.

C. Frames: Channel formed; fabricated from 0.060-inch nominal-thickness steel sheet; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral door strike full height on vertical main frames.

D. Doors: One piece; fabricated from 0.075-inch nominal-thickness steel sheet; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges.

1. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than 15 inches wide; welded to inner face of doors.
2. Door Style:

a. Perforated Vents: Manufacturer's standard shape and configuration.

E. Hinges: Welded to door and attached to door frame with no fewer than two factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees.

1. Continuous Hinges: Manufacturer's standard, steel, full height.

F. Recessed Door Handle and Latch: Stainless-steel cup with integral door pull, recessed so locking device does not protrude beyond face of door; pry and vandal resistant.

1. Single-Point Latching: Nonmoving latch with steel padlock loop that projects through recessed cup and is finished to match metal locker body.

a. Latch Hook: Equip each door with one latch hook, fabricated from 0.120-inch nominal-thickness steel sheet; welded midway up full-height door strike; with resilient silencer.

G. Equipment: Equip each metal locker with identification plate and the following unless otherwise indicated:

1. Double-Tier Units: One double-prong ceiling hook and two single-prong wall hooks.

H. Accessories:

1. Legs: 6 inches high; formed by extending vertical frame members, or fabricated from 0.075-inch nominal-thickness steel sheet; welded to bottom of locker.

a. Closed Front and End Bases: Fabricated from 0.036-inch (0.91-mm) nominal-thickness steel sheet.

2. Boxed End Panels: Fabricated from 0.048-inch nominal-thickness steel sheet.

I. Finish: powder coat.

1. Color(s): As selected by Owner from manufacturer's full range.

2.3 LOCKER BENCHES

A. Provide bench units with overall assembly height of 17-1/2 inches.

B. Bench Tops: Manufacturer's standard one-piece units, with rounded corners and edges.

1. Size: Minimum 9-1/2 inches wide by 1-1/4 inches thick.
2. Extruded aluminum with clear anodic finish.

C. Fixed Pedestals: Manufacturer's standard supports, with predrilled fastener holes for attaching bench top and anchoring to floor, complete with fasteners and anchors, and as follows:

1. Tubular Steel: 1-1/2-inch- diameter steel tubing threaded on both ends, with standard pipe flange at top and bell-shaped cast-iron base; with baked-enamel or powder-coat finish; anchored with exposed fasteners.

a. Color: Match metal lockers

2.4 FABRICATION

A. Fabricate metal lockers square, rigid, and without warp and with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch and free of sharp edges and burrs.

1. Form body panels, doors, shelves, and accessories from one-piece steel sheet unless otherwise indicated.
2. Provide fasteners, filler plates, supports, clips, and closures as required for complete installation.

B. Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments. Factory weld frame members of each metal locker together to form a rigid, one-piece assembly.

C. All-Welded Construction: Factory preassemble metal lockers by welding all joints, seams, and connections; with no bolts, nuts, screws, or rivets used in assembly of main locker groups. Factory weld main locker groups into one-piece structures. Grind exposed welds flush.

D. Hooks: Manufacturer's standard ball-pointed type, aluminum or steel; zinc plated.

E. Identification Plates: Manufacturer's standard, etched, embossed, or stamped aluminum plates, with numbers and letters at least 3/8 inch high.

F. Individual Sloping Tops: Fabricated in width to fit one locker frame in lieu of flat locker tops; with integral back; finished to match lockers. Provide wedge-shaped divider panels between lockers.

G. Boxed End Panels: Fabricated with 1-inchwide edge dimension, and designed for concealing fasteners and holes at exposed ends of nonrecessed metal lockers; finished to match lockers.

2.5 STEEL SHEET FINISHES

A. Factory finish steel surfaces and accessories except stainless-steel and chrome-plated surfaces.

B. Powder-Coat Finish: Immediately after cleaning and pretreating, electrostatically apply manufacturer's standard, baked-polymer, thermosetting powder finish. Comply with resin manufacturer's written instructions for application, baking, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, and support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install level, plumb, and true; shim as required, using concealed shims.

1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches o.c. Using concealed fasteners, install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion.
2. Anchor single rows of metal lockers to walls near top of lockers and to floor.

B. All-Welded Metal Lockers: Connect groups together with standard fasteners, with no exposed fasteners on face frames.

C. Equipment and Accessories: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.

1. Attach hooks with at least two fasteners.
2. Attach door locks on doors using security-type fasteners.
3. Identification Plates:

    a. Attach plates to each locker door, near top, centered, with at least two aluminum rivets.

4. Attach boxed end panels with concealed fasteners to conceal exposed ends of nonrecessed metal lockers.

D. Fixed Locker Benches: Provide no fewer than two pedestals for each bench, uniformly spaced not more than 72 inches apart. Securely fasten tops of pedestals to undersides of bench tops, and anchor bases to floor.

3.3 ADJUSTING, CLEANING, AND PROTECTION

A. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding. Verify that integral locking devices operate properly.

B. Protect metal lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.

C. Touch up marred finishes, or replace metal lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION 105113

CONFIDENTIAL DOCUMENT

123200

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

MANUFACTURED WOOD CASEWORK

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
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ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

123200

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
123200	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 123200 - MANUFACTURED WOOD CASEWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Wood-faced cabinets of stock design.
2. Solid-surfacing-material countertops.

B. Related Sections:

1. Division 09 Section "Non-Structural Metal Framing" for reinforcements in metal-framed partitions for anchoring manufactured wood casework.

1.3 DEFINITIONS

A. MDF: Medium-density fiberboard.

B. Exposed Portions of Cabinets: Surfaces visible when doors and drawers are closed, including bottoms of cabinets more than 48 inches above floor, and surfaces visible in open cabinets.

C. Semi-exposed Portions of Cabinets: Surfaces behind opaque doors, such as interiors of cabinets, shelves, dividers, interiors and sides of drawers, and interior faces of doors. Tops of cases 78 inches or more above floor are defined as semi-exposed.

D. Concealed Portions of Cabinets: Surfaces not usually visible after installation, including sleepers, web frames, dust panels, and ends and backs that are placed directly against walls or other cabinets.

E. Hardwood Plywood: A panel product composed of layers or plies of veneer, or of veneers in combination with lumber core, hardboard core, MDF core, or particleboard core, joined with adhesive, and faced both front and back with hardwood veneers.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Show fabrication details, including types and locations of hardware. Show installation details, including field joints and filler panels. Indicate manufacturer's catalog numbers for casework.

C. Qualification Data: For qualified Installer.

D. Warranty: Sample of special warranty.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.

B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

C. Source Limitations: Obtain manufactured wood casework from single source from single manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver manufactured wood casework only after painting, utility roughing-in, and similar operations that could damage, soil, or deteriorate casework have been completed in installation areas. If casework must be stored in other than installation areas, store only in areas where environmental conditions meet requirements specified in "Project Conditions" Article.

B. Keep finished surfaces covered with polyethylene film or other protective covering during handling and installation.

C. Deliver casework as factory-assembled units, packaged individually.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install manufactured wood casework until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

B. Established Dimensions: Where casework is indicated to fit to other construction, establish dimensions for areas where casework is to fit. Coordinate construction to ensure that actual dimensions correspond to established dimensions. Provide fillers and scribes to allow for trimming and fitting.

C. Field Measurements: Verify actual dimensions of construction contiguous with manufactured wood casework by field measurements before fabrication.

1.8 COORDINATION

A. Coordinate layout and installation of framing and reinforcements in walls and partitions for support of manufactured wood casework.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of manufactured wood casework that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Delamination of components or other failures of glue bond.
b. Warping of components.
c. Failure of operating hardware.
d. Deterioration of finishes.

2. Warranty Period: Five years from date of Substantial Completion.

1.10 EXTRA MATERIALS

A. Furnish complete touchup kit for each type and finish of manufactured wood casework provided. Include scratch fillers, stains, finishes, and other materials necessary to perform permanent repairs to damaged casework finish.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Low-Emitting Materials: Provide manufactured wood casework, including countertops, made with adhesives and composite wood products containing no urea formaldehyde.

B. Maximum Moisture Content for Lumber: 7 percent for hardwood and 12 percent for softwood.

C. Hardwood Plywood: HPVA HP-1, either veneer core or particleboard core unless otherwise indicated.

D. Softwood Plywood: DOC PS 1.

E. Particleboard: ANSI A208.1, Grade M-2.

F. MDF: ANSI A208.2, Grade 130 and Grade MD .

G. Hardboard: AHA A135.4, Class 1 Tempered.

2.2 CABINET MATERIALS

A. Exposed Cabinet Materials:

1. Wood Species: White maple.

2. Solid Wood: Clear hardwood lumber of species indicated and selected for grain and color compatible with exposed plywood.
3. Unless otherwise indicated, provide specified edgebanding on all exposed edges.

B. Semi exposed Cabinet Materials:

1. Solid Wood: Sound hardwood lumber, selected to eliminate appearance defects, of same species as exposed wood.

C. Concealed Cabinet Materials:

1. Plywood: Hardwood plywood. Provide backs of same species as faces.

2.3 DESIGN, COLOR, AND FINISH

A. Design: Provide manufactured wood casework of the following design:

1. Lipped overlay with radiused edges and wire pulls.

B. Wood Colors and Finishes: As indicated by manufacturer's designations.

2.4 CABINET FABRICATION

A. Wood-Faced Cabinet Construction: As required by referenced quality standard, but not less than the following:

1. Bottoms of Cabinets and Tops of Wall Cabinets: 3/4-inch veneer-core hardwood plywood.
2. Ends of Cabinets: 3/4-inch hardwood plywood.
3. Shelves: 3/4-inch veneer-core hardwood plywood.
4. Base Cabinet Top Frames: 3/4-by-2-inch solid wood with mortise and tenon or doweled connections, glued and pinned or screwed.
5. Base Cabinet Stretchers: 3/4-by-4-1/2-inch plywood, particleboard, or MDF strips or solid-wood boards at front and back of cabinet, glued and pinned or screwed.
6. Base Cabinet Subtops: 3/4-inch panel product glued and pinned or screwed.
7. Backs of Cabinets: 3/4-inch particleboard-core hardwood plywood where exposed, 1/2-inch hardwood plywood dadoed into sides, bottoms, and tops where not exposed.
8. Drawer Fronts: 3/4-inch solid hardwood.
9. Drawer Sides and Backs: 1/2-inch solid-wood or veneer-core hardwood plywood, with glued dovetail or multiple-dowel joints.
10. Drawer Bottoms: 1/4-inch veneer-core hardwood plywood glued and dadoed into front, back, and sides of drawers. Use 1/2-inch material for drawers more than 24 inches wide.

11. Doors 48 Inches or Less in Height: 3/4 inch thick, with solid hardwood stiles and rails, particleboard or MDF cores, and hardwood face veneers and crossbands.
12. Provide integral toe space of minimum 4 inches by 3 inches.
13. Toe Kicks: 3/4inch net thickness, scribed to floor. Provide toe kicks for cabinets and appliances.

B. Filler Strips: Provide as needed to close spaces between cabinets and walls, ceilings, and indicated equipment. Fabricate from same material and with same finish as cabinets.

2.5 FINISH FOR WOOD-FACED MANUFACTURED CASEWORK

A. Preparation: Sand lumber and plywood for manufactured wood casework construction before assembling. Sand edges of doors and drawer fronts and molded shapes with profile-edge sander. Sand casework after assembling for uniform smoothness at least equivalent to that produced by 220-grit sanding and without machine marks, cross sanding, or other surface blemishes.

B. Staining: Remove fibers and dust and apply wash-coat sealer and stain to exposed and semiexposed surfaces as required to provide uniform color and to match approved samples.

C. Finishing Closed-Grain Woods: Apply manufacturer's standard two-coat, baked, clear finish consisting of a thermosetting catalyzed sealer and a thermosetting catalyzed conversion varnish. Sand and wipe clean between applications of sealer and topcoat. Topcoat may be omitted on concealed surfaces.

2.6 CASEWORK HARDWARE AND ACCESSORIES

A. Hardware, General: Unless otherwise indicated, provide manufacturer's standard satin-finish, commercial-quality, heavy-duty hardware.

1. Use threaded metal or plastic inserts with machine screws for fastening to particleboard except where hardware is through-bolted from back side.

B. Frameless Concealed Hinges (European Type): BHMA A156.9, Type B01602, 135 degrees of opening.

C. Pulls: Solid aluminum wire pulls, fastened from back with two screws. Provide 2 pulls for drawers more than 24 inches wide. Upper cabinet doors to have integral finger pull along bottom edge. Base cabinet doors and drawers to have aligned pull hardware.

D. Door Catches: Zinc-plated, nylon-roller spring catch or dual, self-aligning, permanent magnet catch.

E. Drawer Slides: BHMA A156.9, Type B05091.

1. Heavy Duty (Grade 1HD-100 and Grade 1HD-200): Side mounted; full-overtravel-extension type; zinc-plated, steel ball-bearing slides.

F. Adjustable Shelf Supports: 2-pin locking plastic shelf rests complying with BHMA A156.9, Type B04013.

2.7 COUNTERTOPS

A. Countertops, General: Provide smooth, clean exposed tops and edges in uniform plane free of defects. Provide front and end overhang of 1 inch over base cabinets.

B. Solid-Surfacing-Material Tops: 1/4-inch thick, solid-surfacing material laminated to 3/4-inch thick particleboard with front edge built up with 3/4-inch- thick, solid-surfacing material.

1. Front: 1-inch laminated bullnose.
2. Backsplashes: 3/4-inch thick, solid-surfacing material; slightly eased at edge.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of framing and reinforcements, and other conditions affecting performance of manufactured wood casework.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CASEWORK INSTALLATION

A. Install level, plumb, and true; shim as required, using concealed shims. Where manufactured wood casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.

B. Base Cabinets: Set cabinets straight, level, and plumb. Adjust subtops within 1/16 inch of a single plane. Fasten cabinets to masonry or framing, wood blocking, or reinforcements in walls and partitions with fasteners spaced 24 inches o.c. Bolt adjacent cabinets together with joints flush, tight, and uniform. Align similar adjoining doors and drawers to a tolerance of 1/16 inch.

1. Where base cabinets are not installed adjacent to walls, fasten to floor at toe space with fasteners spaced 24 inches o.c. Secure sides of cabinets to floor, where they do not adjoin other cabinets, with not less than two fasteners.

C. Wall Cabinets: Hang cabinets straight, level, and plumb. Adjust fronts and bottoms within 1/16 inch of a single plane. Fasten to hanging strips, masonry, or framing, blocking, or reinforcements in walls or partitions. Align similar adjoining doors to a tolerance of 1/16 inch.

1. Fasten through back, near top and bottom, at ends, and not more than 16 inches o.c.
2. Use toggle bolts at hollow masonry.
3. Use expansion anchors at solid masonry.

4. Use No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish at metal-framed partitions.

D. Install hardware uniformly and precisely. Set hinges snug and flat in mortises unless otherwise indicated. Adjust and align hardware so moving parts operate freely and contact points meet accurately. Allow for final adjustment after installation.

E. Adjust casework and hardware so doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

3.3 INSTALLATION OF TOPS

A. Field Jointing: Where possible make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.

B. Secure tops to cabinets with Z- or L-type fasteners or equivalent, using two or more fasteners at each front, end, and back.

C. Abut top and edge surfaces in one true plane, with internal supports placed to prevent deflection.

D. Secure backsplashes to tops with concealed metal brackets at 16 inches o.c. and walls with adhesive.

E. Seal junctures of tops, splashes, and walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.

3.4 CLEANING AND PROTECTING

A. Repair or remove and replace defective work as directed on completion of installation.

B. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Owner.

C. Protection: Provide 6-mil plastic or other suitable water-resistant covering over countertop surfaces. Tape to underside of countertop at a minimum of 48 inches o.c. Remove protection at Substantial Completion.

END OF SECTION 123200

CONFIDENTIAL DOCUMENT

123553

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

LABORATORY CASEWORK

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
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ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

123553

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
123553	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 123553 - LABORATORY CASEWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal laboratory casework.
2. Filler and closure panels.
3. Laboratory countertops.
4. Laboratory sinks.

B. Related Sections:

1. Division 09 Non-Structural Metal Framing for metal blocking for anchoring laboratory casework.
2. Division 09 Section "Non-Structural Metal Framing" for reinforcements in metal-framed partitions for anchoring laboratory casework.
3. Divisions 22 and 26 Sections for installing service fittings specified in this Section, including connecting service utilities.

1.3 DEFINITIONS

A. Exposed Surfaces of Casework: Surfaces visible when doors and drawers are closed, including bottoms of cabinets more than 48 inches above floor, and visible surfaces in open cabinets or behind glass doors.

1. Ends of cabinets, including those installed directly against walls or other cabinets, are defined as "exposed."
2. Ends of cabinets indicated to be installed directly against and completely concealed by walls or other cabinets are defined as "concealed."

B. Semi exposed Surfaces of Casework: Surfaces behind opaque doors, such as cabinet interiors, shelves, and dividers; interiors and sides of drawers; and interior faces of doors. Tops of cabinets 78 inches or more above floor are defined as "semiexposed."

C. Concealed Surfaces of Casework: Include sleepers, web frames, dust panels, and other surfaces not usually visible after installation.

1.4 PERFORMANCE REQUIREMENTS

A. System Structural Performance: Laboratory casework and support framing system shall withstand the effects of the following gravity loads and stresses without permanent deformation, excessive deflection, or binding of drawers and doors:

1. Support Framing System: 600 lb/ft.
2. Suspended Base Cabinets (Internal Load): 160 lb/ft.
3. Work Surfaces (Including Tops of Suspended Base Cabinets): 160 lb/ft.
4. Wall Cabinets (Upper Cabinets): 160 lb/ft.
5. Shelves: 40 lb/sq. ft.

B. Delegated Design: Design laboratory casework, including comprehensive engineering analysis by a qualified professional engineer, using seismic performance requirements and design criteria indicated.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For laboratory casework. Include plans, elevations, sections, details, and attachments to other work.

1. Indicate locations of hardware.
2. Indicate locations and types of service fittings.
3. Indicate locations of blocking and reinforcements required for installing laboratory casework.
4. Include details of utility spaces showing supports for conduits and piping.
5. Include details of support framing system.
6. Indicate locations of and clearances from adjacent walls, doors, windows, other building components, and other laboratory equipment.
7. Include coordinated dimensions for laboratory equipment specified in other Sections.

C. Delegated-Design Submittal: For laboratory casework indicated to comply with seismic performance requirements, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Qualification Data: For qualified manufacturer.

E. Product Test Reports for Casework: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating compliance of laboratory casework with requirements of specified product standard.

F. Product Test Reports for Countertop Surface Material: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating compliance of laboratory countertop surface materials with requirements specified for chemical and physical resistance.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that produces casework of types indicated for this Project that has been tested for compliance with SEFA 8

B. Source Limitations: Obtain laboratory casework from single source from single manufacturer unless otherwise indicated.

1. Obtain countertops, sinks and accessories from casework manufacturer.

C. Casework Product Standard: Comply with SEFA 8, "Laboratory Furniture - Casework, Shelving and Tables - Recommended Practices."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect finished surfaces during handling and installation with protective covering of polyethylene film or other suitable material.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install laboratory casework until building is enclosed, utility roughing-in and wet work are complete and dry, and temporary HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

1.9 COORDINATION

A. Coordinate layout and installation of framing and reinforcements for support of laboratory casework.

B. Coordinate installation of laboratory casework with installation of fume hoods and other laboratory equipment.

1.10 EXTRA MATERIALS

A. Furnish complete touchup kit for each type and color of metal laboratory casework provided. Include fillers, primers, paints, and other materials necessary to perform permanent repairs to damaged laboratory casework finish.

B. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Cabinet Mounting Clips and Related Hardware: Quantity equal to 5 percent of amount installed, but no fewer than 2 of each type.

PART 2 - PRODUCTS

2.1 METAL CABINET MATERIALS

A. Metal: Cold-rolled, commercial steel (CS) sheet, complying with ASTM A 1008/A 1008M; matte finish; suitable for exposed applications.

B. Nominal Metal Thickness:

1. Sides, Ends, Fixed Backs, Bottoms, Tops, Soffits, and Items Not Otherwise Indicated: 0.048 inch. Except for flammable liquid storage cabinets, bottoms may be 0.036 inch if reinforced.
2. Back Panels, Doors, Drawer Fronts and Bodies, and Shelves: 0.036 inch except 0.048 inch for back panels and doors of flammable liquid storage cabinets and for unreinforced shelves more than 36 inches long.
3. Intermediate Horizontal Rails, Table Aprons and Cross Rails, Center Posts, and Top Gussets: 0.060 inch.
4. Drawer Runners, Sink Supports, and Hinge Reinforcements: 0.075 inch.
5. Leveling and Corner Gussets: 0.105 inch.

2.2 AUXILIARY CABINET MATERIALS

A. Glass for Glazed Doors: Clear laminated tempered glass complying with ASTM C 1172, Kind LT, Condition A, Type I, Class I, Quality-Q3; with 2 lites not less than 3.0 mm thick and with clear, polyvinyl butyral interlayer.

2.3 COUNTERTOP, AND SINK MATERIALS

A. Epoxy: Factory-molded, modified epoxy-resin formulation with smooth, nonspecular finish.

1. Manufacturers: Subject to compliance with requirements
2. Physical Properties:

a. Flexural Strength: Not less than 10,000 psi.
b. Modulus of Elasticity: Not less than 2,000,000 psi.
c. Hardness (Rockwell M): Not less than 100.
d. Water Absorption (24 Hours): Not more than 0.02 percent.
e. Heat Distortion Point: Not less than 260 deg F.

3. Chemical Resistance: Epoxy-resin material has the following ratings when tested with indicated reagents according to NEMA LD 3, Test Procedure 3.4.5:

a. No Effect: Acetic acid (98 percent), acetone, ammonium hydroxide (28 percent), benzene, carbon tetrachloride, dimethyl formamide, ethyl acetate, ethyl alcohol, ethyl ether, methyl alcohol, nitric acid (70 percent), phenol, sulfuric acid (60 percent), and toluene.
b. Slight Effect: Chromic acid (60 percent) and sodium hydroxide (50 percent).

4. Color: As selected by Owner from manufacturer's full range.
5. Sink to be provided with all necessary drains, strainers and tail pieces.

2.4 METAL CABINETS

A. Manufacturers: Subject to compliance with requirements

B. Fabrication: Assemble and finish units at point of manufacture. Use precision dies for interchangeability of like-size drawers, doors, and similar parts. Perform assembly on precision jigs to provide units that are square. Reinforce units with angles, gussets, and channels. Except where otherwise specified, integrally frame and weld cabinet bodies to form dirt and vermin-resistant enclosures. Where applicable, reinforce base cabinets for sink support. Maintain uniform clearance around door and drawer fronts of 1/16 to 3/32 inch.

C. Flush Doors: Outer and inner pans that nest into box formation, with full-height channel reinforcements at center of door. Fill doors with noncombustible, sound-deadening material.

D. Glazed Doors: Hollow-metal stiles and rails of similar construction as flush doors, with glass held in resilient channels or gasket material.

E. Hinged Doors: Mortise for hinges and reinforce with angles welded inside inner pans at hinge edge.

F. Drawers: Fronts made from outer and inner pans that nest into box formation, with no raw metal edges at top. Sides, back, and bottom fabricated in one piece with rolled or formed top of sides for stiffening and comfortable grasp for drawer removal. Provide drawers with rubber bumpers, polymer roller slides, and positive stops to prevent metal-to-metal contact or accidental removal.

G. Adjustable Shelves: Front, back, and ends formed down, with edges returned horizontally at front and back to form reinforcing channels.

H. Toe Space: Fully enclosed, 4 inches high by 3 inches deep, with no open gaps or pockets.

I. Filler and Closure Panels: Provide where indicated and as needed to close spaces between cabinets and walls, ceilings, and indicated equipment. Fabricate from same material and with same finish as cabinets and with hemmed or flanged edges unless otherwise indicated.

1. Provide knee-space panels (modesty panels) at spaces between base cabinets, where cabinets are not installed against a wall or where space is not otherwise closed. Fabricate from back-to-back panels or of hollow construction to eliminate exposed hemmed or flanged edges.

2.5 LABORATORY CASEWORK SYSTEM

A. Manufacturers: Subject to compliance with requirements.

B. Provide casework manufacturer's standard integrated system that includes support framing, suspended modular cabinets, filler and closure panels, countertops, and fittings needed to assemble system. System includes hardware and fasteners for securing support framing to permanent construction.

1. Cabinet Construction: Metal.
2. System includes filler and closure panels to close spaces between support framing, cabinets, shelves, countertops, floors, and walls unless otherwise indicated. Fabricate panels from same material and with same finish as metal cabinets and with hemmed or flanged edges.

C. Support Framing: Casework manufacturer's standard system consisting of vertical supports and connecting braces and rails as follows:

1. Cabinets, shelves, and countertops are supported from vertical wall supports except where floor-supported base cabinets are indicated.

D. Countertops: Provide in modular lengths indicated, without seams.

2.6 METAL CABINET FINISH

A. General: Prepare, treat, and finish welded assemblies after assembling. Prepare, treat, and finish components that are to be assembled with mechanical fasteners before assembling. Prepare, treat, and finish concealed surfaces same as exposed surfaces.

B. Preparation: After assembly, clean surfaces of mill scale, rust, oil, and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it.

C. Chemical-Resistant Finish: Immediately after cleaning and pretreating, apply laboratory casework manufacturer's standard two-coat, chemical-resistant, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.

1. Chemical and Physical Resistance of Finish System: Finish complies with acceptance levels of cabinet surface finish tests in SEFA 8. Acceptance level for chemical spot test shall be no more than four Level 3 conditions.
2. Colors for Metal Laboratory Casework Finish: As selected by Owner from manufacturer's full range.

2.7 HARDWARE

A. General: Provide laboratory casework manufacturer's standard, commercial-quality, heavy-duty hardware complying with requirements indicated for each type.

B. Hinges: Stainless-steel, 5-knuckle hinges complying with BHMA A156.9, Grade 1, with antifriction bearings and rounded tips. Provide 2 for doors 48 inches high or less and 3 for doors more than 48 inches high.

C. Drawer Pulls: Stainless steel back-mounted pulls. Provide 2 pulls for drawers more than 24 inches wide.

1. Design: Wire pulls.
2. Overall Size: 1-1/4 by 4-1/2 inches.

D. Door Catches: Nylon-roller spring catches. Provide 2 catches on doors more than 48 inches high.

E. Drawer Slides: Side mounted, epoxy-coated steel, self-closing; designed to prevent rebound when drawers are closed; complying with BHMA A156.9, Type B05091.

1. Heavy Duty (Grade 1HD-100 and Grade 1HD-200): Full-overtravel-extension, ball-bearing type.

F. Label Holders: Stainless steel, aluminum, or chrome plated; sized to receive standard label cards approximately 1 by 2 inches , attached with screws or rivets. Provideon all drawers.

2.8 COUNTERTOPS, , AND SINKS

A. Countertops, General: Provide units with smooth surfaces in uniform plane free of defects. Make exposed edges and corners straight and uniformly beveled. Provide front and end overhang of 1 inch , with continuous drip groove on underside 1/2 inch from edge.

B. Sinks, General: Provide sizes indicated or laboratory casework manufacturer's closest standard size of equal or greater volume.

1. Outlets: Provide with strainers and tailpieces, NPS 1-1/2, unless otherwise indicated.
2. Overflows: For each sink provide overflow of standard beehive or open-top design with separate strainer. Height 2 inches less than sink depth. Provide in same material as strainer.

C. Epoxy Countertops, and Sinks:

1. Countertop Fabrication: Fabricate with factory cutouts for sinks, holes for service fittings and accessories, and with butt joints assembled with epoxy adhesive and concealed metal splines.

a. Countertop Configuration: Flat, 1 inch thick, with beveled edge and corners, and with drip groove and integral coved backsplash.

2. Sink Fabrication: Molded in 1 piece with smooth surfaces, coved corners, and bottom sloped to outlet; 1/2-inch minimum thickness.

a. Provide with polypropylene strainers and tailpieces.
b. Provide sinks for drop-in installation with 1/4-inch- thick lip around perimeter of sink.
c. Provide integral sinks in epoxy countertops, bonded to countertops with invisible joint line.

d. Provide manufacturer's recommended adjustable support system for table- and cabinet-type installations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of reinforcements, and other conditions affecting performance of laboratory casework.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF CABINETS

A. Comply with installation requirements in SEFA 2.3. Install level, plumb, and true; shim as required, using concealed shims. Where laboratory casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical. Do not exceed the following tolerances:

1. Variation of Tops of Base Cabinets from Level: 1/16 inch in 10 feet.
2. Variation of Bottoms of Upper Cabinets from Level: 1/8 inch in 10 feet.
3. Variation of Faces of Cabinets from a True Plane: 1/8 inch in 10 feet.
4. Variation of Adjacent Surfaces from a True Plane (Lippage): 1/32 inch.
5. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch.

B. Base Cabinets: Fasten cabinets to utility-space framing, partition framing, wood blocking, or reinforcements in partitions with fasteners spaced not more than 24 inches o.c. Bolt adjacent cabinets together with joints flush, tight, and uniform.

C. Wall Cabinets: Fasten to hanging strips, masonry, partition framing, blocking, or reinforcements in partitions. Fasten each cabinet through back, near top, at not less than 24 inches o.c.

D. Install hardware uniformly and precisely. Set hinges snug and flat in mortises.

E. Adjust laboratory casework and hardware so doors and drawers align and operate smoothly without warp or bind and contact points meet accurately. Lubricate operating hardware as recommended by manufacturer.

3.3 INSTALLATION OF COUNTERTOPS

A. Comply with installation requirements in SEFA 2.3. Abut top and edge surfaces in one true plane with flush hairline joints and with internal supports placed to prevent deflection. Locate joints only where shown on Shop Drawings.

B. Field Jointing: Where possible, make in same manner as shop-made joints using dowels, splines, fasteners, adhesives, and sealants recommended by manufacturer. Prepare edges in shop for field-made joints.

C. Fastening:

1. Secure countertops, except for epoxy countertops, to cabinets with Z-type fasteners or equivalent, using two or more fasteners at each cabinet front, end, and back.
2. Secure epoxy countertops to cabinets with epoxy cement, applied at each corner and along perimeter edges at not more than 48 inches o.c.
3. Where necessary to penetrate countertops with fasteners, countersink heads approximately 1/8 inch and plug hole flush with material equal to countertop in chemical resistance, hardness, and appearance.

D. Provide required holes and cutouts for service fittings.

E. Provide scribe moldings for closures at junctures of countertop, curb, and splash with walls as recommended by manufacturer for materials involved. Match materials and finish to adjacent laboratory casework. Use chemical-resistant, permanently elastic sealing compound where recommended by manufacturer.

F. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

3.4 INSTALLATION OF SINKS

A. Comply with installation requirements in SEFA 2.3.

B. Underside Installation of Epoxy Sinks: Use laboratory casework manufacturer's recommended adjustable support system for table- and cabinet-type installations. Set top edge of sink unit in sink and countertop manufacturers' recommended chemical-resistant sealing compound or adhesive and firmly secure to produce a tight and fully leakproof joint. Adjust sink and securely support to prevent movement. Remove excess sealant or adhesive while still wet and finish joint for neat appearance.

3.5 INSTALLATION OF LABORATORY ACCESSORIES

A. Install accessories according to Shop Drawings, installation requirements in SEFA 2.3, and manufacturer's written instructions.

3.6 CLEANING AND PROTECTING

A. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Owner.

B. Protect countertop surfaces during construction with 6-mil plastic or other suitable water-resistant covering. Tape to underside of countertop at a minimum of 48 inches o.c.

END OF SECTION 123553

CONFIDENTIAL DOCUMENT

132100

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

CONTROLLED ENVIRONMENT ROOMS

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

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Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
132100	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 132100 – CONTROLLED ENVIRONMENT ROOMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Furnish and install controlled environment rooms complete with all equipment, controls and accessories required for specified operation and performance, coordinating with other trades as required to complete the specified work.

1.3 SCOPE OF WORK

A. Work included in this section includes the following:

1. Complete controlled environment room(s) including all components required to achieve and maintain specified temperature and/or humidity levels;
2. Transportation and delivery of components to their final location, including all lighting fixtures and accessories specified herein.
3. All refrigeration equipment, refrigerant piping, electrical power wiring, and control wiring integral to the room.
4. Installation and materials for all electrical and data outlets inside the room. Electrical receptacles to be circuited through control console. If multiple circuits are required to service receptacles within the room, these may be circuited directly from building electrical panels and not through CER control console.
5. Closure trim between insulated room panels and adjacent walls, floor and/or ceiling furnished and installed as appropriate.
6. Startup and field testing of rooms.

1.4 RELATED SECTIONS

A. Work included in this section is to be coordinated with related work specified elsewhere, including but not limited to:

1. Applicable provisions of Division 1 shall govern the work of this section.
2. Division 11: Laboratory casework and equipment.
3. Division 21: Furnish and install all fire suppression systems, coordinating penetrations with CER manufacturer.
4. Division 22: Furnishing and installation of plumbing fixtures and utilities, including final connections to service fixtures.

5. Division 23: Furnishing and installation of ventilation supply/exhaust ductwork. Division 23 will be responsible for all ventilation air ductwork to and from CER or desiccant dehumidification unit servicing the CER, as required. Division 23 scope includes all required transition pieces, registers, grills, dampers and diffusers. Ceiling penetration(s) shall not exceed 4" in diameter.
6. Division 22: Final condensate drain connections at sink tailpiece or floor sink as indicated on plans.
7. Division 26: Electrical service required for controlled environment room, including final electrical connection to each CER control panel and final connection with disconnect to each CER condensing unit.
8. Division 28: Connection of CER control panel alarm contacts to building monitoring system.

1.5 REFERENCE STANDARDS

A. Comply with all applicable codes, specifications and standards below, except where more stringent local codes may apply:

1. ASHRAE/ANSI: American Society of Heating, Refrigeration and Air Conditioning Engineers, Standard 15-1994 – Refrigeration Components, Safety and Use of Refrigerants.
2. FM: Factory Mutual Standard #4880 – Insulated Panel Construction
3. NEC: National Electrical Code
4. NSF: National Sanitary Foundation Seal of Approval – Room Panels.
5. UL: Underwriters Laboratories, 508A – Industrial Control Panels
6. UL: Underwriters Laboratories, 723 – Room Panel Flame Spread Ratings

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications.

1. Controlled environment room(s) shall be produced by a manufacturer with a minimum of 10 years' experience in manufacturing equipment of the same type and scope of project specified herein. A minimum of 200 rooms shall have been fabricated and installed within the past 5 years. Manufacturer shall submit a statement of qualification with the submittal materials.

    a. Installer Qualifications.

2. Installer shall be factory trained and shall have a minimum of 10 years of experience in the installation of laboratory controlled environment rooms.

    a. Single Source Responsibility.

3. Controlled environment rooms shall be designed, manufactured and installed by one supplier for single source responsibility.

1.7 SUBMITTALS

A. Submittals required under this section shall be submitted electronically in PDF format, and shall include the following items:

1. Product Data: Submit technical product data sheets for all materials, equipment and components to be supplied under this Section, including at minimum insulated urethane panels and panel accessories, lighting, fans, evaporator coils, condensing units, humidifiers, dehumidifiers, controllers, and recorders.
2. Shop Drawings: Submit shop drawings, including fully dimensioned plan view, elevation and sections at not less than ¼ inch scale. Drawings shall include overall panel layout, panel finishes, doors, accessories, hardware, control panels, refrigeration equipment, refrigerant, refrigeration piping, condensate lines, utility requirements, connection points, and all other information required for proper coordination with related work.
3. Schematics and Calculations: Submit all calculations necessary to demonstrate compliance with load requirements contained herein, including cooling, heating, humidification and/or dehumidification load calculations as applicable. Provide electrical schematic showing all power and control system components, including voltages and amperage loads. Provide refrigeration piping schematic showing all system components clearly identified.
4. Equipment schedule indicating operating temperature/humidity conditions, utility requirements, and model/quantity for all evaporator coils, condensing units, dehumidifiers, humidifiers, and controls.
5. Finish Samples: Submit 6”x 6” samples of all metal finishes to be used in the construction of the ceiling, wall, and floor panels.
6. Closeout submittals shall be submitted prior to substantial completion, and shall include:

    a. Operation and Maintenance Manuals, including startup, operation, and maintenance instructions, replacement parts list, and factory contact information.
    b. Test reports: Submit reports of all specified factory and field performance tests.
    c. Certificate of Warranty, with warranty period commencing on date of substantial completion.

1.8 PROJECT HANDLING

A. All equipment and components shall be protected to avoid damage during transportation, storage, and installation, including protection of final product from damage by other trades prior to final completion.

B. Prior to installation, materials shall be stored off the ground and shall be protected from the elements. No equipment shall be delivered to the site until installation areas are secure and weathertight.

1.9 COORDINATION

A. CER manufacturer shall coordinate scheduling with Owner’s Representative or General Contractor, and shall schedule installation in sequence to ensure that rooms are protected from damage by other trades and to prevent delays in overall project completion.

1.10 WARRANTY

A. Manufacturer shall provide a written warranty that all CER equipment and components shall be free of defects in materials and workmanship under normal use and service. Manufacturer's warranty shall cover all parts and labor for a period of one year and shall commence upon acceptance date. Additional warranties shall be provided for the following items as indicated:

1. Ten years: Insulated panels, including doors.
2. Five years: Refrigeration compressors.

PART 2 – PRODUCTS

2.1 GENERAL

A. Controlled Environment Room shall be furnished as a complete functional unit with essential piping, ductwork, control systems and conditioning systems to satisfy the environmental conditions listed in this specification and on the drawings. Room shall be shipped in sections that shall be designed to pass through standard doorways. Construction shall allow for future disassembly and relocation. All metal surfaces will be finished smooth with punching and shearing neatly done.

2.2 PERFORMANCE REQUIREMENTS

A. Controlled Environment Room shall be designed to maintain the temperature and humidity ranges indicated on the CER room schedule, including the combination of highest temperate/highest humidity and of lowest temperature/lowest humidity within the ranges specified. Performance shall be achieved with the cumulative loads specified, including loads from lighting, fans, ventilation air, and other equipment within the room as specified.

1. Control

    a. Temperature control, defined as the control of temperature at a single point within the chamber over a period of time, shall be maintained at setpoint ± 0.3°C. For rooms operating in degrees Fahrenheit, control shall be maintained at setpoint ±0.6°F.
    b. Humidity control (if applicable), defined as the control of relative humidity at a single point within the chamber over a period of time, shall be maintained at setpoint ± 5% RH.
    c. Temperature and humidity control shall be documented as indicated under the Sustained Operation Testing requirement.

2. Uniformity

    a. Temperature uniformity, defined as the uniformity of temperature at a minimum of twelve points evenly distributed on a horizontal plan at 44" AFF and no more than 12" from each wall, shall be maintained at setpoint ± 1.0°C.
    b. Humidity uniformity, measured at a minimum of three points within the chamber, shall be maintained at setpoint ± 5% RH.

c. Temperature and humidity uniformity shall be documented as indicated under the Chamber Uniformity Testing requirement.

3. Chamber Design Loads

a. Ambient conditions: Rooms shall be designed to operate in ambient conditions ranging from 60°F to 85°F, and at humidity levels ranging from 15% to 75%RH.
b. Door openings: Temperature and humidity calculations shall assume two (2) door openings per hour for an average duration of 30 seconds each.
c. Temperature calculations shall assume electrical equipment load of 5 watts per square foot in each controlled environment room.
d. Cooler temperature and humidity calculations shall assume one (1) person working the controlled environment room continuously for 8 hours per day.
e. Temperature Range: Air-cooled condensing units shall designed for air temperatures from -3° to 95°F.

2.3 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with this specification, acceptable manufacturers include:

1. Basis of Design: Bally Refrigerated Structures Division, Morehead City, NC 28557, (585)-749-0722.

B. Proposed substitutions must be approved in an addendum prior to bid date as specified in bid documents. Manufacturers who have not received prior approval will be unacceptable.

2.4 ROOM CONSTRUCTION

A. Modular Panel Construction

1. Provide insulated panel construction manufactured by one of the following:

a. Bally Refrigerated Boxes, Morehead City, NC, (800) 242-2559
b. Kolpak, a division of the Manitowoc Company, Parsons, TN, (800) 826-7036

2. Panel construction: Panels shall consist of urethane insulation foamed in place between interior and exterior metals skins precisely foamed with steel and dies and roll-form equipment and thoroughly checked with gauges for accuracy. To assure perfect alignment and maximum strength, corner panels shall employ a right-angle configuration with exterior horizontal dimensions of 12” on each side. Sections shall be made of 11½”, 23”, 34½”, and 46” widths and shall be interchangeable, unless otherwise required to attain specified chamber dimensions. No section shall be less than 11½” or more than 46” in width, except door sections where required to accommodate door width.
3. Panel insulation: Panels shall contain 100% urethane insulation and have no internal wood or structural members between the skins. The metal skins shall be placed into heated molds and liquid urethane injected between them. Urethane insulation shall have a minimum compressive strength of 28 pounds per square inch and shall be minimum 97% closed cell structure. Insulated panels shall comply with current EPA Regulations.

4. Gaskets: To insure tight joints, panel edges must have foamed-in-place tongues and grooves with a flexible vinyl gasket on the interior and exterior of all tongue edges. Gaskets shall be NSF Certified and resistant to damage from oil, fats, water and detergents. Gaskets must be foamed in place and not attached by staples or other fasteners.
5. Assembly: Panels shall be joined by non-corrosive cam action speed locks, consisting of a hooked locking arm placed in one panel, and a steel rod positioned in the adjoining panel, so that when the arm is rotated, the hook engages the rod and draws the panels tightly together with cam action. Arms and rods shall be housed in individual steel pockets. Pockets on one side of the panel shall be connected to pockets on the other side in width, by the use of 2" wide metal straps set into and completely surrounded by the insulation. Each vertical joint shall contain a minimum of three locking devices, and the distance between locks shall not exceed 46". Seal wrench holes with flush-mounted plastic, aluminum or stainless steel caps.
6. Certifications:

    a. Panels shall comply with the Energy Independence and Security Act of 2007 (EISA) and shall further carry a minimum insulating value of R-29 for coolers and R-32 for freezers.
    b. Panels shall be certified by Underwriters Laboratories as having a flame spread of 25 or lower and a smoke generation of 450 or lower when tested in accordance with ASTM E84.
    c. Panels shall be NSF certified.

B. Wall & Ceiling Panels:

1. Interior finish

    a. Interior surface shall consist of 26 gauge smooth galvanized steel with a white polyester enamel finish.

2. Exposed exterior finish

    a. Exposed exterior surface shall consist of 26 gauge embossed galvanized steel with a white polyester enamel finish.

3. Unexposed exterior finish shall consist of 26 gauge embossed Galvalume steel, mill finish.
4. Wall panels shall be reinforced to support wall-mounted shelving as shown on Drawings.
5. Wall and ceiling panels shall contain all required junction boxes and electrical conduit foamed in place and not surface mounted. Surface-mounted conduit exposed within the room shall be avoided.
6. Ceiling panels shall be reinforced as required to support CER equipment loads and maintenance traffic on top of the room. Ceiling panels shall not be designed for regular foot traffic.

C. Floor

1. Polished concrete floor shall be provided by other. Contractor shall provide 4" of batt insulation below CER, to prevent the forming of condensation.

D. Horizontal Sliding Entrance Doors

1. Casings/Header: Extruded aluminum profiles shall be insulated with polystyrene inserts. No organics such as wood or wood composites shall be accepted.
2. Track System: Aluminum with integrated hood. Trolley assemblies shall have stainless steel bushings and bearings at each panel hanging point. Guidance system includes a panel mounted guide rail, floor mounted HDPE bottom door guide and leading edge hook. Track system to provide a down and in motion to closed position.
3. Power Operator: Microprocessor-based control system with integrated encoder-based positioning system. The user interface shall provide self-diagnostics with keypad and LCD readout. Operator shall include automated self-positioning on start-up, adjustable opening and close speeds, adjustable soft starts, partial open, time delay close, cycle counter, overload protection, and automatic reset on overload. Operator shall be provided with heated motor, transmission and control panel.
4. Door Panel: Aluminum inner frame with steel corner brackets and 24 gauge steel or 0.040 aluminum face sheets. Panel insulation shall be polyurethane with a minimum R-value of 32. Panel shall be provided with triple pane window, sealed, heated, and constructed with heat reflective tempered safety glass and metal frame. No organics such as wood or wood composites shall be used for the door panel structure or blocking.
5. Door Hardware: Exterior and recessed interior pull handles. Interior emergency release shall be provided. All hardware and mechanism shall be corrosion resistant materials. Door shall have safety release handle inside of the CER.

2.5 INSTRUMENTATION AND CONTROLS

A. General

1. All operating controls, instrumentation, functional switches and major electrical components shall be located in a single, surface-mounted control console mounted at operator eye level at the latch side of the entrance door to each room unless otherwise shown on the drawings. Control console shall be ADA compliant and exterior depth shall not exceed 4 inches. The control panel shall be hinged for easy opening by authorized service personnel.
2. All room equipment except condensing unit, unless otherwise indicated on drawings, shall be circuited through the control console and wired by CER installer, with a single-point connection to the control console supplied by Division 16.
3. Control panel assembly shall contain only commercially available components available from third-party suppliers. CER manufacturer’s proprietary printed circuit boards are not acceptable.
4. Overcurrent protection shall be provided within the control console. All branch circuits shall be equipped with circuit breakers. Fuses are not permitted.
5. Control panel assembly shall be tested by a UL listed shop in accordance with NFPA 70 and UL 508A, and shall bear a UL 508A label.

B. Color Touchscreen Interface

1. User interface shall consist of a LCD color touchscreen display at least 7 inches in diagonal with minimum resolution of 640 x 480 pixels.
2. Color touchscreen shall provide intuitive operation and sufficient on-screen instructions such that reference manuals are not required for day-to-day operation.

3. Color touchscreen shall provide multi-level password-protected access to monitor and adjust all chamber operating parameters, including but not limited to the following functions:

    a. Temperature setpoint
    b. Real-time temperature display in 0.1°C or 0.1°F increments
    c. Humidity setpoint (if applicable)
    d. Real-time humidity display in 0.1% RH increments
    e. User-selectable temperature display in °C or °F.
    f. High & low temperature and humidity alarm setpoints
    g. Alarm time delay period
    h. Alarm silence with adjustable callback timer
    i. Automatic, programmable defrost system with automatic bypass when operating above 3°C, adjustable.
    j. Manual defrost and manual defrost termination capabilities for testing and maintenance.
    k. Real-time system clock.
    l. Real-time graphical trend data with minimum of 31 day viewable history
    m. Print and/or download trend data for minimum of 360 days in PDF or CSV format
    n. Parameter change log.
    o. Alarm history log
    p. Remote access capability via Ethernet, RS-485 Modbus or similar, non-proprietary communications protocol.

C. Temperature & Humidity Controller

1. Temperature and humidity control (if applicable) shall be user-selectable PID or hysteresis control using programmable logic controller with fixed programmable logic. Control logic shall be stored on non-volatile memory card within the controller.
2. Manufacturers: Subject to compliance with project requirements, provide programmable control device by one of the following:

    a. Allen-Bradley
    b. Emerson Controls
    c. Siemens

3. Controller shall include a minimum of six (6) open loop control circuits for lights or other on/off switchable operations.
4. Sensors:

    a. Temperature sensor shall be 100 ohm platinum RTD or Type T Thermocouple. Temperature sensor shall be located for fast responsiveness and shall display and control air temperature. Sensor shall not display “product temperature” or be placed in glycol or other cold mass to improve display performance.
    b. Humidity sensor shall be thin-film capacitance sensor with accuracy of ±2% RH or better. Wet bulb/dry bulb, lithium chloride, gold grid, bulk resistance, or similar sensors are not acceptable.

5. Temperature safety limit controls shall be provided:

a. High temperature safety limit control shall activate an alarm and shall de-energize all electric heaters, hot gas valves, dehumidifiers and other heat-producing equipment within the room. When temperature returns to normal range, limit controls shall automatically reset.
b. Low temperature safety limit control shall activate an alarm and shall shut down the refrigeration compressor. When temperature returns to normal range, limit controls shall automatically reset.

D. Alarm Systems

1. Temperature Alarm

a. Control system to include both audible and visible alarm indicators upon high or low alarm conditions. High/low safety alarms set digitally in 0.1°C increments.
b. Upon an alarm event, a popup text message shall appear on-screen indicating the alarm type, alarm setpoint, and current chamber conditions. The popup text message shall remain on-screen until the alarm condition clears or the alarm is acknowledged by an operator.
c. Control system shall include an field adjustable alarm delay timer and alarm silence button which will temporarily silence audible alarm buzzer. The alarm delay timer shall be adjustable from 0 to 30 minutes before the alarm buzzer is activated.
d. Provide remote alarm dry contacts for connection to building automation or monitoring systems. Alarm dry contacts shall be of active design, such that contacts will close upon power failure, controller failure, or temperature alarm event.

2. Personnel Emergency Alarm

a. Rooms shall be equipped with a reset type, electrically powered emergency alarm system. Alarm shall be circuited from the control console on a low voltage circuit. The system shall consist of an actuator within the room, and an audible/visual alarm mounted on the front of the chamber. Alarm shall be silenced only by deactivating the switch inside the chamber. All conduit and junction boxes for personnel emergency alarm system shall be foamed in place. Exposed conduit shall not be permitted.

1) The alarm system actuator shall be a heavy duty, oil-tight switch, equipped with a red button marked “EMERGENCY ALARM – PULL TO RESET.” The actuator button shall be mounted on the interior wall of the room adjacent to the doorjamb and 12 inches (305 mm) above finished floor. Coordinate alarm actuator location with casework locations. Emergency alarm actuator shall be lighted.
2) The external alarm indicator shall include both high decibel horn and strobe and shall white with blue strobe to avoid confusion with fire alarm systems. Alarm indicator shall be mounted over CER door, and shall be prominently labeled: “PERSONNEL EMERGENCY.”
3) Provide an independent set of alarm dry contacts for connection to remote annunciator panel or to building automation system.

E. Monitoring System

1. Provide Vaisala Viewlinc monitoring system or equal. System shall include the following components and features:

a. 2-channel temperature and humidity logger located in each controlled environment room. Each logger shall have the following capabilities:

1) Capacity of 120,000 samples
2) 10-year battery life
3) Ethernet communication
4) NIST calibrated accuracy of ±0.15°C or better over range from -25°C to +70°C
5) NIST calibrated accuracy of ±2% RH or better over range from 10% -90% RH

b. Continuous monitoring system (CMS) with PC-based software and the following capabilities.

1) Continuous monitoring with adjustable sampling rates
2) Remote alarm notifications via SMTP
3) 21 CFR Part 11 compliant data storage.

c. Any ancillary components, including routers or network connection points required for system operation.

1) PC server or workstation to be furnished and installed by others.
2) All software installation by others.
3) Network cabling and connections to be furnished and installed by others.
4) System validation by others, if required.

F. Redundant Systems

1. Rooms equipped with redundant refrigeration systems shall provide controls that perform the following functions, adjustable by user through the touchscreen user interface.

a. Automatic switchover from primary to backup system on high or low temperature alarm event. When such switchover occurs, touchscreen shall indicate the failed system and shall inhibit periodic switchovers until the failed system has been manually acknowledged and reset.
b. Weekly switchover from primary to backup system to ensure equal system wear and current readiness of both systems. Weekly switchover shall include user selectable switchover day/time and shall only occur when no system failures are indicated.

2.6 MECHANICAL SYSTEMS

A. General

1. The mechanical systems shall include the following major components: condensing unit, evaporator fan coil, thermostatic expansion valve with external equalizer, hot gas and liquid line solenoid valves, and all required refrigeration piping.
2. The refrigeration system design shall be continuous proportional hot gas bypass in which the compressor does not cycle to control temperature. At manufacturer's option, hot gas modulation may be accomplished by 2-way modulating valve or pulse-width modulation using rapid cycle solenoid valves with extended stem. Standard refrigeration solenoid valves are not permitted.
3. Refrigeration system shall be sized to accommodate all chamber loads with sufficient excess capacity to satisfy system recovery tests. For sizing purposes, each system shall be capable of removing not less than 5 watts of live load per square foot of floor area, in addition to chamber equipment and lighting.
4. Refrigerant shall be R404a or R134a. All rooms on a single project shall use the same refrigerant.
5. Compressor and evaporator shall be sized with matching capacities such that regular defrost cycles are not required for rooms operating at +4°C or above.
6. Redundant systems. Provide each room with two (2) independent refrigeration systems for 100% redundancy. Each system shall be capable of operating independently to control chamber temperature under maximum load conditions. Dual-circuit evaporator fan coils may be used, based on room size and system capacities.

B. Condensing Units

1. Compressor-Condensing Unit shall be UL labeled and of hermetic, semi-hermetic or Scroll type, and shall include high/low pressure safety control with automatic reset, suction accumulator, receiver with fusible plug, liquid line drier, sight glass, suction line drier, vibration absorbers, and thermal protection.

    a. Condensing unit shall be air-cooled.

        1) Cooler condensing units located on roof of structure.

2. Compressor shall be manufactured by Bally.
3. All components shall be designed for 250 psig working pressure or 150 percent of maximum operating pressure, whichever is greater.
4. Condensing units shall be designed to operate at an ambient temperature of -3°F.

C. Evaporators

1. Room air shall be continuously conditioned in a low velocity, low profile ceiling evaporator plenum. Evaporator plenum shall hang down inside room a maximum 16" from ceiling. Evaporator plenum shall include evaporator coil, fan motors, heating elements (if applicable), expansion valve, and condensate drain pan.
2. Evaporator coil shall be copper tube, aluminum fin design with heavy gauge aluminum housing. Maximum 8 fins per inch, minimum 4 rows deep. Air velocity shall be less than 500 fpm.

3. Evaporator fan motors shall be lifetime sealed high efficiency permanent split capacitor (PSC) or electronically commutated (ECM) motors. Shaded pole motors are not permitted.

D. Defrost System

1. All systems operating at temperatures of 10°C or below shall be equipped with a programmable automatic defrost system to control length of defrost and the time of day of defrost cycle.
2. Systems operating at temperature of +4°C and above shall be designed to not require regular defrost cycles in normal operation.
3. Rooms operating above 0°C shall be equipped with hot gas defrost system.
4. Rooms operating below 0°C shall have electric defrost system that includes automatically controlled drain pan heaters, mechanical fan delay and defrost termination switches, and condensate drain line heaters.
5. On rooms with redundant refrigeration systems, the standby system shall be brought online during the defrost cycle of the primary system to minimize temperature upset during defrost.

E. Piping and Insulation

1. Install all refrigerant components in accordance with applicable codes and good practice for proper system operation. Piping shall be routed so as to minimize exposed piping.
2. All refrigerant piping shall be seamless copper tubing, Type L ACR.
3. Brazing material shall be minimum 15% silver solder alloy, Harris Stay Silv 15 or equal.
4. Suction lines shall be sized for 500-700 fpm on horizontal runs pitched ¼ inch per 10 feet toward condensing unit to ensure oil return. Suitable P-traps shall be located at the base of each suction riser of four (4) feet or greater with additional P-traps not more than 15’ apart on extended risers.
5. Liquid lines shall be sized for maximum 2 psig pressure drop.
6. For rooms operating at +2°C or above, condensate drain lines shall be run in 3/4 inch Schedule 40 PVC or in 7/8 inch Type L copper. In rooms operating below +2°C, drain lines shall be run in 7/8 inch Type L copper and shall be heated and insulated to prevent ice buildup. Condensate drains shall be gravity fed and pitched 1/4 inch per foot. All condensate drain lines shall contain a union allowing the condensate drain pan to be easily lowered for maintenance or service. In rooms with sinks, the drain lines shall be run below sink with connection to sink tailpiece by Division 15. In rooms without sinks, drain lines shall be extended to exterior of controlled environment room and terminated at condensate drain.
7. Suction lines, hot gas lines and freezer condensate lines shall be insulated with Armaflex closed cell foam plastic insulation or equal, minimum ½” wall thickness. Insulation shall meet NFPA-90A flam spread and smoke developed requirements and shall comply with state and local fire codes. Joints shall be bonded using manufacturer’s recommended sealant to provide a complete vapor barrier.

F. Heating Systems

1. Heaters shall be incoloy sheathed Nichrome wire with a maximum watt density of 23 watts per square inch. Heaters shall be mounted on downstream side of evaporator coil and shall be positioned so as to prevent accidental contact with the heated surfaces.

2. Provide mechanical limit control to monitor air temperature in the conditioning plenum, disabling heaters in the event air temperature exceeds preset limits. High limit cutout shall be factory preset and non-adjustable, with high limit cutout not to exceed 65°C. Tripped limit control shall be equipped with manual reset button.

G. Dehumidification Systems

1. Rooms designed for operation at or below a 10°C dewpoint shall be equipped with a desiccant dehumidification system sized to maintain specified chamber conditions.
2. Dehumidifier shall be of the non-cycling sorption type with a single desiccant rotary structure. The casing will be fabricated as a unitized body with welded aluminum construction for maximum strength and durability. Suitable access panel shall allow access for inspection or servicing without disconnecting ducting or electrical wiring. Airflow balancing dampers to be furnished.
3. Dehumidifier shall be factory assembled, fully automatic, complete with silica gel HoneyCombe desiccant wheel, reactivation heaters, reactivation energy control system, roughing filters, motors, fans, non-racheting desiccant drive unit, automatic controller and all components' auxiliaries. Reactivation energy modulation shall be stepless solid state proportioning type. Dehumidifier shall be functionally tested at the manufacturer's factory and shipped complete with all components necessary to maintain normal operation.
4. Desiccant shall not channel, cake or fracture due to repeated temperature and moisture cycling. The materials of construction shall be non-toxic and NFPA 225-ASTM E84 compliant. Full face contact pressure seals shall be provided to separate the process and reactivation air streams and eliminate detrimental leakage of air or moisture with static pressure differentials of up to 3″ of water gauge.
5. Desiccant dehumidifier shall be circuited and controlled from chamber control console.

2.7 LIGHTING

A. Lighting output shall be a minimum of 75 foot-candles as measured 40 inches above finished floor at 22°C.

B. Low temperature electronic ballasts shall be provided for cold rooms operating below 10°C.

C. Lighting systems shall utilize cool white fluorescent T8 lamps. Lamps and ballasts shall be enclosed in UL listed vapor-proof fixtures surface mounted with no exposed conduit.

D. Incandescent, vapor-proof lights shall be provided for rooms operating below 0°C.

E. Provide exterior light switch with pilot light at latch side of entrance door.

2.8 ACCESSORIES

A. Electrical receptacles. Electrical receptacles shall be 115V, 20 amps, NEMA 5-20R, located as shown on electrical plans.

1. Electrical receptacles shall be foamed in place in wall panel with conduit concealed and stubbed through the top of the ceiling panel. CER manufacturer shall provide electrical receptacles and circuit them through the control console.

B. Casework and Shelving. Casework and shelving shall be supplied by the laboratory equipment supplier. Controlled environment room manufacturer to provide reinforced wall panels for wall-mounted counters or shelving as shown on plans.

2.9 UTILITY REQUIREMENTS

A. Electrical Services. Division 26 shall make final electrical connections at two points for each room:

1. Service to be provided at control console shall be 115/208 VAC, 60 hz, 3 phase, 4 wire service.
2. Service to be provided at condensing unit shall be 208-230 VAC, 3 phase, 60 hz, 3 wire service with disconnect.

B. Ventilation System. Division 23 shall provide conditioned air supply and exhaust to the room at a rate of 0.5 cfm per square foot for all occupied spaces. CER manufacturer shall provide inlet and exhaust dampers for final connection by Division 15.

C. Drains. Division 22 to provide floor drain within 10’ of controlled environment room as shown on plans, unless sink is provided within CER for condensate drain connections.

D. Fire Suppression. Division 21 for fire suppression systems to be provide by fire sprinkler contractor. Penetrations and sprinkler layout to be coordinated with controlled environment room manufacturer.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine conditions and confirm field measurements prior to beginning work and notify Owner in writing of unsatisfactory conditions.

3.2 INSTALLATION

A. Install work in accordance with approved submittals and written specification.

B. Install components straight, plumb level, and true. Install service lines at right angles to walls and floors except where required to pitch to drains.

C. Install all components in accordance with manufacturer’s written instructions and good refrigeration practices. All electrical installation shall be performed in accordance with National Electrical Code.

3.3 CLOSURE TRIM & SEALANTS

A. Seal all service penetrations with silicone to maintain vapor barriers and insulation. Seal off all electrical conduits to prevent condensation in electrical devices.

B. Install all closure trim to cover gaps between controlled environment room panels and adjacent wall/ceiling surfaces.

3.4 STARTUP & TESTING

A. General Requirements

1. Provide written startup report indicating, at minimum, date/time of startup, pressure test duration and start/end pressures, vacuum test results, refrigerant type and volume, and operating pressures once system has stabilized at setpoint.
2. Controlled environment rooms shall be tested by the manufacturer for proper operation. Manufacturer shall notify owner a minimum of 7 days in advance to provide owner opportunity to witness the room tests. Manufacturer shall provide written documentation of all test results. Written test reports for sustained operation and uniformity testing shall include: control setpoint, date/time test was initiated, date/time test was completed, manufacturer model and serial number of test instrument(s), calibration certification for each test instrument.
3. For any tests not satisfactorily completed, manufacturer shall make appropriate chamber modifications and repeat the failed test.

B. Refrigerant Piping Test

1. Pressure test: Refrigerant piping shall be pressurized with dry nitrogen gas and shall hold a pressure of 250 psi for a minimum of 2 hours prior to startup.
2. Vacuum test: Refrigeration systems shall be evacuated to below 500 microns and then monitored for pressure rise above 500 microns for a period of 20 minutes prior to charging and startup.

C. Sustained Operation Testing (24 hours, single point)

1. Sustained operation test shall demonstrate consistent control at a single point over a period of 24 hours. For rooms designed to operate over a range of temperature conditions, the test shall consist of 24-hour operation at each of the maximum, minimum and one intermediate point for a total of 72 hours of sustained operation testing.
2. Rooms with humidity control shall record chamber humidity levels to demonstrate consistent control at a single point over a period of 24 hours. For rooms designed to operate over a range of humidity conditions, the test shall consist of 24-hour operation at each of the maximum, minimum and one intermediate point for a total of 72 hours of sustained operation testing. Minimum humidity test shall coincide with minimum temperature test, and maximum humidity test shall coincide with maximum temperature test to ensure limits of humidity system operation.
3. Integrated data logging feature of touchscreen control interface shall be sufficient to document sustained operation, with data to be printed or downloaded for submittal of test results.

D. Chamber Uniformity Testing (8 hours, 12 point)

1. Each room shall be temperature mapped with a minimum of ten (10) temperature sensors evenly distributed on a plane 44” above finished floor, with sensors located a minimum of 12” from walls, counters and shelving obstructions.
2. Test instrument(s) shall have been certified for accuracy by a recognized testing laboratory within one (1) year prior to testing.
3. Uniformity test shall be conducted for a minimum of eight (8) hours per room.

E. Chamber Recovery Testing (30 second door opening, 3 minute recovery)

1. To demonstrate adequate system capacity for chamber recovery, perform a chamber recovery test on each chamber at minimum operating temperature.
2. With chamber conditions stabilized, open door to a minimum angle of 120 degrees for a period of 30 seconds. When 30 second period is complete, close the door and wait for chamber to recover. Document start time, door open time, door close time, maximum chamber temperature reached, and system recovery time.

3.5 PROTECTION

A. Protect controlled environment room panels and equipment as required to prevent damage.

3.6 FIELD ADJUSTMENTS AND CLEANING

A. Maintain clean work area, removing all packing materials and other construction waste to approved dumpster location.

B. Clean control console exterior and exposed room panels (interior/exterior), leaving room in move-in condition.

PART 4 – ROOM SCHEDULE

4.1 ROOM SCHEDULE

Room # Name	Interior Dimensions	Room Interior Height	Temp Range (°C)	Humidity Range (%RH)	Refrigerant	Control Panel Electrical
216 Final Walk-In	18’-7 x 31’-0”	16’-0”	2°C - 8°C	Noncondensing	R-404a	208 / 3-ph /20A

END OF SECTION 132100

CONFIDENTIAL DOCUMENT

210500

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

COMMON WORK RESULTS FOR FIRE SUPRESSION

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

210500

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
210500	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 210500 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Mechanical sleeve seals.
3. Sleeves.
4. Escutcheons.
5. Grout.
6. Equipment installation requirements common to equipment sections.
7. Painting and finishing.
8. Concrete bases.
9. Supports and anchorages.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Mechanical sleeve seals.
2. Escutcheons.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Fire-Suppression Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for fire-suppression installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for fire-suppression items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Product Selection from Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 21 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 21 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Available Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Stainless steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

2.6 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.

1. Finish: Polished chrome-plated.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

1. Finish: Polished chrome-plated.

E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.

F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.

G. One-Piece, Floor-Plate Type: Cast-iron floor plate.

H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.7 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 21 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel and/or light fixture removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
c. Insulated Piping: One-piece, stamped-steel type with spring clips.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge and set screw.

g. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed hinge and spring clips.
h. Bare Piping in Equipment Rooms: One-piece, stamped-steel type set screw or spring clips.
i. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

M. Sleeves are not required for core-drilled holes.

N. Permanent sleeves are not required for holes formed by removable PE sleeves.

O. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

a. Steel Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).
b. Steel Sheet Sleeves: For pipes NPS 6 (DN 150) and larger, penetrating gypsum-board partitions.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

P. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

Q. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

R. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Firestopping" for materials.

S. Verify final equipment locations for roughing-in.

T. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 21 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

E. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.3 PAINTING

A. Painting of fire-suppression systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.4 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Miscellaneous Cast-in-Place Concrete."

3.5 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor fire-suppression materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.6 GROUTING

A. Mix and install grout for fire-suppression equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 210500

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210523

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

GENERAL-DUTY VALVES FOR WATER-BASED FIRE-SUPPRESSION PIPING

ImmuCell

Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

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210523

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ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
210523	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 210523 - GENERAL-DUTY VALVES FOR WATER-BASED FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Two-piece ball valves with indicators.
2. Bronze butterfly valves with indicators.
3. Iron butterfly valves with indicators.
4. Check valves.
5. Bronze OS&Y gate valves.
6. Iron OS&Y gate valves.
7. NRS gate valves.
8. Indicator posts.
9. Trim and drain valves.

1.3 DEFINITIONS

A. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

B. NRS: Nonrising stem.

C. OS&Y: Outside screw and yoke.

D. SBR: Styrene-butadiene rubber.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.

2. Protect threads, flange faces, and weld ends.
3. Set valves open to minimize exposure of functional surfaces.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
3. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.
4. Protect flanges and specialties from moisture and dirt.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. UL Listed: Valves shall be listed in UL's "Online Certifications Directory" under the headings listed below and shall bear UL mark:

1. Main Level: HAMV - Fire Main Equipment.

a. Level 1: HCBZ - Indicator Posts, Gate Valve.
b. Level 1: HLOT - Valves.

1) Level 3: HLUG - Ball Valves, System Control.
2) Level 3: HLXS - Butterfly Valves.
3) Level 3: HMER - Check Valves.
4) Level 3: HMRZ - Gate Valves.

2. Main Level: VDGT - Sprinkler System & Water Spray System Devices.

a. Level 1: VQGU - Valves, Trim and Drain.

B. FM Global Approved: Valves shall be listed in its "Approval Guide," under the headings listed below:

1. Automated Sprinkler Systems:

a. Indicator posts.
b. Valves.

1) Gate valves.
2) Check valves.

a) Single check valves.

3) Miscellaneous valves.

C. Source Limitations for Valves: Obtain valves for each valve type from single manufacturer.

D. ASME Compliance:

1. ASME B16.1 for flanges on iron valves.
2. ASME B1.20.1 for threads for threaded-end valves.
3. ASME B31.9 for building services piping valves.

E. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

F. NFPA Compliance: Comply with NFPA 24 for valves.

G. Valve Pressure Ratings: Not less than the minimum pressure rating indicated or higher as required by system pressures.

H. Valve Sizes: Same as upstream piping unless otherwise indicated.

I. Valve Actuator Types:

1. Worm-gear actuator with handwheel for quarter-turn valves, except for trim and drain valves.
2. Handwheel: For other than quarter-turn trim and drain valves.
3. Handlever: For quarter-turn trim and drain valves NPS 2 (DN 50) and smaller.

2.2 TWO-PIECE BALL VALVES WITH INDICATORS

A. Available Manufacturers:

1. NIBCO INC
2. Victaulic Company.

B. Description:

1. UL 1091, except with ball instead of disc and FM Global standard for indicating valves (butterfly or ball type), Class Number 1112.
2. Minimum Pressure Rating: 175 psig (1200 kPa).
3. Body Design: Two piece.
4. Body Material: Forged brass or bronze.
5. Port Size: Full or standard.
6. Seats: PTFE.
7. Stem: Bronze or stainless steel.
8. Ball: Chrome-plated brass.
9. Actuator: Worm gear or traveling nut.
10. Supervisory Switch: Internal or external.
11. End Connections for Valves NPS 1 (DN 25) through NPS 2 (DN 50): Threaded ends.
12. End Connections for Valves NPS 2-1/2 (DN 65): Grooved ends.

2.3 BRONZE BUTTERFLY VALVES WITH INDICATORS

A. Available Manufacturers:

1. Globe Fire Sprinkler Corp
2. Milwaukee Valve Company.

B. Description:

1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball type), Class Number 1112.
2. Minimum: Pressure rating: 175 psig (1200 kPa).
3. Body Material: Bronze.
4. Seat Material: EPDM.
5. Stem Material: Bronze or stainless steel.
6. Disc: Stainless steel.
7. Actuator: Worm gear or traveling nut.
8. Supervisory Switch: Internal or external.
9. Ends Connections for Valves NPS 1 (DN 25) through NPS 2 (DN 50): Threaded ends.
10. Ends Connections for Valves NPS 2-1/2 (DN 65): Grooved ends.

2.4 IRON BUTTERFLY VALVES WITH INDICATORS

A. Available Manufacturers:

1. Globe Fire Sprinkler Corp
2. NIBCO Inc
3. Tyco Fire & Building Products
4. Victaulic Co

B. Description:

1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball type), Class Number 112.
2. Minimum Pressure Rating: 175 psig (1200 kPa).
3. Body Material: Cast or ductile iron with nylon, EPDM, epoxy, or polyamide coating.
4. Seat Material: EPDM.
5. Stem: Stainless steel.
6. Disc: Ductile iron, nickel plated.
7. Actuator: Worm gear or traveling nut.
8. Supervisory Switch: Internal or external.
9. Body Design: Grooved-end connections.

2.5 CHECK VALVES

A. Available Manufacturers:

B. Description:

1. Standard: UL 312 and FM Global standard for swing check valves, Class Number 1210.
2. Minimum Pressure Rating: 175 psig (1200 kPa).
3. Type: Single swing check.
4. Body Material: Cast iron, ductile iron, or bronze.
5. Clapper: Bronze, ductile iron, or stainless steel[with elastomeric seal].
6. Clapper Seat: Brass, bronze, or stainless steel.
7. Hinge Shaft: Bronze or stainless steel.
8. Hinge Spring: Stainless steel.
9. End Connections: Flanged, grooved, or threaded.

2.6 IRON OS&Y GATE VALVES

A. Available Manufacturers:

1. Clow Valve Co
2. Kennedy Valve Co
3. Mueller Co
4. NIBCO Inc
5. Victaulic

B. Description:

1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: 175 psig (1200 kPa).
3. Body and Bonnet Material: Cast or ductile iron.
4. Wedge: Cast or ductile iron, or bronze with elastomeric coating.
5. Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.
6. Stem: Brass or bronze.
7. Packing: Non-asbestos PTFE.
8. Supervisory Switch: External.
9. End Connections: Grooved.

2.7 NRS GATE VALVES

A. Available Manufacturers:

1. Clow Valve Co
2. Kennedy Valve Co
3. Mueller Co
4. NIBCO Inc
5. Victaulic

B. Description:

1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: 175 psig (1200 kPa).
3. Body and Bonnet Material: Cast or ductile iron.
4. Wedge: Cast or ductile iron with elastomeric coating.
5. Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.
6. Stem: Brass or bronze.
7. Packing: Non-asbestos PTFE.
8. Supervisory Switch: External.
9. End Connections: Flanged or Grooved.

2.8 INDICATOR POSTS

A. Available Manufacturers:

1. Clow Valve Co
2. Kennedy Valve Co
3. Mueller Co
4. NIBCO Inc

B. Description:

1. Standard: UL 789 and FM Global standard for indicator posts.
2. Type: Underground or Wall.
3. Base Barrel Material: Cast or ductile iron.
4. Extension Barrel: Cast or ductile iron.
5. Cap: Cast or ductile iron.
6. Operation: Wrench for post and Handwheel for wall.

2.9 TRIM AND DRAIN VALVES

A. Ball Valves:

1. Available Manufacturers:

a. Milwaukee Valve C0
b. NIBCO Inc
c. Potter Roemer LLC
d. Victaulic

2. Description:

a. Pressure Rating: 175 psig (1200 kPa).
b. Body Design: Two piece.
c. Body Material: Forged brass or bronze.

d. Port size: Full or standard.
e. Seats: PTFE.
f. Stem: Bronze or stainless steel.
g. Ball: Chrome-plated brass.
h. Actuator: Handlever.
i. End Connections for Valves NPS 1 (DN 25) through NPS 2-1/2 (DN 65): Threaded ends.
j. End Connections for Valves NPS 1-1/4 and NPS 2-1/2 (DN 32 and DN 65): Grooved ends.

B. Angle Valves:

1. Available Manufacturers:

a. Fire Protection Products
b. NIBCO Inc

2. Description:

a. Pressure Rating: 175 psig (1200 kPa).
b. Body Material: Brass or bronze.
c. Ends: Threaded.
d. Stem: Bronze.
e. Disc: Bronze.
f. Packing: Asbestos free.
g. Handwheel: Malleable iron, bronze, or aluminum.

C. Globe Valves:

1. Available Manufacturers:

a. NIBCO Inc

2. Description:

a. Pressure Rating: 175 psig (1200 kPa).
b. Body Material: Bronze with integral seat and screw-in bonnet.
c. Ends: Threaded.
d. Stem: Bronze.
e. Disc Holder and Nut: Bronze.
f. Disc Seat: Nitrile.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron, bronze, or aluminum.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 GENERAL REQUIREMENTS FOR VALVE INSTALLATION

A. Comply with requirements in the following Sections for specific valve installation requirements and applications:

1. Section 211000 "Water Based Fire Suppression Systems" for application of valves in fire-suppression sprinkler systems
2. Section 211100 "Facility Fire-Suppression Water-Service Piping" for application of valves in fire-suppression water-service piping outside the building.

B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Install valves having threaded connections with unions at each piece of equipment arranged to allow easy access, service, maintenance, and equipment removal without system shutdown. Provide separate support where necessary.

E. Install valves in horizontal piping with stem at or above the pipe center.

F. Install valves in position to allow full stem movement.

G. Install valve tags. Comply with requirements in Section 210553 "Identification for Fire-Suppression Piping and Equipment" for valve tags and schedules and signs on surfaces concealing valves; and the NFPA standard applying to the piping system in which valves are installed. Install permanent identification signs indicating the portion of system controlled by each valve.

H. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections.

I. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

END OF SECTION 210523

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210548

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

VIBRATION AND SEISMIC CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

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210548

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Design Specification

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Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
210548	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 210548 - VIBRATION AND SEISMIC CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Isolation pads.
2. Isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Restraining braces.

1.3 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: C
2. Assigned Seismic Use Group or Building Category as Defined in the IBC: II.

a. Component Importance Factor: 1.5.
b. Component Response Modification Factor: 2.5.
c. Component Amplification Factor: 1.0.

3. Design Spectral Response Acceleration at Short Periods (0.2 Second): 40.7.
4. Design Spectral Response Acceleration at 1-Second Period: 18.4.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.

    a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES.
    b. Annotate to indicate application of each product submitted and compliance with requirements.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators, seismic restraints, and for designing vibration isolation bases.
2. Seismic-Restraint Details:

    a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
    b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
    c. Preapproval and Evaluation Documentation: By an evaluation service member of ICC-ES, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

C. Welding certificates.

D. Qualification Data: For professional engineer and testing agency.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC and NFPA 13 unless requirements in this Section are more stringent.

C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ace Mountings Co., Inc.
2. Amber/Booth Company, Inc.
3. California Dynamics Corporation.
4. Isolation Technology, Inc.
5. Kinetics Noise Control.
6. Mason Industries.
7. Vibration Eliminator Co., Inc.
8. Vibration Isolation.
9. Vibration Mountings & Controls, Inc.

C. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.

1. Resilient Material: Oil- and water-resistant neoprene.

D. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.

1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

E. Restrained Mounts: All-directional mountings with seismic restraint.

1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

2.2 SEISMIC-RESTRAINT DEVICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amber/Booth Company, Inc.
2. California Dynamics Corporation.
3. Cooper B-Line, Inc.; a division of Cooper Industries.
4. Hilti, Inc.
5. Kinetics Noise Control.
6. Loos & Co.; Cableware Division.
7. Mason Industries.
8. TOLCO Incorporated; a brand of NIBCO INC.
9. Unistrut; Tyco International, Ltd.

C. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

D. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

F. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

G. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to type and size of attachment devices used.

H. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

I. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

J. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.3 FACTORY FINISHES

A. Finish: Manufacturer's standard prime-coat finish ready for field painting.

1. Powder coating on springs and housings.
2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
3. Baked enamel or powder coat for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of ICC-ES.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment Restraints:

1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
2. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES providing required submittals for component.

B. Piping Restraints:

1. Comply with requirements in MSS SP-127 and NFPA 13.
2. Space lateral supports a maximum of 40 feet (12 m) o.c., and longitudinal supports a maximum of 80 feet (24 m) o.c.
3. Brace a change of direction longer than 12 feet (3.7 m).

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES providing required submittals for component.

E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

F. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

G. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

H. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Division 13 Section "Water-Based Fire-Suppression Systems" for piping flexible connections.

3.5 FIRE-SUPPRESSION VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE SCHEDULE

A. Supported or Suspended Equipment: AFFF Foam Tank.

1. Equipment Location: RO Room 113.
2. Pads:

    a. Material: Neoprene.
    b. Thickness: 3/4 inches (mm) thick.
    c. Number of Pads:

3. Isolator Type:
4. Minimum Deflection: Insert inches (mm).
5. Component Importance Factor: 1.5.
6. Component Response Modification Factor: 2.5.
7. Component Amplification Factor: 1.0.

B. Supported or Suspended Equipment: Fire Sprinkler Riser.

1. Equipment Location: Mechanical 112.
2. Pads:

    a. Material: Neoprene.
    b. Thickness: 3/4 inches (mm) thick.
    c. Number of Pads:

3. Isolator Type:
4. Minimum Deflection: Insert inches (mm).
5. Component Importance Factor: 1.5.
6. Component Response Modification Factor: 2.5.
7. Component Amplification Factor: 1.0.

END OF SECTION 210548

CONFIDENTIAL DOCUMENT

210553

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
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ImmuCell Project Manager ImmuCell	Elizabeth Williams		
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0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
210553	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 210553 - IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Stencils.
5. Valve tags.
6. Warning tags.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment-Label Schedule: Include a listing of all equipment to be labeled and the proposed content for each label.

D. Valve Schedules: Valve numbering scheme.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: stainless steel, 0.025 inch (0.64 mm) thick, with predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.

4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
5. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
6. Fasteners: Stainless-steel rivets or self-tapping screws.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, with predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
6. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

D. Equipment-Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, with predrilled holes for attachment hardware.

B. Letter Color: White.

C. Background Color: Red.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).

F. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service and showing flow direction according to ASME A13.1.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe-Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm) and proportionately larger lettering for greater viewing distances.

E. Pipe-Label Colors:

1. Background Color: Safety Red.
2. Letter Color: White.

2.4 STENCILS

A. Stencils for Piping:

1. Lettering Size: At least 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm) and proportionately larger lettering for greater viewing distances.
2. Stencil Material: Fiberboard or metal.
3. Stencil Paint: Safety Red, exterior, gloss, alkyd enamel. Paint may be in pressurized spray-can form.
4. Identification Paint: White, exterior, alkyd enamel. Paint may be in pressurized spray-can form.

2.5 VALVE TAGS

A. Description: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping-system abbreviation and 1/2-inch (13-mm) numbers.

1. Tag Material: stainless steel, 0.025 inch (0.64 mm) thick, with predrilled holes for attachment hardware.
2. Fasteners: Brass wire-link chain.
3. Valve-Tag Color: Safety Red.
4. Letter Color: White.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be installed.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

A. Piping: Painting of piping is specified in Section 099000 "Painting and Coating."

B. Stenciled Pipe-Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

C. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection excluding short takeoffs. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit a view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

D. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes including pipes where flow is allowed in both directions.

3.5 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in fire-suppression piping systems. List tagged valves in a valve-tag schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below:

1. Valve-Tag Size and Shape:

a. Fire-Suppression Sprinkler System: 1-1/2 inches (38 mm) round.
b. Dry-Pipe Sprinkler System: 1-1/2 inches (38 mm) round.

3.6 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

3.7 LABEL AND SIGNAGE SCHEDULE

A. At a minimum, provide labels and signs at the following locations and/or equipment:

1. Flow test station. Sign to read: “INSPECTOR’S TEST.”
2. Drains. Sigh to read: “MAIN DRAIN.”
3. Fire Department Connection. Sign to read: “FDC.” Also provide sign 50 feet from FDC location with arrow and “FDC” to direct emergency responders to FDC location.
4. AFFF Tank. Provide label indicating type of AFFF concentrate that is used.
5. Sprinkler Riser. Standard sprinkler system placard.
6. Main valve and backflow preventer valves: Sign to read: “Valves shall remain open at all times.”

END OF SECTION 210553

SECTION 210553 - IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

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A. Section Includes:

1. Equipment labels.
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3. Pipe labels.
4. Stencils.
5. Valve tags.
6. Warning tags.

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A. Product Data: For each type of product.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment-Label Schedule: Include a listing of all equipment to be labeled and the proposed content for each label.

D. Valve Schedules: Valve numbering scheme.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: stainless steel, 0.025 inch (0.64 mm) thick, with predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.

4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
5. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
6. Fasteners: Stainless-steel rivets or self-tapping screws.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, with predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
6. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

D. Equipment-Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, with predrilled holes for attachment hardware.

B. Letter Color: White.

C. Background Color: Red.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).

F. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service and showing flow direction according to ASME A13.1.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe-Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm) and proportionately larger lettering for greater viewing distances.

E. Pipe-Label Colors:

1. Background Color: Safety Red.
2. Letter Color: White.

2.4 STENCILS

A. Stencils for Piping:

1. Lettering Size: At least 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm) and proportionately larger lettering for greater viewing distances.
2. Stencil Material: Fiberboard or metal.
3. Stencil Paint: Safety Red, exterior, gloss, alkyd enamel. Paint may be in pressurized spray-can form.
4. Identification Paint: White, exterior, alkyd enamel. Paint may be in pressurized spray-can form.

2.5 VALVE TAGS

A. Description: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping-system abbreviation and 1/2-inch (13-mm) numbers.

1. Tag Material: stainless steel, 0.025 inch (0.64 mm) thick, with predrilled holes for attachment hardware.
2. Fasteners: Brass wire-link chain.
3. Valve-Tag Color: Safety Red.
4. Letter Color: White.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be installed.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

A. Piping: Painting of piping is specified in Section 099000 "Painting and Coating."

B. Stenciled Pipe-Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

C. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection excluding short takeoffs. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit a view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

D. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes including pipes where flow is allowed in both directions.

3.5 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in fire-suppression piping systems. List tagged valves in a valve-tag schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below:

1. Valve-Tag Size and Shape:

a. Fire-Suppression Sprinkler System: 1-1/2 inches (38 mm) round.
b. Dry-Pipe Sprinkler System: 1-1/2 inches (38 mm) round.

3.6 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

3.7 LABEL AND SIGNAGE SCHEDULE

A. At a minimum, provide labels and signs at the following locations and/or equipment:

1. Flow test station. Sign to read: “INSPECTOR’S TEST.”
2. Drains. Sigh to read: “MAIN DRAIN.”
3. Fire Department Connection. Sign to read: “FDC.” Also provide sign 50 feet from FDC location with arrow and “FDC” to direct emergency responders to FDC location.
4. AFFF Tank. Provide label indicating type of AFFF concentrate that is used.
5. Sprinkler Riser. Standard sprinkler system placard.
6. Main valve and backflow preventer valves: Sign to read: “Valves shall remain open at all times.”

END OF SECTION 210553

CONFIDENTIAL DOCUMENT

211000

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

WATER BASED FIRE SUPPRESSION SYSTEMS

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

211000

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
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Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
211000	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 211000 - WATER-BASED FIRE-SUPPRESSION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following fire-suppression piping inside the building:

1. Wet-pipe sprinkler systems.
2. Dry-pipe sprinkler systems.

B. Section Includes:

1. Pipes, fittings, and specialties.
2. Fire-protection valves.
3. Fire-department connections.
4. Backflow preventer.
5. Sprinklers.
6. Alarm devices.
7. Manual control stations.
8. Pressure gages.

C. This Section includes the following fire-suppression piping inside the building, above ground:

1. Wet-pipe sprinkler systems.
2. Dry-pipe sprinkler systems.

D. Related Sections include the following:

1. Section 104416 "Fire Extinguishers" for cabinets and fire extinguishers.
2. Section 210500 “Common Work Results for Fire Suppression.”
3. Section 210523 “General Duty Valves for Fire Protection Piping.”
4. Section 210548 “Vibration and Seismic Controls for Fire Suppression Piping and Equipment.”
5. Section 210553 “Identification for Fire Suppression Piping and Equipment.”
6. Section 211339 “Foam Water Systems.”
7. Division 28 Section "Fire Detection and Alarm" for alarm devices not specified in this Section.

1.3 DEFINITIONS

A. CPVC: Chlorinated polyvinyl chloride plastic.

B. CR: Chlorosulfonated polyethylene synthetic rubber.

C. High-Pressure Piping System: Fire-suppression piping system designed to operate at working pressure higher than standard 175 psig (1200 kPa).

D. PE: Polyethylene plastic.

E. Underground Service-Entrance Piping: Underground service piping below the building.

F. FM: Factory Mutual Insurance Company

1.4 SYSTEM DESCRIPTIONS

A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

B. Dry-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Opening of sprinklers releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into piping and discharges from opened sprinklers.

1.5 PERFORMANCE REQUIREMENTS

A. Standard Piping System Component Working Pressure: Listed for at least 175 psig (1200 kPa).

B. Fire-suppression sprinkler system design shall be approved by authorities having jurisdiction and Factory Mutual Insurance Company.

1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
2. Sprinkler Occupancy Hazard Classifications:

    a. Office Areas: Light Hazard where indicated.
    b. Mechanical Equipment Rooms: Ordinary Hazard, Group 2.
    c. Electrical Equipment Rooms: Ordinary Hazard, Group 2.
    d. Manufacturing Areas: Ordinary Hazard, Group 2.
    e. Storage Rooms 207 and 210: Ordinary Hazard, Group 2.
    f. Final Walk-in: Extra Hazard, Group.
    g. Solvent Storage and Weight Dispensing: Special Hazard 1 AFFF.

3. Minimum Density for Automatic-Sprinkler Piping Design:

    a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. (6.3 mL/s over 139-sq. m) area.

b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. (9.5 mL/s over 139-sq. m) area.
c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 2500-sq. ft. (18.9 mL/s over 139-sq. m) area.
d. Extra-Hazard, Group 1 Occupancy: 0.30 gpm over 2500-sq. ft. (18.9 mL/s over 232-sq. m) area.
e. Special Hazard 1 AFFF System: 0.30 gpm/sf over 2500 sf.
f. Area of remote sprinkler operation shall be increased by 30% for dry systems.

4. Maximum Protection Area per Sprinkler:

a. Hazardous Materials Storage Areas: 100 sq. ft. (9.3 sq. m).
b. Storage: 100 sq. ft. (9.3 sq. m).
c. Shipping/Receiving: 100 sq. ft. (9.3 sq. m).
d. Office Areas: 130 or 225 sq. ft (20.9 sq. m).
e. All Other Areas: 130 sq. ft. (12.1 sq. m).

5. Total Combined Hose-Stream Demand Requirement: According to NFPA 13, unless otherwise indicated:

a. Light-Hazard Occupancies: 100 gpm (6.3 L/s) for 30 minutes.
b. Ordinary-Hazard Occupancies: 250 gpm (15.75 L/s) for 60 to 90 minutes.
c. Extra-Hazard Occupancies: 500 gpm (31.5 L/s) for 90 to 120 minutes.
d. Special Hazard 1: 500 gpm (31.5 L/s) for 90 to 120 minutes.

C. Seismic Performance: Fire-suppression piping shall be capable of withstanding the effects of earthquake motions determined according to NFPA 13 and ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads." See specification section 210548 “Vibration and Seismic Controls for Fire-Suppression Piping and Equipment.”

1.6 SUBMITTALS

A. Product Data: For the following:

1. Piping materials, including flexible connections and sprinkler specialty fittings.
2. Pipe hangers and supports, including seismic restraints.
3. Valves, including listed fire-protection valves, unlisted general-duty valves, and specialty valves and trim.
4. Sprinklers, escutcheons, and guards. Include sprinkler flow characteristics, mounting, finish, and other pertinent data.
5. Hose connections, including size, type, and finish.
6. Fire department connections, including type; number, size, and arrangement of inlets; caps and chains; size and direction of outlet; escutcheon and marking; and finish.
7. Backflow Preventer. Include flow characteristics
8. Alarm devices, including electrical data.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Fire-flow test report for water main.

D. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction and FM, including hydraulic calculations.

E. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."

F. Welding certificates.

G. Field quality-control test reports.

H. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

C. NFPA Standards: Fire-suppression-system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13, "Installation of Sprinkler Systems."
2. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

1.8 COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.9 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sprinkler Cabinets: Finished, wall-mounting, steel cabinet with hinged cover, with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler on Project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell end and plain end.

1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron gland, rubber gasket, and steel bolts and nuts.

B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell end and plain end.

1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Gaskets: AWWA C111, rubber.

2.3 STEEL PIPE AND FITTINGS

A. Threaded-End, Standard-Weight Black Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, hot-dip galvanized where indicated and with factory- or field-formed threaded ends.

1. Cast-Iron Threaded Flanges: ASME B16.1.
2. Malleable-Iron Threaded Fittings: ASME B16.3.
3. Gray-Iron Threaded Fittings: ASME B16.4.
4. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe hot-dip galvanized where indicated. Include ends matching joining method.
5. Steel Threaded Couplings: ASTM A 865 hot-dip galvanized-steel pipe where indicated.

B. Plain-End, Standard-Weight Black Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795 hot-dip galvanized-steel pipe where indicated.

1. Steel Welding Fittings: ASTM A 234/A 234M, and ASME B16.9 or ASME B16.11.
2. Steel Flanges and Flanged Fittings: ASME B16.5.

C. Grooved-End, Standard-Weight Black Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, hot-dip galvanized where indicated and with factory- or field-formed, square-cut- or roll-grooved ends.

1. Grooved-Joint Piping Systems:

a. Available Manufacturers:

1) Anvil International, Inc.
2) Central Sprinkler Corp.
3) Ductilic, Inc.
4) JDH Pacific, Inc.
5) National Fittings, Inc.
6) Shurjoint Piping Products, Inc.
7) Southwestern Pipe, Inc.
8) Star Pipe Products; Star Fittings Div.
9) Victaulic Co. of America.
10) Ward Manufacturing.

b. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.
c. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, prelubricated rubber gasket listed for use with housing, and steel bolts and nuts.

D. Grooved-End, Schedule 10 Black Steel Pipe: ASTM A 135 or ASTM A 795, Schedule 10 in NPS 5 (DN 125) and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10 (DN 150 to DN 250); with factory- or field-formed, roll-grooved ends.

1. Grooved-Joint Piping Systems:

a. Manufacturers:

1) Anvil International, Inc.
2) Central Sprinkler Corp.
3) Ductilic, Inc.
4) JDH Pacific, Inc.
5) National Fittings, Inc.
6) Shurjoint Piping Products, Inc.
7) Southwestern Pipe, Inc.
8) Star Pipe Products; Star Fittings Div.
9) Victaulic Co. of America.
10) Ward Manufacturing.

b. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.

c. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, prelubricated rubber gasket listed for use with housing, and steel bolts and nuts.

E. Threadable, Thinwall Steel Pipe: Not Acceptable.

F. Schedule 5 Steel Pipe: Not Acceptable.

G. Steel Pressure-Seal Fittings: Not Acceptable.

2.4 CORROSION-PROTECTIVE ENCASEMENT FOR PIPING

A. Encasement for Underground Metal Piping: ASTM A 674 or AWWA C105, PE film, 0.008-inch (0.20-mm) minimum thickness, tube or sheet.

2.5 SPRINKLER SPECIALTY FITTINGS

A. Sprinkler specialty fittings shall be listed in UL's "Fire Protection Equipment Directory" or FM Global "Approval Guide," with 175-psig (1200-kPa) minimum working-pressure rating, and made of materials compatible with piping.

B. Outlet Specialty Fittings:

1. Available Manufacturers:

a. Anvil International, Inc.
b. Central Sprinkler Corp.
c. Ductilic, Inc.
d. JDH Pacific, Inc.
e. National Fittings, Inc.
f. Shurjoint Piping Products, Inc.
g. Southwestern Pipe, Inc.
h. Star Pipe Products; Star Fittings Div.
i. Victaulic Co. of America.
j. Ward Manufacturing.

2. Mechanical-T and -Cross Fittings: UL 213, ductile-iron housing with EPDM gaskets, bolts and nuts, and threaded or grooved outlets.
3. Snap-On and Strapless Outlet Fittings: Not Acceptable.

C. Sprinkler Drain and Alarm Test Fittings: Cast- or ductile-iron body; with threaded inlet and outlet of same size as connected piping, integral test valve, orifice and sight glass.

1. Available Manufacturers:

a. Central Sprinkler Corp.
b. Fire-End and Croker Corp.
c. Reliable Automatic Sprinkler Co., Inc.

d. Tyco Fire & Building Products LP.
e. Viking Corp.
f. Victaulic Co. of America.

D. Sprinkler Branch-Line Test Fittings: UL 199, Brass body with threaded inlet, capped drain outlet, and threaded outlet for sprinkler.

1. Available Manufacturers:

a. Elkhart Brass Mfg. Co., Inc.
b. Fire-End and Croker Corp.
c. Potter-Roemer; Fire-Protection Div.

E. Sprinkler Inspector's Test Fitting: Cast- or ductile-iron housing with threaded inlet and drain outlet and sight glass.

1. Available Manufacturers:

a. AGF Manufacturing Co.
b. Central Sprinkler Corp.
c. G/J Innovations, Inc.
d. Triple R Specialty of Ajax, Inc.
e. Tyco Fire & Building Products LP.
f. Victaulic Company.
g. Viking Corporation.

F. Drop-Nipple Fittings: UL 1474, adjustable with threaded inlet and outlet, steel pipe with EPDM-rubber O-ring seals.

1. Available Manufacturers:

a. CECA, LLC.
b. Merit.

G. Flexible, Sprinkler Hose Fittings: UL 1474, 175 psig minimum rated, flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.

1. Available Manufacturers:

a. Fivalco Inc.
b. FlexHead Industries, Inc.
c. Gateway Tubing, Inc.

2.6 LISTED FIRE-PROTECTION VALVES

A. Valves shall be listed in UL's "Fire Protection Equipment Directory" or FM Global "Approval Guide," with 175-psig (1200 kPa) minimum pressure rating.

B. Gate Valves with Wall Indicator Posts:

1. Gate Valves: UL 262, cast-iron body, bronze mounted, with solid disc, nonrising stem, operating nut, and flanged ends.
2. Indicator Posts: UL 789, horizontal-wall type, cast-iron body, with operating wrench, extension rod, locking device, and cast-iron barrel.
3. Available Manufacturers:

    a. Grinnell Fire Protection.
    b. McWane, Inc.; Kennedy Valve Div.
    c. NIBCO.
    d. Stockham.

C. Ball Valves: Comply with UL 1091, except with ball instead of disc.

1. NPS 1-1/2 (DN 40) and Smaller: Bronze body with threaded ends.
2. NPS 2 and NPS 2-1/2 (DN 50 and DN 65): Bronze body with threaded ends or ductile-iron body with grooved ends.
3. NPS 3 (DN 80): Ductile-iron body with grooved ends.
4. Available Manufacturers:

    a. NIBCO.
    b. Victaulic Co. of America.

D. Butterfly Valves: UL 1091.

1. NPS 2 (DN 50) and Smaller: Bronze body with threaded ends.

    a. Available Manufacturers:

        1) Global Safety Products, Inc.
        2) Milwaukee Valve Company.

2. NPS 2-1/2 (DN 65) and Larger: Bronze, cast-iron, or ductile-iron body; wafer type or with flanged or grooved ends.

    a. Available Manufacturers:

        1) Central Sprinkler Corp.
        2) Global Safety Products, Inc.
        3) McWane, Inc.; Kennedy Valve Div.
        4) Mueller Company.
        5) NIBCO.
        6) Pratt, Henry Company.
        7) Victaulic Co. of America.

E. Check Valves NPS 2 (DN 50) and Larger: UL 312, swing type, cast-iron body with flanged or grooved ends.

1. Available Manufacturers:

    a. AFAC Inc.
    b. American Cast Iron Pipe Co.; Waterous Co.
    c. Central Sprinkler Corp.
    d. Clow Valve Co.
    e. Crane Co.; Crane Valve Group; Crane Valves.
    f. Crane Co.; Crane Valve Group; Jenkins Valves.
    g. Firematic Sprinkler Devices, Inc.
    h. Globe Fire Sprinkler Corporation.
    i. Grinnell Fire Protection.
    j. Hammond Valve.
    k. Matco-Norca, Inc.
    l. McWane, Inc.; Kennedy Valve Div.
    m. Mueller Company.
    n. NIBCO.
    o. Potter-Roemer; Fire Protection Div.
    p. Reliable Automatic Sprinkler Co., Inc.
    q. Star Sprinkler Inc.
    r. Stockham.
    s. United Brass Works, Inc.
    t. Venus Fire Protection, Ltd.
    u. Victaulic Co. of America.
    v. Watts Industries, Inc.; Water Products Div.

F. Gate Valves: UL 262, OS&Y type.

1. NPS 2 (DN 50) and Smaller: Bronze body with threaded ends.

    a. Available Manufacturers:

        1) Crane Co.; Crane Valve Group; Crane Valves.
        2) Hammond Valve.
        3) NIBCO.
        4) United Brass Works, Inc.

2. NPS 2-1/2 (DN 65) and Larger: Cast-iron body with flanged ends.

    a. Available Manufacturers:

        1) Clow Valve Co.
        2) Crane Co.; Crane Valve Group; Crane Valves.
        3) Crane Co.; Crane Valve Group; Jenkins Valves.
        4) Hammond Valve.
        5) Milwaukee Valve Company.
        6) Mueller Company.
        7) NIBCO.
        8) Red-White Valve Corp.
        9) United Brass Works, Inc.

G. Indicating Valves: UL 1091, with integral indicating device and ends matching connecting piping.

1. Indicator: Electrical, 115-V ac, prewired, single-circuit, supervisory switch and Visual.
2. NPS 2 (DN 50) and Smaller: Ball or butterfly valve with bronze body and threaded ends.

a. Available Manufacturers:

1) Milwaukee Valve Company.
2) NIBCO.
3) Victaulic Co. of America.

3. NPS 2-1/2 (DN 65) and Larger: Butterfly valve with cast- or ductile-iron body; wafer type or with flanged or grooved ends.

a. Available Manufacturers:

1) Central Sprinkler Corp.
2) Grinnell Fire Protection.
3) McWane, Inc.; Kennedy Valve Div.
4) Milwaukee Valve Company.
5) NIBCO.
6) Victaulic Co. of America.

2.7 UNLISTED GENERAL-DUTY VALVES

A. Ball Valves NPS 2 (DN 50) and Smaller: MSS SP-110, 2-piece copper-alloy body with chrome-plated brass ball, 600-psig (4140-kPa) minimum CWP rating, blowout-proof stem, and threaded ends.

B. Check Valves NPS 2 (DN 50) and Smaller: MSS SP-80, Type 4, Class 125 minimum, swing type with bronze body, nonmetallic disc, and threaded ends.

C. Gate Valves NPS 2 (DN 50) and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, solid wedge, and threaded ends.

D. Globe Valves NPS 2 (DN 50) and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, nonmetallic disc, and threaded ends.

2.8 SPECIALTY VALVES

A. Sprinkler System Control Valves: Specialty valves shall be listed in UL's "Fire Protection Equipment Directory" or FM Global "Approval Guide," cast- or ductile-iron body with flanged or grooved ends, and 175-psig (1200-kPa) minimum pressure rating.

1. Available Manufacturers:

a. AFAC Inc.
b. Central Sprinkler Corp.

c. Firematic Sprinkler Devices, Inc.
d. Globe Fire Sprinkler Corporation.
e. Grinnell Fire Protection.
f. Reliable Automatic Sprinkler Co., Inc.
g. Star Sprinkler Inc.
h. Venus Fire Protection, Ltd.
i. Victaulic Co. of America.
j. Viking Corp.

2. Alarm Check Valves: UL 193, designed for horizontal or vertical installation, with bronze grooved seat with O-ring seals, single-hinge pin, and latch design. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gauges, retarding chamber, and fill-line attachment with strainer.

a. Drip Cup Assembly: Pipe drain with check valve to main drain piping.

B. AFFF Foam System

1. See specification section 211339 “Foam-Water Systems.”

C. Automatic Drain Valves: UL 1726, NPS 3/4 (DN 20), ball-check device with threaded ends.

1. Available Manufacturers:

a. AFAC Inc.
b. Grinnell Fire Protection.

2.9 SPRINKLERS

A. Sprinklers shall be listed in UL's "Fire Protection Equipment Directory" or FM Global "Approval Guide," with 175-psig (1200-kPa) minimum pressure rating.

B. Available Manufacturers:

1. AFAC Inc.
2. Central Sprinkler Corp.
3. Firematic Sprinkler Devices, Inc.
4. Globe Fire Sprinkler Corporation.
5. Grinnell Fire Protection.
6. Reliable Automatic Sprinkler Co., Inc.
7. Star Sprinkler Inc.
8. Tyco Fire & Building Products LP.
9. Venus Fire Protection, Ltd.
10. Victaulic Co. of America.
11. Viking Corp.

C. Automatic Sprinklers: With heat-responsive element complying with the following:

1. UL 199, for nonresidential applications.

D. Sprinkler Types and Categories: Nominal 1/2-inch (12.7-mm) or 17/32-inch (13.5-mm) orifice for "Ordinary" temperature classification rating and standard response, unless otherwise indicated or required by application.

E. Sprinkler types, features, and options as follows:

1. Concealed ceiling sprinklers, including cover plate.
2. Extended-coverage sprinklers.
3. Pendent sprinklers.
4. Pendent, dry-type sprinklers.
5. Quick-response sprinklers, where indicated.
6. Recessed sprinklers, including escutcheon.
7. Sidewall sprinklers.
8. Sidewall, dry-type sprinklers.
9. Upright sprinklers.
10. Intermediate level upright and pendent sprinklers

F. Sprinkler Finishes: Chrome plated, bronze, and painted.

G. Special Coatings: UL listed corrosion-resistant plating and Teflon.

H. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Chrome-plated steel, recessed 2 piece, with 1-inch (25-mm) vertical adjustment.
2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

I. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler.

2.10 HOSE CONNECTIONS

A. Available Manufacturers:

1. AFAC Inc.
2. Central Sprinkler Corp.
3. Elkhart Brass Mfg. Co., Inc.
4. Fire-End and Croker Corp.
5. Fire Protection Products, Inc.
6. GMR International Equipment Corporation.
7. Grinnell Fire Protection.
8. Guardian Fire Equipment Incorporated.
9. McWane, Inc.; Kennedy Valve Div.
10. Mueller Company.
11. Potter-Roemer; Fire-Protection Div.
12. United Brass Works, Inc.

B. Description: UL 668, brass or bronze, 300-psig (2070-kPa) minimum pressure rating, 2-1/2 inch hose valve for connecting fire hose. Include angle or gate pattern design; female NPS inlet and male hose outlet; and lugged cap, gasket, and chain. Include NPS 1-1/2 or NPS 2-1/2 (DN 40 or DN 65) as indicated, and hose valve threads according to NFPA 1963 and matching local fire department threads.

1. Valve Operation: Nonadjustable type.
2. Finish: Rough chrome-plated.

2.11 HOSE VALVE CABINET

A. Cabinet type: Suitable for fire hose valve.

B. Cabinet construction: Non-rated.

C. Cabinet Material: Stainless-steel sheet.

D. Recessed Cabinet:

1. Trimless with Hidden Flange: Flange of same metal and finish as box overlaps surrounding wall finish and is concealed from view by an overlapping door.

E. Cabinet Trim Material: Stainless-steel sheet.

F. Door Material: Stainless-steel sheet.

G. Door Style: Vertical duo panel with frame.

H. Door Glazing: Tempered break glass.

I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide projecting door pull and friction latch.
2. Provide concealed hinge permitting door to open 180 degrees.

J. Accessories:

1. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as directed by Owner.

a. Identify fire hose valve in fire-protection cabinet with the words "FIRE HOSE VALVE."

1) Location: Applied to cabinet door.
2) Application Process: Engraved.
3) Lettering Color: Red.
4) Orientation: Vertical.

K. Materials:

1. Stainless Steel: ASTM A 666, Type 304.

a. Finish: No. 8 mirror-like reflective, non-directional polish.

2. Tempered Break Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 1.5 mm thick.

2.12 FIRE DEPARTMENT CONNECTIONS

A. Available Manufacturers:

1. AFAC Inc.
2. Central Sprinkler Corp.
3. Elkhart Brass Mfg. Co., Inc.
4. Fire-End and Croker Corp.
5. Fire Protection Products, Inc.
6. GMR International Equipment Corporation.
7. Guardian Fire Equipment Incorporated.
8. Potter-Roemer; Fire-Protection Div.
9. Reliable Automatic Sprinkler Co., Inc.
10. United Brass Works, Inc.

B. Wall-Type, Fire Department Connection: UL 405, 175-psig (1200-kPa) minimum pressure rating; with corrosion-resistant-metal body with brass inlets, brass wall escutcheon plate, brass lugged caps with gaskets and brass chains, and brass lugged swivel connections. Include inlets with threads according to NFPA 1963 and matching local fire department sizes and threads, outlet with pipe threads, extension pipe nipples, check devices or clappers for inlets, and escutcheon plate with marking similar to "AUTO SPKR & STANDPIPE."

1. Type: Exposed, projecting, with two inlets and round escutcheon plate.
2. Finish: Rough chrome-plated.

2.13 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Water-Motor-Operated Alarm: UL 753, mechanical-operation type with pelton-wheel operator with shaft length, bearings, and sleeve to suit wall construction and 10-inch- (250-mm-) diameter, cast-aluminum alarm gong with red-enamel factory finish. Include NPS 3/4 (DN 20) inlet and NPS 1 (DN 25) drain connections.

1. Available Manufacturers:

a. AFAC Inc.
b. Central Sprinkler Corp.
c. Firematic Sprinkler Devices, Inc.

d. Globe Fire Sprinkler Corporation.
e. Grinnell Fire Protection.
f. Reliable Automatic Sprinkler Co., Inc.
g. Star Sprinkler Inc.
h. Viking Corp.

C. Electrically Operated Alarm: UL 464, with 6-inch- (150-mm-) minimum diameter, vibrating-type, metal alarm bell with red-enamel factory finish and suitable for outdoor use.

1. Available Manufacturers:

a. Potter Electric Signal Company.
b. System Sensor.

D. Water-Flow Indicator: UL 346, electrical-supervision, paddle-operated-type, water-flow detector with 250-psig (1725-kPa) pressure rating and designed for horizontal or vertical installation. Include two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.

1. Available Manufacturers:

a. ADT Security Services, Inc.
b. Grinnell Fire Protection.
c. ITT McDonnell & Miller.
d. Potter Electric Signal Company.
e. System Sensor.
f. Viking Corp.
g. Watts Industries, Inc.; Water Products Div.

E. Pressure Switch: UL 346, electrical-supervision-type, water-flow switch with retard feature. Include single-pole, double-throw, normally closed contacts and design that operates on rising pressure and signals water flow.

1. Available Manufacturers:

a. Grinnell Fire Protection.
b. Potter Electric Signal Company.
c. System Sensor.
d. Tyco Fire & Building Products LP.
e. Viking Corp.

F. Valve Supervisory Switch: UL 346, electrically supervised with single-pole, double-throw switch with normally closed contacts. Include design that signals controlled valve is in other than fully open position. Electrical components shall be listed and labeled as defined in NFPA 70.

1. Available Manufacturers:

a. McWane, Inc.; Kennedy Valve Div.

b. Potter Electric Signal Company.
c. System Sensor.

G. Indicator-Post Supervisory Switch: UL 346, electrically supervised, single-pole, double-throw switch with normally closed contacts. Include design that signals controlled indicator-post valve is in other than fully open position.

1. Available Manufacturers:

a. Potter Electric Signal Company.
b. System Sensor.

2.14 BACKFLOW PREVENTER

A. Double-Check Backflow Preventer:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Ames Co.
b. Conbraco Industries, Inc.
c. FEBCO; SPX Valves & Controls.
d. Watts Industries, Inc.; Water Products Div.
e. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1048 and FMG approved or UL listed.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 5 psig (35 kPa) maximum, through middle 1/3 of flow range.
5. Size: 6” NPS (150 DN).
6. Design Flow Rate: 2000 gpm (L/s).
7. Body: Cast iron with interior lining complying with AWWA C550 or that is FDA approved.
8. End Connections: Flanged.
9. Configuration: Designed for horizontal, straight through flow.
10. Accessories:

a. Valves: Outside screw and yoke gate-type with flanged ends on inlet and outlet. Provide with supervisory switches on valves.

2.15 PRESSURE GAUGES

A. Available Manufacturers:

1. AGF Manufacturing Co.
2. AMETEK, Inc.; U.S. Gauge.
3. Ashcroft, Inc.
4. Brecco Corporation.
5. WIKA Instrument Corporation.

B. Description: UL 393, 3-1/2- to 4-1/2-inch- (90- to 115-mm-) diameter, dial pressure gage with range of 0 to 250 psig (0 to 1725 kPa) minimum.

1. Water System Piping: Include caption "WATER" on dial face.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in Part 1 "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 EARTHWORK

A. Excavate and backfill as required for the installation of this work.

B. Trenches for underground piping shall be excavated to required depths. Where rock is encountered, excavate to a grade 6 inches below the lowest part of the pipe and refill the excavation below pipe grade with sand and gravel. Trenches shall have uniform grade as specified hereafter or shown on the Drawings.

C. Pipe trenches shall not be wider than 4 inches on each side of the pipe but not less than 12 inches wide.

D. Excavations shall be done on an unclassified basis. No extras shall be allowed regardless of type or hardness of material encountered.

E. No backfilling shall be done on any Fire Protection system requiring testing or inspection until such testing or inspection has been completed satisfactorily.

F. Shore and brace as required to maintain banks of excavation and avoid cave-ins and make good any damages to adjoining property or work in place caused by failure to properly shore excavations. Shoring shall conform to OSHA and Department of Labor and Industry requirements.

G. Backfilling shall be made in 8 inch layers (maximum), mechanically tamped. Wood, old forms, shoring, etc., shall be removed before backfilling. Backfill shall not contain any frozen material, ashes, slag, combustible material, rocks over 6 inches in the largest dimension, or any other material which the Owner considers unsuitable for the purpose. Particular care shall be exercised in backfilling areas where construction shall be placed above the backfill.

H. Satisfactory soil materials for backfill where contaminated soil is removed whether surplus from the existing site or trucked-in new shall meet the following requirements:

1. ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, and SM free from rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

I. Compaction of soil and backfill shall be as follows:

1. Soil and backfill shall be compacted in 8 inch layers (maximum) with each layer of soil or backfill compacted at 95 percent maximum dry density according to ASTM D 1557.

J. Shoring shall be removed after equipment and piping have been installed and tested.

K. Keep available at all times pumping equipment which shall be used to pump any water from pipe trenches and excavation under this Contract.

L. Remove from the site surplus excavated materials resulting from work. Surplus excavated materials include materials not suitable for use as backfill.

M. Notify utility companies through “Call 811 Before You Dig” system for verification of underground utilities before any excavation takes place.

3.3 EXAMINATION

A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.

B. Examine walls and partitions for suitable thicknesses, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.4 PIPING APPLICATIONS, GENERAL

A. Shop weld pipe joints where welded piping is indicated.

B. Do not use welded joints for galvanized-steel pipe.

C. Flanges, flanged fittings, unions, nipples, and transition and special fittings with finish and pressure ratings same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.

D. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends; cast- or malleable-iron threaded fittings; and threaded joints.

E. Underground Service-Entrance Piping: Ductile-iron, mechanical-joint pipe and fittings and restrained joints. Include corrosion-protective encasement.

3.5 SPRINKLER SYSTEM PIPING APPLICATIONS

A. Standard-Pressure, Wet-Pipe Sprinkler System, 175-psig (1200-kPa) Maximum Working Pressure:

1. Sprinkler-Piping Fitting Option: Specialty sprinkler fittings, NPS 3 (DN 80) and smaller, including mechanical-T and -cross fittings, may be used downstream from sprinkler zone valves.
2. NPS 1-1/2 (DN 40) and Smaller: Threaded-end, black, standard-weight steel pipe; cast- or malleable-iron threaded fittings; and threaded joints.
3. NPS 2 (DN 50): Threaded-end, black, standard-weight steel pipe; cast- or malleable-iron threaded fittings; and threaded joints.
4. NPS 2 (DN 50): Grooved-end, black, standard-weight steel pipe; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
5. NPS 2 (DN 50): Grooved-end, Schedule 10 steel pipe; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
6. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): Grooved-end, Schedule 10 steel pipe; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
7. NPS 4 to NPS 6 (DN 100 to DN 150): Grooved-end, Schedule 10 steel pipe; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

3.6 JOINT CONSTRUCTION

A. Refer to Section 210500 "Common Work Results for Fire Suppression" for basic piping joint construction.

B. Threaded Joints: Comply with NFPA 13 for pipe thickness and threads. Do not thread pipe smaller than NPS 8 (DN 200) with wall thickness less than Schedule 40 unless approved by authorities having jurisdiction and threads are checked by a ring gage and comply with ASME B1.20.1. Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

C. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

D. Grooved Joints: Assemble joints with listed coupling and gasket, lubricant, and bolts.

1. Steel Pipe: Square-cut or roll-groove piping as indicated. Use grooved-end fittings and rigid, grooved-end-pipe couplings, unless otherwise indicated.
2. Dry-Pipe Systems: Use fittings and gaskets listed for dry-pipe service.

3.7 SERVICE-ENTRANCE PIPING

A. Connect fire-suppression piping to water-service piping of size and in location indicated for service entrance to building.

B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping.

3.8 PIPING INSTALLATION

A. Refer to Section 210500 "Common Work Results for Fire Suppression" for basic piping installation.

B. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Owner before deviating from approved working plans.
2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

C. Install underground ductile-iron service-entrance piping according to NFPA 24 and with restrained joints. Encase piping in corrosion-protective encasement.

D. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.

F. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger connections.

G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, sized and located according to NFPA 13.

H. Install sprinkler piping with drains for complete system drainage.

I. Install sprinkler zone control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

J. Install drain valves on standpipes.

K. Install ball drip valves to drain piping between fire department connections and check valves. Drain to floor drain or outside building.

L. Install alarm devices in piping systems.

M. Hangers and Supports: Comply with NFPA 13 for hanger materials.

1. Install sprinkler system piping hangers according to NFPA 13.

N. Earthquake Protection: Install piping according to NFPA 13 to protect from earthquake damage.

O. Install pressure gauges on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gauges with connection not less than NPS 1/4 (DN 8) and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gauges to permit removal, and install where they will not be subject to freezing.

P. Fill wet-pipe sprinkler system piping with water.

3.9 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Listed Fire-Protection Valves: UL listed and FMG approved for applications where required by NFPA 13.

a. Shutoff Duty: Use ball, butterfly, or gate valves.

2. Unlisted General-Duty Valves: For applications where UL-listed and FMG-approved valves are not required by NFPA 13.

a. Shutoff Duty: Use ball, butterfly, or gate valves.
b. Throttling Duty: Use ball or globe valves.

3.10 VALVE INSTALLATION

A. Install listed fire-protection valves, unlisted general-duty valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Specialty Valves:

1. Alarm Check Valves: Install in vertical position for proper direction of flow, including bypass check valve and retarding chamber drain-line connection.

3.11 SPRINKLER APPLICATIONS

A. Drawings indicate sprinkler types to be used. Where specific types are not indicated, use the following sprinkler types:

1. All sprinklers shall be standard response.
2. Rooms without Ceilings: Upright sprinklers.
3. Rooms with Ceilings: Concealed sprinklers unless noted otherwise.
4. All Manufacturing Areas with Ceilings: Concealed sprinklers rated for clean room.
5. Platforms: Intermediate Level Upright or Pendents.
6. Wall Mounting: Sidewall sprinklers.

7. Spaces Subject to Freezing: Upright or Pendent, dry sprinklers.
8. Dry-Sprinkler Systems: Upright sprinklers.
9. Special Applications: Corrosion resistant coated heads where indicated.
10. Sprinkler Finishes:

    a. Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; UL listed corrosion resistant coated where exposed to acids, chemicals, or other corrosive fumes.
    b. Recessed Sprinklers: Bright chrome, with bright chrome two-piece adjustable recessed escutcheon.

3.12 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels and tiles at center or 1'-0" from end of tile.

B. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing. Use dry-type sprinklers with water supply from heated space.

C. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.

3.13 HOSE-CONNECTION INSTALLATION

A. Install freestanding hose connections for access and minimum passage restriction.

B. Provide recessed stainless steel cabinet for hose valve located in clean areas.

3.14 FIRE HOSE CABINET INSTALLATION

A. General: Install fire-hose cabinets in locations and at mounting heights indicated or, if not indicated, at heights indicated below:

    1. Fire-Hose Cabinets: 54 inches (1372 mm) above finished floor to top of cabinet.

B. Fire-Hose Cabinets: Fasten cabinets to structure, square and plumb.

    1. Unless otherwise indicated, provide recessed fire-protection cabinets.
    2. Provide inside latch and lock for break-glass panels.
    3. Fasten mounting brackets to inside surface of fire-hose cabinets, square and plumb.

3.15 FIRE DEPARTMENT CONNECTION INSTALLATION

A. Install wall-type, fire department connections in vertical wall.

B. Install ball drip valve at each check valve for fire department connection.

3.16 BACKFLOW PREVENTER INSTALLATION

A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.

B. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.

C. Do not install bypass piping around backflow preventers.

D. Support NPS 2-1/2 (DN 65) and larger backflow preventers and piping on concrete piers or pipe stands.

3.17 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Install ball drip valves at each check valve for fire department connection. Drain to floor drain or outside building.

D. Connect piping to specialty valves, hose valves, specialties, fire department connections, and accessories.

E. Electrical Connections: Power wiring is specified in Division 26.

F. Connect alarm devices to fire alarm.

G. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

H. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

I. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.18 LABELING AND IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

3.19 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Energize circuits to electrical equipment and devices.
4. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
5. Coordinate with fire alarm tests. Operate as required.
6. Verify that equipment hose threads are same as local fire department equipment.

B. Report test results promptly and in writing to Owner and authorities having jurisdiction.

C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

3.20 CLEANING AND PROTECTION

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

C. Protect sprinklers from damage until Substantial Completion.

3.21 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 211000

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211339

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

FOAM-WATER SYSTEMS

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
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The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

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211339

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
211339	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 211339 - FOAM-WATER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes fixed, low-expansion, AFFF fire-extinguishing systems and the following:

1. Concentrate piping and piping specialties.
2. Proportioning tanks and proportioning devices.
3. Foam concentrate.
4. Discharge devices.
5. Monitoring and alarm devices.

B. Related Sections include the following:

1. Division 21 Section "Water-Based Fire-Suppression Systems" for water supply and foam-water piping materials and specialties and controls.

1.3 DEFINITIONS

A. AFFF: Aqueous film-forming foam.

B. AR-AFFF: Alcohol-resistant aqueous film-forming foam.

C. ATS: Acceptance Testing Specifications.

1.4 SYSTEM DESCRIPTION

A. Description: Engineered, fixed, wet-pipe, automatically actuated, low-expansion, AR-AFFF fire-extinguishing system for flammable-liquid fires. System includes diaphragm proportioning tanks and devices as described in NFPA 16.

1.5 PERFORMANCE REQUIREMENTS

A. Standard Piping System Component Working Pressure: Listed for at least 175 psig (1200 kPa).

B. Minimum design parameters to be used with the approval of authorities having jurisdiction are as follows:

1. Solution: 3 percent foam-water solution.
2. Sprinkler Spacing: Maximum of 100 sq. ft. (9.5 sq. m) per sprinkler, and maximum 12-foot (3.7-m) spacing.
3. Design Density: Minimum 0.30 gpm/sq. ft. (0.203 L/s per sq. m).
4. Foam Supply: Minimum 20-minute discharge time.
5. Water Supply: Minimum 60 minutes.
6. Remote Area: Minimum 2500-sq. ft. (238-sq. m) design area for closed-sprinkler systems.
7. Sprinkler Temperature Rating: 135 to 170 deg F (57 to 77 deg C) for sprinklers.

C. Seismic Performance: Fire-suppression piping shall be capable of withstanding the effects of earthquake motions determined according to NFPA 13. See specification section 210548 "Vibration and Seismic controls for Fire-Suppression Piping and Equipment."

1.6 SUBMITTALS

A. Product Data: For the following:

1. Piping and equipment seismic restraints.
2. Valves.
3. Proportioning tanks and proportioning devices.
4. Foam concentrate.
5. Discharge devices. Include flow characteristics.
6. Monitoring and alarm devices. Include electrical data.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Include the following for each hazard area, drawn to scale:

1. Include plans, elevations, sections, details, and attachments to other work. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: Power, signal, and control wiring.
3. Design Calculations: For amount of foam concentrate required for each hazard area.
4. Plans: Show the following:

    a. Foam-solution proportioning tanks and devices, piping, discharge devices, monitoring and alarm devices, and accessories.
    b. Method of attaching hangers to building structure.
    c. Fire alarm panel.
    d. Equipment and furnishings.

C. Permit-Approved Drawings: Working plans, prepared according to NFPA 16, that have been approved by authorities having jurisdiction. Include design calculations.

D. Welding certificates.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For foam fire extinguishing to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Valves and specialties.
2. Proportioning tanks and proportioning devices.
3. Foam concentrate.
4. Discharge devices. Include flow characteristics.
5. Monitoring and alarm devices.

1.7 QUALITY ASSURANCE

A. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. FMG Compliance: Provide components that are FMG approved and that are listed in FMG's "Fire Protection Approval Guide."

D. UL Compliance: Provide equipment listed in UL's "Fire Protection Equipment Directory."

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Discharge Devices: Not less than 20 percent of amount of each type installed.
2. Foam Concentrate: Not less than 200 percent of amount installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ansul Incorporated.
2. Chemguard Inc.
3. National Foam, Inc.; Division of Kidde Fire Fighting.
4. Viking Corporation (The).

2.2 PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, ASTM A 135, ASTM A 106, or ASTM A 795, Type E or S, Grade A or B, Schedule 40, with factory- or field-formed threaded ends.

1. Cast-Iron Threaded Flanges: ASME B16.1.
2. Malleable-Iron Threaded Fittings: ASME B16.3.
3. Gray-Iron Threaded Fittings: ASME B16.4.
4. Butt-Weld Fittings: ASTM A 234/A 234M, Grade WPB, Schedule 40, carbon-steel butt-weld fittings.
5. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe. Include ends matching joining method.
6. Steel Threaded Couplings: ASTM A 865.

B. Stainless Steel: ASTM A 312/A 312M, Schedule 40, with factory-formed threaded or beveled ends; ASTM A 376/A 376M for seamless pipe; or ASTM A 213/A 213M, ASTM A 249/A 249M, and ASTM A 269 for seamless and welded tubing.

1. Class 150 Threaded Fittings: ASME B16.3 and MSS SP 114.
2. Butt-Weld Fittings: ASTM A 403/A 403M.
3. Flanges, Forged Fittings and Flanges, and Socket-Weld Fittings: ASTM A 182/A 182M.
4. Bar Stock and Compression Fittings: ASTM A 276 and ASTM A 479/A 479M.

C. Refer to Division 21 Section "Common Work Results for Fire Suppression" for basic joining materials.

2.3 VALVES

A. Ball Valves: Bronze body with threaded or flanged ends. Comply with UL 1091, except with stainless-steel ball instead of disc.

2.4 SPECIALTIES

A. Concentrate Storage Tank: Buna-N, bladder-type proportioning tank complying with UL 162 and ASME Boiler and Pressure Vessel Code: Section VIII. Include bladder, internal piping, fill and drain, pipe assembly, glass sight gage, piping, and valves. Concentrate to be contained in the bladder.

1. Orientation: Vertical design with skirt support.

B. Proportioning Controller: Venturi type complying with UL 162 and of capacity to match design at minimum and maximum flow.

C. Concentrate Control Valve: Water-operated ball or deluge valve designed to open with flow through the proportioning controller.

D. Concentrate Strainers: Bronze body and stainless-steel mesh strainer with minimum 0.125-inch (3.2-mm) perforations to remove solids that would block system components.

E. Provide devices that comply with NFPA 16, are compatible with the foam concentrate, and are designed to be drained and cleaned.

2.5 FOAM CONCENTRATE

A. Description: AR-AFFF liquid concentrate, complying with NFPA 11 and UL 162, for making foam-water fire-extinguishing foam solution.

2.6 PRESSURE GAGES

A. Description: Comply with UL 393, with 3-1/2-inch- (90-mm-) minimum diameter dial, 0- to 300-psig (0- to 2070-kPa) dial range, and caption "WATER" or "CONCENTRATE" on dial face.

2.7 DISCHARGE DEVICES

A. General: Discharge devices shall be listed and approved by UL and FMG.

B. Sprinklers: Closed, non-air-aspirating type complying with UL 162 and suitable for discharging foam.

2.8 MONITORING DEVICES

A. Valve Supervisory Switches: UL 753, electrical, single pole, double throw, with normally closed contacts. Include design that signals controlled valve is in other than fully open position.

2.9 ALARM DEVICES

A. Description: UL listed or FMG approved, low voltage, and surface mounting. Alarm and monitoring devices are specified in Division 28 Section "Fire Detection and Alarm."

PART 3 - EXECUTION

3.1 CONCENTRATE STORAGE TANK INSTALLATION

A. Install proportioning tanks on concrete bases. Concrete bases are specified in Division 21 Section "Common Work Results for Fire Suppression."

B. Install tanks level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

C. Install seismic restraints for tanks. Anchor tanks to substrate.

3.2 PIPING APPLICATIONS

A. Flanged pipe and fittings and flanged joints may be used to connect to specialties and accessories and where required for maintenance.

B. AR-AFFF-Concentrate Piping: Stainless-steel pipe with welded fittings and joints.

C. Foam-solution piping is specified in Division 21 Section "Water-Based Fire-Suppression Systems."

3.3 PIPING INSTALLATION

A. Install piping and other components level and plumb.

B. Refer to Division 21 Section "Common Work Results for Fire Suppression " for basic pipe installation and joint construction.

C. Install proportioning tanks anchored to substrate.

D. Install pipe and fittings, valves, and discharge devices according to requirements listed in NFPA 16, "Installation of Deluge Foam-Water Sprinkler and Foam-Water Spray Systems."

1. Support piping using supports and methods according to NFPA 13.
2. Install seismic restraints for proportioning tanks and piping systems.
3. Install monitoring and alarm devices according to NFPA 16 and NFPA 72.

3.4 CONNECTIONS

A. Piping installation requirements are specified in Division 21 Section "Water-Based Fire Suppression Systems." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Provide concentrate control, maintenance service, and drain valves with piping to permit maintenance of the foam concentrate with continuous sprinkler system service.

C. Install proportioning controller in fire-suppression piping to provide coverage to area indicated on Drawings.

D. Install piping adjacent to equipment to allow service and maintenance.

E. Connect electrical devices to building's fire alarm system. Electrical power, wiring, and devices are specified in Division 28 Section "Fire Detection and Alarm."

3.5 LABELING

A. Install labeling on piping, equipment, and panels according to Division 22 Section "Identification for Fire Protection Piping and Equipment."

3.6 CHARGING SYSTEM

A. Fill proportioning tanks with foam concentrate after field quality-control testing is complete and satisfactory results have been achieved.

3.7 FIELD QUALITY CONTROL

A. Inspection: Engage the services of a qualified professional engineer to inspect installed fire-extinguishing systems, prepare installation report, and certify that installation complies with the Contract Documents, calculations, and requirements of authorities having jurisdiction.

B. Comply with operating instructions and procedures in NFPA 16, "Acceptance Tests" Chapter. Include the following tests and inspections to demonstrate compliance with requirements:

1. Check mechanical items.
2. Inspect equipment and fire-extinguishing foam concentrate, and check mountings for adequate anchoring to substrate.
3. Check electrical systems.
4. Flush piping.
5. Perform acceptance test.
6. Perform pressure test.
7. Perform operating test.
8. Perform discharge test.
9. Correct malfunctioning equipment, then retest to demonstrate compliance. Replace equipment that cannot be satisfactorily corrected or does not perform as specified and indicated, then retest to demonstrate compliance. Repeat procedure until satisfactory results are obtained.

    a. Report test results promptly and in writing to Owner and authorities having jurisdiction.

C. Perform the following field tests and inspections and prepare test reports:

1. After installing foam fire-extinguishing piping system and after electrical circuitry has been energized, test for compliance with requirements.
2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, "Inspection and Test Procedures" and "System Function Tests." Certify compliance with test parameters.
3. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
4. Operational Test: After electrical circuitry has been energized, start systems to confirm proper unit operation.
5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 211339

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220500

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

COMMON WORK RESULTS FOR PLUMBING

ImmuCell
Portland, ME

Reviews / Approvals

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The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

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220500

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
220500	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Transition fittings.
3. Dielectric fittings.
4. Mechanical sleeve seals.
5. Sleeves.
6. Escutcheons.
7. Grout.
8. Plumbing demolition.
9. Equipment installation requirements common to equipment sections.
10. Painting and finishing.
11. Concrete bases.
12. Supports and anchorages.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. PP: Polypropylene plastic.
2. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished, provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. Solvent Cements for PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

I. Plastic-Piping Electrofusion Joints: Make polyolefin drainage-piping joints according to ASTM F 1290

2.4 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

1. Available Manufacturers:

a. Cascade Waterworks Mfg. Co.
b. Dresser Industries, Inc.; DMD Div.
c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
d. JCM Industries.
e. Smith-Blair, Inc.
f. Viking Johnson.

2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
3. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
4. Aboveground Pressure Piping: Pipe fitting.

B. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

1. Available Manufacturers:

a. Eslon Thermoplastics.

C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

1. Available Manufacturers:

    a. Thompson Plastics, Inc.

D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.

1. Available Manufacturers:

    a. NIBCO INC.
    b. NIBCO, Inc.; Chemtrol Div.

E. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

1. Available Manufacturers:

    a. Cascade Waterworks Mfg. Co.
    b. Fernco, Inc.
    c. Mission Rubber Company.
    d. Plastic Oddities, Inc.

2.5 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

1. Available Manufacturers:

    a. Capitol Manufacturing Co.
    b. Central Plastics Company.
    c. Eclipse, Inc.
    d. Epco Sales, Inc.
    e. Hart Industries, International, Inc.
    f. Watts Industries, Inc.; Water Products Div.
    g. Zurn Industries, Inc.; Wilkins Div.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

1. Available Manufacturers:

    a. Capitol Manufacturing Co.
    b. Central Plastics Company.

c. Epco Sales, Inc.
d. Watts Industries, Inc.; Water Products Div.

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Available Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.

2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

1. Available Manufacturers:

a. Calpico, Inc.
b. Lochinvar Corp.

G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F .

1. Available Manufacturers:

a. Perfection Corp.
b. Precision Plumbing Products, Inc.
c. Sioux Chief Manufacturing Co., Inc.
d. Victaulic Co. of America.

2.6 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Available Manufacturers:

a. Link-seal
b. Advance Products & Systems, Inc.
c. Calpico, Inc.
d. Metraflex Co.
e. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM or NBR for standard temperatures services; Silicone for high temperature services. Interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

3. Pressure Plates: Glass reinforced or Carbon steel, depending on pipe service. Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

A. Galvanized-Steel Sheet: 0.0359-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.

F. PVC Pipe: ASTM D 1785, Schedule 40.

2.8 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Stamped-Steel Type: With set screw and chrome-plated finish.

C. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw, and chrome-plated finish.

2.9 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors.

M. Sleeves are not required for core-drilled holes.

N. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.

    a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.

1) Seal space outside of sleeve fittings with grout.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

O. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals or manufacturer’s written recommendation, whichever is larger.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

Q. Verify final equipment locations for roughing-in.

R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
3. PVC Nonpressure Piping: Join according to ASTM D 2855.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

3.3 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

E. Install flexible connectors on equipment side of shutoff valves, horizontally and parallel to equipment shafts if possible.

3.5 PAINTING

A. Painting of plumbing systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 4000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete".

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.8 GROUTING

A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 220500

CONFIDENTIAL DOCUMENT

220519

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

METERS AND GAUGES FOR PLUMBING PIPING

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
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The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

220519

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
220519	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 220519 - METERS AND GAUGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Bimetallic-actuated thermometers.
2. Thermowells.
3. Dial-type pressure gauges.
4. Gage attachments.
5. Test plugs.
6. Test-plug kits.

B. Related Sections:

1. Division 21 fire-suppression piping Sections for fire-protection pressure gauges.
2. Division 22 Section “Domestic Water Piping" for water meters inside the building.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product Certificates: For each type of meter and gage, from manufacturer.

C. Operation and Maintenance Data: For meters and gauges to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 BIMETALLIC-ACTUATED THERMOMETERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ashcroft Inc.
2. Tel-Tru Manufacturing Company.
3. Trerice, H. O. Co.

4. Weiss Instruments, Inc.
5. Weksler Instruments Corp.

B. Standard: ASME B40.200.

C. Case: Liquid-filled and sealed type; stainless steel with 5-inch nominal diameter.

D. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F

E. Connector Type: Union joint, adjustable angle, with unified-inch screw threads.

F. Connector Size: 1/2 inch, with ASME B1.1 screw threads.

G. Stem: 0.25 in diameter; stainless steel.

H. Window: Plain glass.

I. Ring: Stainless steel.

J. Element: Bimetal coil.

K. Pointer: Dark-colored metal.

L. Accuracy: Plus or minus 1 percent of scale range.

2.2 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material: Brass or Stainless Steel
4. Type: Stepped shank unless straight or tapered shank is indicated.
5. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
6. Internal Threads: 1/2, 3/4, and 1 inch with ASME B1.1 screw threads.
7. Bore: Diameter required to match thermometer bulb or stem.
8. Insertion Length: Length required to match thermometer bulb or stem.
9. Lagging Extension: Include on thermowells for insulated piping and tubing.
10. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

2.3 PRESSURE GUAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gauges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AMETEK, Inc.; U.S. Gauge.
b. Ashcroft Inc.

c. Marsh Bellofram.
d. Trerice, H. O. Co.
e. Weiss Instruments, Inc.
f. Weksler Instruments Corp.
g. WIKA Instrument Corporation - USA.

2. Standard: ASME B40.100.
3. Case: Sealed type; stainless steel; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi
8. Pointer: Dark-colored metal.
9. Window: Glass
10. Ring: Stainless steel
11. Accuracy: Plus or minus 1 percent of full scale range.

2.4 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.

B. Valves: Brass or stainless-steel needle, with NPS 1/4, ASME B1.20.1 pipe threads.

2.5 TEST PLUGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Peterson Equipment Co., Inc.
2. Sisco Manufacturing Company, Inc.
3. Trerice, H. O. Co.
4. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: NPS 1/2, ASME B1.20.1 pipe thread.

E. Minimum Pressure Rating: 500 psig

F. Minimum Temperature Rating: Air and Water, minus 30 deg F to 275 deg F.

G. Core Inserts: EPDM self-sealing rubber.

2.6 TEST-PLUG KITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Peterson Equipment Co., Inc.
2. Sisco Manufacturing Company, Inc.
3. Trerice, H. O. Co.
4. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.

B. Furnish one test-plug kit(s) containing two thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.

C. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F.

D. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch diameter dial and tapered-end sensing element. Dial range shall be at least 20 to 240 deg F.

E. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch diameter dial and probe. Dial range shall be at least 0 to 100 psig.

F. Carrying Case: Metal or plastic, with formed instrument padding.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

E. Install direct-mounted pressure gauges in piping tees with pressure gage located on pipe at the most readable position.

F. Install valve and snubber in piping for each pressure gage for fluids.

G. Install test plugs in piping tees.

H. Install thermometers in the following locations:

1. Inlet and outlet of each water heater.

I. Install pressure gauges in the following locations:

1. Building water service entrance into building.
2. Inlet and outlet of each pressure-reducing valve.

J. Suction and discharge of each domestic water pump. Thermometer stems shall be of length to match thermowell insertion length.

3.2 CONNECTIONS

A. Install meters and gauges adjacent to machines and equipment to allow service and maintenance of meters, gauges, machines, and equipment.

3.3 ADJUSTING

A. Adjust faces of meters and gauges to proper angle for best visibility.

3.4 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Domestic Cold-Water Piping: 0 to 100 deg F

B. Scale Range for Domestic Hot-Water Piping: 30 to 240 deg F

3.5 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Water Service Piping: 0 to 160 psi

B. Scale Range for Domestic Water Piping: 0 to 160 psi

END OF SECTION 220519

CONFIDENTIAL DOCUMENT

220523

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

GENERAL-DUTY VALVES FOR PLUMBING PIPING

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
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The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

220523

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
220523	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Bronze angle valves.
2. Bronze ball valves.
3. Bronze lift check valves.
4. Bronze swing check valves.
5. Bronze gate valves.
6. Iron gate valves.
7. Bronze globe valves.

B. Related Sections:

1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Nonrising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

G. SWP: Steam working pressure.

1.4 SUBMITTALS

A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Handlever: For quarter-turn valves NPS 6 and smaller.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. Gate Valves: With rising stem.
2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Solder Joint: With sockets according to ASME B16.18.
3. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE ANGLE VALVES

A. Class 125, Bronze Angle Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Hammond Valve.
b. Milwaukee Valve Company.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig .
c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
d. Ends: Threaded.
e. Stem and Disc: Bronze.
f. Packing: Asbestos free.
g. Handwheel: Malleable iron**,** bronze, or aluminum.

2.3 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Conbraco Industries, Inc.; Apollo Valves.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Hammond Valve.
d. Lance Valves; a division of Advanced Thermal Systems, Inc.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig .
c. CWP Rating: 600 psig .
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
j. Port: Full.

2.4 BRONZE LIFT CHECK VALVES

A. Class 125, Lift Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig .
c. Body Design: Vertical flow.
d. Body Material: ASTM B 61 or ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: Bronze.

2.5 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. American Valve, Inc.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Division.
e. Hammond Valve.
f. Kitz Corporation.
g. Milwaukee Valve Company.
h. NIBCO INC.
i. Powell Valves.
j. Red-White Valve Corporation.
k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
l. Zy-Tech Global Industries, Inc.

2. Description:

a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 200 psig.
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: Bronze.

2.6 BRONZE GATE VALVES

A. Class 125, NRS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. American Valve, Inc.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Division.
e. Hammond Valve.
f. Kitz Corporation.
g. Milwaukee Valve Company.
h. NIBCO INC.
i. Powell Valves.
j. Red-White Valve Corporation.
k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
l. Zy-Tech Global Industries, Inc.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig.
c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
d. Ends: Threaded or solder joint.
e. Stem: Bronze.

f. Disc: Solid wedge; bronze.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron**,** bronze, or aluminum.

2.7 IRON GATE VALVES

A. Class 125, OS&Y, Iron Gate Valves

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Apollo Valves; Conbraco Industries, Inc.
b. Crane; Crane Energy Flow Solutions.
c. Hammond Valve.
d. Milwaukee Valve Company.
e. NIBCO INC.
f. Powell Valves.
g. Watts; a Watts Water Technologies company.
h. Zurn Industries, LLC.

2. Description:

a. Standard: MSS SP-70, Type I.
b. CWP Rating: 200 psig.
c. Body Material: Gray iron with bolted bonnet.
d. Ends: Flanged.
e. Trim: Bronze.
f. Disc: Solid wedge.
g. Packing and Gasket: Asbestos free.

2.8 BRONZE GLOBE VALVES

A. Class 125, Bronze Globe Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Stockham Division.
c. Hammond Valve.
d. Kitz Corporation.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Powell Valves.
h. Red-White Valve Corporation.
i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
j. Zy-Tech Global Industries, Inc.

2. Description:

   a. Standard: MSS SP-80, Type 1.
   b. CWP Rating: 200 psig.
   c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
   d. Ends: Threaded or solder joint.
   e. Stem and Disc: Bronze.
   f. Packing: Asbestos free.
   g. Handwheel: Malleable iron**,** bronze, or aluminum.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install check valves for proper direction of flow and as follows:

   1. Swing Check Valves: In horizontal position with hinge pin level.
   2. Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball, butterfly**,** or gate valves.
2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
3. Throttling Service: Globe valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2-1/2 (DN 50) and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Bronze Angle Valves: Class 125, bronze disc.
3. Ball Valves: Two piece, full port, brass or bronze with stainless-steel trim.
4. Bronze Swing Check Valves: Class 125, bronze disc.
5. Bronze Gate Valves: Class 125 NRS.
6. Bronze Globe Valves: Class 125, bronze disc.

B. Pipe NPS 3 and Larger:

1. Bronze Valves May be provided with threaded ends instead of flanged ends.
2. Ball Valves: Two piece, full port, bronze with stainless-steel trim.
3. Iron gate valves: Class 125 OS&Y with flanged ends.

END OF SECTION 220523

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ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

ImmuCell

Portland, ME

Reviews / Approvals

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The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

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ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
220529	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following hangers and supports for plumbing system piping and equipment:

1. Steel pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Pipe positioning systems.

B. Related Sections include the following:

1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Division 21 Section "Water-Based Fire-Suppression Systems" for pipe hangers for fire-suppression piping.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry Inc.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Design seismic-restraint hangers and supports for piping and equipment.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Steel pipe hangers and supports.
2. Thermal-hanger shield inserts.
3. Powder-actuated fastener systems.
4. Pipe positioning systems.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers. Include Product Data for components.
2. Metal framing systems. Include Product Data for components.
3. Pipe stands. Include Product Data for components.

C. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel." AWS D1.4, "Structural Welding Code--Reinforcing Steel." ASME Boiler and Pressure Vessel Code: Section IX.

B. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."
2. AWS D1.2, "Structural Welding Code--Aluminum."
3. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
4. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Manufacturers:

1. AAA Technology & Specialties Co., Inc.
2. Bergen-Power Pipe Supports.
3. B-Line Systems, Inc.; a division of Cooper Industries.
4. Carpenter & Paterson, Inc.
5. Empire Industries, Inc.
6. ERICO/Michigan Hanger Co.
7. Globe Pipe Hanger Products, Inc.
8. Grinnell Corp.
9. GS Metals Corp.
10. National Pipe Hanger Corporation.
11. PHD Manufacturing, Inc.
12. PHS Industries, Inc.
13. Piping Technology & Products, Inc.
14. Tolco Inc.

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Manufacturers:

1. B-Line Systems, Inc.; a division of Cooper Industries.
2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
3. GS Metals Corp.
4. Power-Strut Div.; Tyco International, Ltd.
5. Thomas & Betts Corporation.
6. Tolco Inc.
7. Unistrut Corp.; Tyco International, Ltd.

C. Coatings: Manufacturer's standard finish unless bare metal surfaces are indicated.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Manufacturers:

1. Carpenter & Paterson, Inc.
2. ERICO/Michigan Hanger Co.
3. PHS Industries, Inc.
4. Pipe Shields, Inc.
5. Rilco Manufacturing Company, Inc.
6. Value Engineered Products, Inc.

C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.

D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate.

E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Manufacturers:

a. Hilti, Inc.
b. ITW Ramset/Red Head.
c. Masterset Fastening Systems, Inc.
d. MKT Fastening, LLC.
e. Powers Fasteners.

B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated or stainless steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Manufacturers:

    a. B-Line Systems, Inc.; a division of Cooper Industries.
    b. Empire Industries, Inc.
    c. Hilti, Inc.
    d. ITW Ramset/Red Head.
    e. MKT Fastening, LLC.
    f. Powers Fasteners.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use padded hangers for piping that is subject to scratching.

F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.

10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.

G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.

H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.

J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

K. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

L. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

M. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.2 HANGER AND SUPPORT INSTALLATION

A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

G. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

H. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

I. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

J. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.

K. Insulated Piping: Comply with the following:

1. Attach clamps and spacers to piping.

    a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    c. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

    a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.

5. Insert Material: Length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.4 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils .

B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 220529

CONFIDENTIAL DOCUMENT

220553

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

ImmuCell
Portland, ME

Reviews / Approvals

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The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

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220553

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
220553	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Pipe labels.
3. Valve tags.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032- 0.032-inch**0.025-inch0.032-inch0.032-inch** minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

2.3 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link or beaded chain; or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "Interior Painting."

B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

C. Pipe Label Color Schedule:

1. Compressed-Air Piping:

a. Background Color: Blue.
b. Letter Color: White.

2. Domestic Water Piping:

    a. Background Color: Green.
    b. Letter Color: White.

3. Sanitary Waste Process Waste Piping:

    a. Background Color: Black.
    b. Letter Color: White.

3.4 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

    a. Cold Water: 1-1/2 inches, round.
    b. Hot Water: 1-1/2 inches, round.
    c. Compressed Air: 1-1/2 inches, round.

2. Valve-Tag Color:

    a. Cold Water: Natural.
    b. Hot Water: Natural.
    c. Compressed Air: Natural.

3. Letter Color:

    a. Cold Water: Black.
    b. Hot Water: Black.
    c. High-Pressure Compressed Air: Black.

END OF SECTION 220553

CONFIDENTIAL DOCUMENT

220700

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

PLUMBING INSULATION

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

220700

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ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
220700	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 220700 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Insulation Materials:

a. Cellular glass.
b. Flexible elastomeric.
c. Mineral fiber.

2. Insulating cements.
3. Adhesives.
4. Mastics.
5. Lagging adhesives.
6. Sealants.
7. Factory-applied jackets.
8. Field-applied fabric-reinforcing mesh.
9. Field-applied cloths.
10. Field-applied jackets.
11. Tapes.
12. Securements.

B. Related Sections include the following:

1. Division 23 Section "Mechanical Systems Insulation."

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

B. Qualification Data: For qualified Installer.

C. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

D. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Cell-U-Foam Corporation; Ultra-CUF.
    b. Pittsburgh Corning Corporation; Foamglas Super K.

2. Block Insulation: ASTM C 552, Type I.
3. Special-Shaped Insulation: ASTM C 552, Type III.
4. Board Insulation: ASTM C 552, Type IV.
5. Preformed Pipe Insulation with Factory-Applied ASJ: Comply with ASTM C 552, Type II, Class 2.
6. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

G. Flexible Elastomeric: Closed-Cell, sponge or expanded rubber materials. Comply with ASTM C 534, Type I for tubular material and Type II for sheet materials.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the work include, but are not limited to, the following:
    a. Aeroflex USA Inc; Aerocel.
    b. Armacell LLC; AP Armaflex.
    c. RBX Corporation: Insul Sheet 1800 and Insul Tube 180.

H. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Fibrex Insulations Inc.; Coreplus 1200.
    b. Johns Manville; Micro-Lok.
    c. Knauf Insulation; 1000(Pipe Insulation.
    d. Manson Insulation Inc.; Alley-K.
    e. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

I. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ] complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements :

a. CertainTeed Corp.; CrimpWrap.
b. Johns Manville; MicroFlex.
c. Knauf Insulation; Pipe and Tank Insulation.
d. Manson Insulation Inc.; AK Flex.
e. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following]:

a. Insulco, Division of MFS, Inc.; Triple I.
b. P. K. Insulation Mfg. Co., Inc.; Super-Stik.

B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Insulco, Division of MFS, Inc.; SmoothKote.
b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
c. Rock Wool Manufacturing Company; Delta One Shot.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Cellular-Glass Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Products, Division of ITW; CP-96.
b. Foster Products Corporation, H. B. Fuller Company; 81-33.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Aeroflex USA Inc.; Aeroseal.
b. Armacell LCC; 520 Adhesive.
c. Foster Products Corporation, H. B. Fuller Company; 85-75.
d. RBX Corporation; Rubatex Contact Adhesive.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Products, Division of ITW; CP-82.
b. Foster Products Corporation, H. B. Fuller Company; 85-20.
c. ITW TACC, Division of Illinois Tool Works; S-90/80.
d. Marathon Industries, Inc.; 225.
e. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Products, Division of ITW; CP-82.
b. Foster Products Corporation, H. B. Fuller Company; 85-20.
c. ITW TACC, Division of Illinois Tool Works; S-90/80.
d. Marathon Industries, Inc.; 225.
e. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Dow Chemical Company (The); 739, Dow Silicone.

b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
c. P.I.C. Plastics, Inc.; Welding Adhesive.
d. Speedline Corporation; Speedline Vinyl Adhesive.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Products, Division of ITW; CP-35.
b. Foster Products Corporation, H. B. Fuller Company; 30-90.
c. ITW TACC, Division of Illinois Tool Works; CB-50.
d. Marathon Industries, Inc.; 590.
e. Mon-Eco Industries, Inc.; 55-40.
f. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.08 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
5. Color: White.

2.5 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Products, Division of ITW; CP-76.
b. Foster Products Corporation, H. B. Fuller Company; 30-45.
c. Marathon Industries, Inc.; 405.
d. Mon-Eco Industries, Inc.; 44-05.
e. Pittsburgh Corning Corporation; Pittseal 444.
f. Vimasco Corporation; 750.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F.

5. Color: White or gray.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Childers Products, Division of ITW; CP-76-8.
   b. Foster Products Corporation, H. B. Fuller Company; 95-44.
   c. Marathon Industries, Inc.; 405.
   d. Mon-Eco Industries, Inc.; 44-05.
   e. Vimasco Corporation; 750.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Childers Products, Division of ITW; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.7 FIELD-APPLIED JACKETS

A. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Johns Manville; Zeston.
b. P.I.C. Plastics, Inc.; FG Series.
c. Proto PVC Corporation; LoSmoke.
d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

5. Factory-fabricated tank heads and tank side panels.

B. Metal Jacket:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Products, Division of ITW; Metal Jacketing Systems.
b. PABCO Metals Corporation; Surefit.
c. RPR Products, Inc.; Insul-Mate.

2. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005, Temper H-14.

a. Factory cut and rolled to size.
b. Finish and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper.
d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
e. Factory-Fabricated Fitting Covers:

1) Same material, finish, and thickness as jacket.
2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) Tee covers.
4) Flange and union covers.
5) End caps.
6) Beveled collars.

7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.

a. Factory cut and rolled to size.
b. Material, finish, and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Indoor Applications: 1-mil thick, heat-bonded polyethylene and kraft paper.
d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
e. Factory-Fabricated Fitting Covers:

1) Same material, finish, and thickness as jacket.
2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) Tee covers.
4) Flange and union covers.
5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.8 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
b. Compac Corp.; 104 and 105.
c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
    b. Compac Corp.; 110 and 111.
    c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
    d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
    b. Compac Corp.; 130.
    c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
    d. Venture Tape; 1506 CW NS.

2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
    b. Compac Corp.; 120.
    c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
    d. Venture Tape; 3520 CW.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.9 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Products; Bands.
b. PABCO Metals Corporation; Bands.
c. RPR Products, Inc.; Bands.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing or closed seal.
3. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing or closed seal.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch diameter shank, length to suit depth of insulation indicated.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) AGM Industries, Inc.; CWP-1.
2) GEMCO; CD.
3) Midwest Fasteners, Inc.; CD.
4) Nelson Stud Welding; TPA, TPC, and TPS.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) AGM Industries, Inc.; CWP-1.
2) GEMCO; Cupped Head Weld Pin.
3) Midwest Fasteners, Inc.; Cupped Head.
4) Nelson Stud Welding; CHP.

3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
2) GEMCO; Perforated Base.
3) Midwest Fasteners, Inc.; Spindle.

b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
c. Spindle: Stainless steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) AGM Industries, Inc.; RC-150.
2) GEMCO; R-150.
3) Midwest Fasteners, Inc.; WA-150.
4) Nelson Stud Welding; Speed Clips.

b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

5. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) GEMCO.
2) Midwest Fasteners, Inc.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.

2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.

2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

E. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.

3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gauges, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.

3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 CELLULAR-GLASS INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.7 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.9 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.10 FINISHES

A. Equipment and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Owner. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.11 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.12 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. Insulation shall be one of the following:

a. Cellular Glass: 1 inch thick.
b. Flexible Elastomeric: 1 inch thick.
c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

B. Domestic Hot, Tepid and Recirculation Piping

1. Insulation shall be one of the following

    a. Cellular Glass: 1-1/2 inch thick
    b. Mineral Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inch thick

C. Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation shall be one of the following:

    a. Flexible Elastomeric: ½" inch thick.

D. Hot Service Drains:

1. All Pipe Sizes: Insulation shall be one of the following:

    a. Cellular Glass: 1 inch thick.
    b. Mineral-Fiber, Preformed Pipe, Type I or II: 1 inch thick.

3.13 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed or in Mechanical Rooms:

1. None.

D. Piping, Exposed:

1. Stainless Steel, Type 304: 0.016 inch thick.

E. Piping, Exposed (Non GMP Spaces):

1. PVC: 30 mils thick.

END OF SECTION 220700

CONFIDENTIAL DOCUMENT

221116

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

DOMESTIC WATER PIPING

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

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Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
221116	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
2. Flexible connectors.
3. Water meters furnished by utility company for installation by Contractor.
4. Escutcheons.
5. Sleeves and sleeve seals.

1.3 SUBMITTALS

A. Product Data: For the following products:

1. Transition fittings.
2. Dielectric fittings.
3. Flexible connectors.
4. Escutcheons.
5. Sleeves and sleeve seals.

B. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

1.5 PROJECT CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of water service.
2. Do not proceed with interruption of water service without Construction Manager's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B) water tube, drawn temper.

1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
5. Copper Pressure-Seal-Joint Fittings:

    a. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
    b. NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.

2.3 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.

1. Standard-Pattern, Mechanical-Joint Fittings: AWWA C110, ductile or gray iron.
2. Compact-Pattern, Mechanical-Joint Fittings: AWWA C153, ductile iron.

    a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

2.4 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.5 SPECIALTY VALVES

A. Comply with requirements in Division 22 Section "General Duty Valves for Plumbing Piping" for general-duty metal valves.

B. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.

2.6 TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Coupling: AWWA C219.

2.7 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.

B. Dielectric Unions:

1. Description:

a. Pressure Rating: 250 psig at 180 deg F .
b. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Description:

a. Factory-fabricated, bolted, companion-flange assembly.
b. Pressure Rating: 150 psig
c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Kits:

1. Description:

a. Nonconducting materials for field assembly of companion flanges.
b. Pressure Rating: 150 psig
c. Gasket: Neoprene or phenolic.

d. Bolt Sleeves: Phenolic or polyethylene.
e. Washers: Phenolic with steel backing washers.

E. Dielectric Couplings:

1. Description:

a. Galvanized-steel coupling.
b. Pressure Rating: 300 psig at 225 deg F
c. End Connections: Female threaded.
d. Lining: Inert and noncorrosive, thermoplastic.

F. Dielectric Nipples:

1. Description:

a. Electroplated steel nipple complying with ASTM F 1545.
b. Pressure Rating: 300 psig at 225 deg F
c. End Connections: Male threaded or grooved.
d. Lining: Inert and noncorrosive, propylene.

2.8 FLEXIBLE CONNECTORS

A. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig
2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.

B. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig
2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

2.9 ESCUTCHEONS

A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.

B. One Piece, Cast Brass: Polished, chrome-plated finish with setscrews.

C. One Piece, Deep Pattern: Deep-drawn, box-shaped brass with chrome-plated finish.

D. One Piece, Stamped Steel: Chrome-plated finish with setscrew or spring clips.

E. Split Casting, Cast Brass: Polished, chrome-plated finish with concealed hinge and setscrew.

F. Split Plate, Stamped Steel: Chrome-plated finish with concealed hinge, setscrew or spring clips.

G. One-Piece Floor Plates: Cast-iron flange.

H. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.10 SLEEVES

A. Cast-Iron Wall Pipes: Fabricated of cast iron, and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

C. Molded-PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

D. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc-coated, with plain ends.

E. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.11 SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, used to fill annular space between pipe and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Plastic
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.12 GROUT

A. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install shutoff valve immediately upstream of each dielectric fitting.

C. Install domestic water piping level without pitch and plumb.

D. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

E. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

F. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

G. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

H. Install piping adjacent to equipment and specialties to allow service and maintenance.

I. Install piping to permit valve servicing.

J. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.

K. Install piping free of sags and bends.

L. Install fittings for changes in direction and branch connections.

M. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

3.2 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.

E. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

F. Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.

G. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

H. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.3 VALVE INSTALLATION

A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.

B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.

C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."

1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.

3.4 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings.

3.5 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.

3.6 FLEXIBLE CONNECTOR INSTALLATION

A. Install bronze-hose flexible connectors in copper domestic water tubing.

B. Install stainless-steel-hose flexible connectors in steel domestic water piping.

3.7 WATER METER INSTALLATION

A. Rough-in domestic water piping for water meter installation and install water meters according to utility company’s requirements.

B. Install water meters according to AWWA M6, utility company's requirements and as indicated on the construction document plans and schematics.

3.8 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:
    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer than 100 Feet: MSS Type 43, adjustable roller hangers.
    c. Longer than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
4. NPS 2-1/2 108 inches with 1/2-inch rod.
5. NPS 3: 10 feet with 1/2-inch rod.

E. Install supports for vertical copper tubing every 10 feet.

F. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.9 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment and machines to allow service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
2. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.
3. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.10 ESCUTCHEON INSTALLATION

A. Install escutcheons for penetrations of walls, ceilings, and floors. Refer to Division 22 “Common Work Results for Plumbing”.

3.11 SLEEVE INSTALLATION

A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.

B. Sleeves are not required for core-drilled holes.

C. Permanent sleeves are not required for holes formed by removable PE sleeves.

D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.

E. Install sleeves in new partitions, slabs, and walls as they are built.

F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.

G. Seal space outside of sleeves in concrete slabs and walls with grout.

H. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.

I. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestop materials and installations.

3.12 SLEEVE SEAL INSTALLATION

A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.

B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.13 IDENTIFICATION

A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.

B. Label pressure piping with system operating pressure.

3.14 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Piping Inspections:

1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

    a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
    b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

C. Piping Tests:

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
4. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and for corrective action required.

D. Domestic water piping will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.15 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

    a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
    b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.16 CLEANING

A. Clean and disinfect potable and non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.

2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Fill and isolate system according to either of the following:

        1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
        2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

    c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
    d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

B. Clean non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:

    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.17 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

D. Aboveground domestic water piping, NPS 3 and smaller, shall be the following:

1. Hard copper tube, ASTM B 88, Type L; cast or wrought- copper solder-joint fittings; and soldered joints.

3.18 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use ball or gate valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
3. Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves.
4. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION 221116

CONFIDENTIAL DOCUMENT

221119

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

DOMESTIC WATER PIPING SPECIALTIES

ImmuCell

Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
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The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

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221119

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
221119	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following domestic water piping specialties:

1. Vacuum breakers.
2. Backflow preventers.
3. Balancing valves.
4. Thermostatic water mixing valves.
5. Strainers.
6. Hose bibbs.
7. Wall hydrants.
8. Drain valves.
9. Water hammer arresters.
10. Air vents.
11. Trap-seal primer systems.

B. Related Sections include the following:

1. Division 22 Section "Meters and Gauges for Plumbing Piping" for thermometers, pressure gauges, and flow meters in domestic water piping.
2. Division 22 Section "Domestic Water Piping" for water meters.
3. Division 22 Section "Emergency Plumbing Fixtures" for water tempering equipment.

1.3 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Field quality-control test reports.

C. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. NSF Compliance:

1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Ames Co.
b. Cash Acme.
c. Conbraco Industries, Inc.
d. FEBCO; SPX Valves & Controls.
e. Rain Bird Corporation.
f. Toro Company (The); Irrigation Div.
g. Watts Industries, Inc.; Water Products Div.
h. Zurn Plumbing Products Group; Wilkins Div.

3. Standard: ASSE 1001.
4. Size: NPS 1/4 to NPS 3, as required to match connected piping.
5. Body: Bronze.
6. Inlet and Outlet Connections: Threaded.
7. Finish: Chrome plated.

B. Hose-Connection Vacuum Breakers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Arrowhead Brass Products, Inc.
b. Cash Acme.
c. Conbraco Industries, Inc.
d. Legend Valve.
e. MIFAB, Inc.

f. Prier Products, Inc.
g. Watts Industries, Inc.; Water Products Div.
h. Woodford Manufacturing Company.
i. Zurn Plumbing Products Group; Light Commercial Operation.
j. Zurn Plumbing Products Group; Wilkins Div.

3. Standard: ASSE 1011.
4. Body: Bronze, nonremovable, with manual drain.
5. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
6. Finish: Chrome or nickel plated

C. Pressure Vacuum Breakers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Ames Co.
b. Conbraco Industries, Inc.
c. FEBCO; SPX Valves & Controls.
d. Flomatic Corporation.
e. Toro Company (The); Irrigation Div.
f. Watts Industries, Inc.; Water Products Div.
g. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1020.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
5. Accessories:

a. Valves: Ball type, on inlet and outlet.

D. Spill-Resistant Vacuum Breakers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Conbraco Industries, Inc.
b. Watts Industries, Inc.; Water Products Div.

3. Standard: ASSE 1056.
4. Operation: Continuous-pressure applications.
5. Accessories:

a. Valves: Ball type, on inlet and outlet.

2.2 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers :

1. Basis-of-Design Product: Subject to compliance with requirements, provide Watts LF909 OSY or a comparable product by one of the following:

    a. Ames Co.
    b. Conbraco Industries, Inc.
    c. FEBCO; SPX Valves & Controls.
    d. Flomatic Corporation.
    e. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 14 psig maximum, through middle 1/3 of flow range.
5. Size: 3” (for main service entrance)
6. Design Flow Rate: 150 gpm (for main service entrance)
7. Body: Cast iron with interior lining complying with AWWA C550 or that is FDA approved
8. End Connections: Flanged
9. Configuration: Designed for horizontal, straight through flow.
10. Accessories:

    a. Valves: Outside screw and yoke gate-type with flanged ends on inlet and outlet.
    b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

B. Backflow-Preventer Test Kits:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Conbraco Industries, Inc.
    b. FEBCO; SPX Valves & Controls.
    c. Flomatic Corporation.
    d. Watts Industries, Inc.; Water Products Div.
    e. Zurn Plumbing Products Group; Wilkins Div.

2. Description: Factory calibrated, with gauges, fittings, hoses, and carrying case with test-procedure instructions.

2.3 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Armstrong International, Inc.
b. Flo Fab Inc.
c. ITT Industries; Bell & Gossett Div.
d. NIBCO INC.
e. TAC Americas.
f. Taco, Inc.
g. Watts Industries, Inc.; Water Products Div.

2. Type: Y-pattern globe valve with two readout ports and memory setting indicator.
3. Body: Brass,
4. Size: Same as connected piping, but not larger than NPS 2.
5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Accessories: Funish to owner Meter hoses, fittings, valves, differential pressure meter, and carrying case.

2.4 THERMOSTATIC, WATER MIXING VALVES:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

a. Armstrong International, Inc.
b. Lawler Manufacturing Company, Inc.
c. Leonard Valve Company.
d. Powers; a Watts Industries Co.
e. Symmons Industries, Inc.

2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig.
4. Type: Exposed-mounting, thermostatically controlled water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded inlets and outlet.
7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Valve Pressure Rating: 125 psig minimum.
9. Tempered-Water Setting: As indicated on drawings**.**
10. Selected Valve Flow Rate at 5-psig Pressure Drop 15 GPM and 20 GPM.
11. Pressure Drop at Design Flow Rate: 5-psig.
12. Valve Finish: Rough bronze.
13. Piping Finish: Copper.
14. Safety shower mixing valve supplied with redundant cold water bypass.

2.5 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.

3. End Connections: Threaded for NPS 2 and smaller;flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. Perforation Size:

    a. Strainers NPS 2 and Smaller: 0.033 inch.
    b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
    c. Strainers NPS 5 and Larger: 0.10 inch.

6. Drain: Factory-installed, hose-end drain valve.

2.6 HOSE BIBBS

A. Hose Bibbs :

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following.

    a. Josam Company.
    b. MIFAB, Inc.
    c. Prier Products, Inc.
    d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    e. Tyler Pipe; Wade Div.
    f. Watts Drainage Products Inc.
    g. Woodford Manufacturing Company.
    h. Zurn Plumbing Products Group; Light Commercial Operation.
    i. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.18.1 for sediment faucets.
3. Body Material: Bronze.
4. Seat: Bronze, replaceable.
5. Supply Connections: NPS 3/4 threaded or solder-joint inlet.
6. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
7. Pressure Rating: 125 psig.
8. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
9. Finish: Rough bronze.
10. Operation: Wheel handle.
11. Provide flange if installed on a finished wall.

2.7 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following.

    a. Josam Company.
    b. MIFAB, Inc.

c. Prier Products, Inc.
d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
e. Tyler Pipe; Wade Div.
f. Watts Drainage Products Inc.
g. Woodford Manufacturing Company.
h. Zurn Plumbing Products Group; Light Commercial Operation.
i. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
3. Pressure Rating: 125 psig.
4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4.
7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Box: Deep, flush mounting with cover.
9. Box and Cover Finish: Stainless Steel.
10. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
11. Nozzle and Wall-Plate Finish: Rough bronze.
12. Operating Keys(s): Two with each wall hydrant.

2.8 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

B. Stop-and-Waste Drain Valves:

1. Standard: MSS SP-110 for ball valves.
2. Pressure Rating: 200-psig minimum CWP or Class 125.
3. Size: NPS 3/4.
4. Body: Copper alloy or ASTM B 62 bronze.
5. Drain: NPS 1/8 side outlet with cap.

2.9 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. AMTROL, Inc.
    b. Josam Company.
    c. MIFAB, Inc.
    d. PPP Inc.
    e. Sioux Chief Manufacturing Company, Inc.
    f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    g. Tyler Pipe; Wade Div.
    h. Watts Drainage Products Inc.
    i. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.10 AIR VENTS

A. Bolted-Construction Automatic Air Vents:

1. Body: Bronze.
2. Pressure Rating: 125-psig minimum pressure rating at 140 deg F.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

B. Welded-Construction Automatic Air Vents.

1. Body: Stainless steel.
2. Pressure Rating: 150-psig minimum pressure rating.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

2.11 TRAP-SEAL PRIMER SYSTEMS

A. Trap-Seal Primer Systems:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

a. PPP Inc.
b. MIFAB

2. Standard: ASSE 1044,
3. Piping: NPS 3/4, ASTM B 88, Type L; copper, water tubing.
4. Cabinet: Surface-mounting steel box with stainless-steel cover.
5. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.
6. Vacuum Breaker: ASSE 1001.
7. Number Outlets: As indicated on drawings.
8. Size Outlets: NPS 1/2.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Locate backflow preventers in same room as connected equipment or system.
2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
3. Do not install bypass piping around backflow preventers.

C. Install water control valves with inlet and outlet shutoff valves. Install pressure gauges on inlet and outlet.

D. Install balancing valves in locations where they can easily be adjusted.

E. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.

1. Install thermometers and water regulators if specified.
2. Install surface mounted on wall as specified.

F. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, solenoid valve, and pump.

G. Install water hammer arresters in water piping according to PDI-WH 201.

H. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.

I. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

J. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Pressure vacuum breakers.
2. Intermediate atmospheric-vent backflow preventers.
3. Reduced-pressure-principle backflow preventers.
4. Double-check backflow-prevention assemblies.
5. Dual-check-valve backflow preventers.
6. Reduced-pressure-detector, fire-protection backflow-preventer assemblies.
7. Double-check, detector-assembly backflow preventers.
8. Water pressure-reducing valves.
9. Calibrated balancing valves.
10. thermostatic, water mixing valves.
11. Trap-seal primer systems.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:

1. Test each reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.

B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.5 ADJUSTING

A. Set field-adjustable flow set points of balancing valves.

B. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 221119

CONFIDENTIAL DOCUMENT

221316

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

SANITARY AND PROCESS WASTE AND VENT PIPING

ImmuCell
Portland, ME

Reviews / Approvals

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The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

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221316

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

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221316	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 221316 - SANITARY AND PROCESS WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the pipe, tube, and fittings for soil, waste, process, and vent piping inside the building:

1.3 DEFINITIONS

A. PP: Polypropylene

B. PVC: Polyvinyl chloride plastic.

C. DD: Domestic Drain

D. PD: Process Drain

E. PVDF: Polyvinylidene fluoride plastic.

1.4 PERFORMANCE REQUIREMENTS

A. Soil, process, waste, and vent piping components and installation shall be capable of withstanding 10-foot head of water at system high point, unless otherwise indicated

B. Process Waste Parameters:

1. pH: 3-11
2. Temperature Range: ambient to 180°F with intermittent to 185°F
3. Typical Chemicals: Phosphoric Acid, Sodium Hydroxide, Isopropyl Alcohol, Propylene Glycol, Acetic Acid, <1% Hydrogen Peroxide. Owner will provide a complete list of chemicals and concentrations for compatibility.

1.5 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

B. Shop Drawings:

1. Process Drainage System: Include plans, elevations, sections, and details.

C. Field quality-control inspection and test reports.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.2 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.

B. Solvent Cement and Adhesive Primer:

1. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 PP PIPE AND FITTINGS

A. PP Drainage Pipe and Fittings: ASTM F 1412, pipe extruded and drainage-pattern fittings molded, with Schedule 40 dimensions, from PP resin complying with ASTM D 4101; with fusion joint ends.

B. Manufacturers: Subject to compliance with requirements. Provide Enfield by IPEX Inc. or approved equal.

2.4 SPECIAL PIPE FITTINGS

A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Available Manufacturers:

a. Dallas Specialty & Mfg. Co.
b. Fernco, Inc.
c. Logan Clay Products Company (The).
d. Mission Rubber Co.
e. NDS, Inc.
f. Plastic Oddities, Inc.

2. Sleeve Materials for Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.

B. Rigid, Unshielded, Nonpressure Pipe Couplings: ASTM C 1461, sleeve-type reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Available Manufacturers:

a. ANACO.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

B. Above grade, soil and sanitary waste piping shall be Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

C. Above grade, sanitary vent piping shall be Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

D. Above grade, gravity drained process waste piping shall be PP, Schedule 40, drainage pattern fittings complying with ASTM D 4101, and fusion joint ends. Refer to section 2.3 for material information.

E. Above and below grade, process vent piping shall be PP, Schedule 40, drainage pattern fittings complying with ASTM D 4101, and fusion joint ends. Refer to section 2.3 for material information.

3.2 PIPING INSTALLATION

A. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

C. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

D. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:

1. Building Process and Sanitary Drain: 2 percent downward in direction of flow for piping NPS 2 1/2 and smaller; 1 percent downward in direction of flow for piping NPS 3 to NPS 6; 0.5 percent downward in direction of flow for piping NPS 8 and larger.
2. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

E. Install engineered soil and waste drainage and vent piping systems as follows:

1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
2. Solvent Drainage System: Comply with ASSE 1043 and solvent fitting manufacturer's written installation instructions.
3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.

F. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.

G. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

H. Install process waste piping inside the building according to the following:

1. Install piping next to equipment, accessories, and specialties to allow service and maintenance.
2. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used unless otherwise indicated.
3. Flanges may be used on aboveground piping unless otherwise indicated.
4. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

5. Install exposed piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise. No exposed piping shall be installed in clean rooms.
6. Install piping at indicated slopes.
7. Install piping free of sags and bends.
8. Install fittings for changes in direction and branch connections.
9. Install escutcheons for penetrations of floors according to the following:

    a. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
    b. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

10. Sleeves are not required for core-drilled holes.
11. Permanent sleeves are not required for holes formed by removable PE sleeves.
12. Install sleeves for pipes passing through concrete floor.

3.3 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

C. Plastic-Piping Electrofusion Joints: Make polyolefin drainage-piping joints according to ASTM F 1290

3.4 HANGER AND SUPPORT INSTALLATION

A. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:

1. Vertical Piping: MSS Type 8 or Type 42 clamps.
2. Install individual, straight, horizontal piping runs according to the following:

    a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet (30 m), if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

E. Install hangers for PP and PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
2. NPS 3: 48 inches with 1/2-inch rod.
3. NPS 4 and 5: 48 inches with 5/8-inch rod.
4. NPS 6: 48 inches with 3/4-inch rod.
5. NPS 8 to NPS 12: 48 inches with 7/8-inch rod.

F. Install supports for vertical PVC piping every 120 inches.

G. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.5 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

3.6 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. All joints must be visually inspected for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.7 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.8 PROTECTION

A. Exposed PP and PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint, or with two coats of manufacturer approved paint system for UV resistance and protection.

END OF SECTION 221316

CONFIDENTIAL DOCUMENT

221319

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

SANITARY AND PROCESS WASTE PIPING SPECIALTIES

ImmuCell

Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
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The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

221319

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
221319	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 221319 - SANITARY AND PROCESS WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following sanitary and process drainage piping specialties:

1. Cleanouts
2. Floor drains

1.3 DEFINITIONS

A. PP: Polypropylene plastic.

B. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities for the following:

1. Floor drains

B. Field quality-control test reports.

C. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.6 COORDINATION

A. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Plastic Floor Cleanouts (Sanitary Waste):

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Zurn Plumbing Products Group
b. Jay R Smith Mfg. Co.
c. Josam Company; Josam Div.
d. Watts

2. Size: Same as connected branch.
3. Body: PVC.
4. Closure Plug: PVC.
5. Plate: Nickel Bronze
6. Riser: Drainage pipe fitting and riser to cleanout of same material as drainage piping.

B. Plastic Floor Cleanouts (Process Waste):

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Ipex, Enfield

2. Size: Same as connected branch
3. Body: Polypropylene
4. Closure Plug: Polypropylene
5. Riser: Drainage pipe fitting and riser to cleanout of same material as drainage piping.

2.2 FLOOR DRAINS

A. Floor Drains – FD-2: (Sanitary Waste)

1. Basis-of-Design Product: Subject to compliance with requirements, provide Zurn 415B or a comparable product by one of the following:

a. Josam Company; Josam Div.
b. Jay R. Smith Manufaccturing
c. Watts Drainage Products

2. Standard: ASME A112.6.3.
3. Material: Cast iron receptor with Dura-Coated cast iron body
4. Seepage Flange: Required
5. Clamping Device: Required

6. Outlet: Bottom, No-hub
7. Top Shape: Circular
8. Strainer: 8” nickel bronze strainer head
9. Trap Material: Plastic drainage piping
10. Trap Pattern: Standard P-trap
11. Trap Primer Connection: Required
12. Sediment Bucket: Required

B. Plastic Floor Drains – FD-4: (Process Waste)

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Ipex, Enfield

2. Standard: ASME A112.6.3.
3. Material: Polypropylene
4. Anchor Flange: Required
5. Clamping Device: Not required
6. Outlet: Bottom
7. Top or Strainer Material: Plastic
8. Top of Body and Strainer Finish: Polypropylene
9. Top Shape: 6” Round
10. Trap Material: Plastic drainage piping
11. Trap Pattern: Standard P-trap
12. Trap Primer: Required

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet (30 m) for larger piping.
4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install floor drains at low points of surface areas to be drained.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:

a. Radius, 12 Inches: Equivalent to 1/2-inch total depression.

3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

F. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

G. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

H. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

I. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

J. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated on drawings.

K. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

3.3 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist. Test system per spec 221316 – Sanitary and Process Waste and Vent Piping.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

CONFIDENTIAL DOCUMENT

221513

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

GENERAL-SERVICE COMPRESSED-AIR PIPING

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

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CONFIDENTIAL DOCUMENT

221513

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
221513	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 221513 - GENERAL-SERVICE COMPRESSED-AIR PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes piping and related specialties for general-service compressed-air systems operating at 200 psig or less.

B. Related Sections include the following:

1. Division 22 Section "General-Service Packaged Air Compressors and Receivers" for general-service air compressors and accessories.
2. Division 40 Section “Stainless Steel Process Piping and Tubing”

1.3 DEFINITIONS

A. Low-Pressure Compressed-Air Piping: System of compressed-air piping and specialties operating at pressures of 150 psig or less.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Dielectric fittings.
2. Safety valves.
3. Pressure regulators. Include rated capacities and operating characteristics.
4. Automatic drain valves.
5. Lubricators. Include rated capacities and operating characteristics.
6. Quick couplings.

B. Brazing and welding certificates.

C. Qualification Data: For Installers.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For general-service compressed-air piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or to AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."

B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

C. ASME Compliance:

1. Comply with ASME B31.1, "Power Piping," for high-pressure compressed-air piping.
2. Comply with ASME B31.9, "Building Services Piping," for low-pressure compressed-air piping.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Copper Tube: CPK2

SYSTEM RATING
150 psig @ 100 F
PIPING MATERIAL
Copper Tubing, Type K, ASTM B280, Type ACR, hard-drawn straight lengths and soft annealed coils, seamless. Tubing shall be factory cleaned, ready for installation, and have ends capped to protect cleanliness of pipe interiors prior to shipping.
Piping used for compressed air, nitrogen, oxygen, and carbon dioxide must be cleaned for oxygen service.
SIZE RANGE
1/4" through 3"
PIPING Finish
Standard manufacturer's finish
FITTINGS
Wrought copper, solder joint pressure fittings, ANSI B16.22
Unions: Wrought copper with copper seats, ANSI B16.22
Dielectric Connections must be used in compressed air piping systems where steel and copper are joined together.

FLANGES
1/2" to 3" 150#. cast bronze solder joint flange, flat face, ANSI B16.24 and ASTM B584, 210 PSI. Higher flange class may be required to mate with equipment. Adapt using appropriate steel flanges where necessary.
GASKETS
1/8" thick, EPDM, full face 150# ANSI dimensions. Garlock Style 563 or approved equal. (For all services except oxygen)
1/8" thick, expanded teflon, full face 150# ANSI dimensions. Garlock GYLON Style 3502 or approved equal (for oxygen service).
BOLTING
Heavy hex head machine bolts ASTM A307-B with heavy hex nuts to ASTM A563-A, carbon steel. (Use fiber washers and inserts to insulate bolts from flanges at dielectric joints).
JOINTS, Brazed
Brazing filler metal shall be Silver braze - AWS A5.8, BCuP-5, 15 percent silver, self-fluxing copper to copper. For copper to brass use manufacturers recommended flux, J.W. Harris "Stay-Silv 15", "Sil-Fos" or approved equal.
INSULATING UNIONS
300# dielectric union, malleable iron galvanized ASTM A197 by brass swivel end, molded nylon insulation, threaded ends. Central Plastic Co. or equal.
VALVES, Ball (Shut-Off)
3” and smaller, three-piece, cast bronze body with solder ends, Teflon seats & seals, 316 stainless steel ball, blow-out proof stem.
Grinnell, Nibco, PBM, Worcester, Apollo, or approved equal.
VALVES. Check
3” and smaller, class 150, swing type, bronze body, replaceable bronze disc, solder joint ends, integral screw on cap.
Nibco, Powell, Stockham, Walworth, or approved equal.
VALVES. Globe (Throttling)
1/2" to 3" shall be a globe valve, class 300, WOG solder ends, brass or bronze body parts, renewable seat and disc, union bonnet, inside screw, and Teflon packing. Nibco, Powell, or approved equal.
DOCUMENTATION
Manufacturer's Cut Sheet.

CLEANING & PACKAGING
All materials shall be cleaned of manufacturing oils and debris per manufacturer's standards. After cleaning, materials shall be packaged by an acceptable method until the item is ready for installation.
Materials for use in oxygen systems shall be cleaned and packaged for oxygen service, and certified free of lubricants.
NOTES:
A. Copper must be insulated from steel and supports.
B. Use dielectric fittings (insulating unions or flange bolt insulating kits) at spec breaks between copper and carbon steel in any piping containing water or aqueous solutions. Dielectric fittings are not required in dry gas service piping.
C. Competed piping systems for all gas services shall be clean and dry, suitable for oxygen service.
D. Unless the manufacturer recommends brazing to a completely assembled valve, valves shall have bonnets disassembled and internals removed, including all seals prior to brazing. Ball valves shall be disassembled, have ball, stem and seals removed, then bare valve body (or machined spacer) and end pieces assembled for fit-up and brazing. After all brazing on that section of the line is completed and the metal has cooled down sufficiently, valves may be reassembled with all components per manufacturer’s instructions.
E. To reduce the formation of oxides which could potentially flake-off the internal surfaces of the tubing, purge with inert gas during brazing operations. Welding grade Argon is not required: Nitrogen is sufficient for this application.
F. Each valve shall be identified by a stainless steel tag with 1/4" tall lettering, displaying the valve tag number shown on the drawing.

B. Stainless Steel: SFO and SF2

1. Refer to Division 40 Section “Stainless Steel Process Piping and Tubing”

2.2 DIELECTRIC FITTINGS

A. General Requirements for Dielectric Fittings: Combination fitting of copper alloy and ferrous materials with insulating material; suitable for system fluid, pressure, and temperature. Include threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Dielectric Unions: Factory-fabricated union assembly, for 250-psig minimum working pressure at 180 deg F.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Capitol Manufacturing Company.
b. Central Plastics Company.
c. EPCO Sales, Inc.
d. Hart Industries International, Inc.
e. Watts Water Technologies, Inc.; Water Products Div.
f. Zurn Plumbing Products Group; Wilkins Div.

C. Dielectric Flanges: Factory-fabricated companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Capitol Manufacturing Company.
b. Central Plastics Company.
c. EPCO Sales, Inc.
d. Watts Water Technologies, Inc.; Water Products Div.

D. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.

2.3 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

2.4 ESCUTCHEONS

A. General Requirements: Manufactured wall and ceiling escutcheons and floor plates, with ID to closely fit around pipe and tube and OD that completely covers opening.

B. One-Piece, Stainless-steel Escutcheons: 304 Stainless-steel construction,finish, with set-screw.

C. One-Piece, Cast-Brass Escutcheons: With set screw.

1. Finish: Polished chrome-plated.

2.5 QUICK COUPLINGS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Aeroquip Corporation; Eaton Corp.
2. Bowes Manufacturing Inc.
3. Foster Manufacturing, Inc.
4. Milton Industries, Inc.
5. Parker Hannifin Corp.; Fluid Connectors Group; Quick Coupling Div.
6. Rectus Corp.
7. Schrader-Bridgeport; Amflo Div.
8. Schrader-Bridgeport/Standard Thomson.
9. Snap-Tite, Inc.; Quick Disconnect & Valve Division.
10. TOMCO Products Inc.
11. Tuthill Corporation; Hansen Coupling Div.

C. General Requirements for Quick Couplings: Assembly with locking-mechanism feature for quick connection and disconnection of compressed-air hose.

D. Automatic-Shutoff Quick Couplings: Straight-through brass body with O-ring or gasket seal and stainless-steel or nickel-plated-steel operating parts.

1. Socket End: With one-way valve and threaded inlet for connection to piping or threaded hose fitting.

E. Valveless Quick Couplings: Straight-through brass body with stainless-steel or nickel-plated-steel operating parts.

1. Socket End: With O-ring or gasket seal, without valve, and with barbed inlet for attaching hose.

2. Plug End: With barbed outlet for attaching hose.

2.6 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Compressed-Air Piping in non-process spaces use spec CPK2.

B. Compressed Air piping exposed within process spaces use spec SF2.

C. Instrument Air piping exposed within process spaces use spec SF0.

3.2 VALVE APPLICATIONS

A. See schedules in Section 2 for valve selections.

3.3 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of compressed-air piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.

C. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and to coordinate with other services occupying that space.

D. Install piping adjacent to equipment and machines to allow service and maintenance.

E. Install air and drain piping with 1 percent slope downward in direction of flow.

F. Install nipples, flanges, unions, transition and special fittings, and valves with pressure ratings same as or higher than system pressure rating, unless otherwise indicated.

G. Equipment and Specialty Flanged Connections:

1. Use steel companion flange with gasket for connection to steel pipe.
2. Use cast-copper-alloy companion flange with gasket and brazed or soldered joint for connection to copper tube. Do not use soldered joints for connection to air compressors or to equipment or machines producing shock or vibration.

H. Extended-tee outlets with brazed branch connection may be used for copper tubing, within extruded-tee connection diameter to run tube diameter ratio for tube type, according to Extruded Tee Connections Sizes and Wall Thickness for Copper Tube (Inches) Table in ASTM F 2014.

I. Install eccentric reducers where compressed-air piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.

J. Install branch connections to compressed-air mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.

K. Install thermometer and pressure gauge on discharge piping from each air compressor and on each receiver. Comply with requirements in Division 22 Section "Meters and Gauges for Plumbing Piping."

L. Install piping to permit valve servicing.

M. Install piping free of sags and bends.

N. Install fittings for changes in direction and branch connections.

3.4 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Brazed Joints for Copper Tubing: Join according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.

D. Extruded-Tee Outlets for Copper Tubing: Form branches according to ASTM F 2014, with tools recommended by procedure manufacturer, and using operators qualified according to Part 1 "Quality Assurance" Article.

E. Flanged Joints: Use asbestos-free, nonmetallic gasket suitable for compressed air. Join flanges with gasket and bolts according to ASME B31.9 for bolting procedure.

F. Dissimilar Metal Piping Material Joints: Use dielectric fittings.

3.5 VALVE INSTALLATION

A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping."

B. Install shutoff valves and unions or flanged joints at compressed-air piping to air compressors.

3.6 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. NPS 2 and Smaller: Use dielectric unions.

C. NPS 2-1/2 to NPS 4: Use dielectric flanges.

3.7 FLEXIBLE PIPE CONNECTOR INSTALLATION

A. Install flexible pipe connectors in discharge piping and in inlet air piping from remote air-inlet filter of each air compressor.

B. Install stainless-steel-hose flexible pipe connectors in steel compressed-air piping.

3.8 SPECIALTY INSTALLATION

A. Install air-line pressure regulators in branch piping to equipment.

B. Install mechanical filters in compressed-air piping at or near end use.

3.9 SLEEVE INSTALLATION

A. Sleeves are not required for core-drilled holes.

B. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs using galvanized-steel pipe.

C. Install sleeves for pipes passing through concrete and masonry walls, gypsum board partitions, and concrete floor and roof slabs.

1. Wall Penetrations: Cut sleeves to length for mounting flush with both surfaces.
2. Floor Penetrations: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

D. Install sleeves in new walls and slabs as new walls and slabs are constructed.

E. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

1. PVC Pipe Sleeves: For pipes smaller than NPS 6.
2. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum board partitions.
3. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements in Division 07 Section "Sheet Metal Flashing and Trim" for flashing.

F. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.10 ESCUTCHEON INSTALLATION

A. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall or ceiling within a clean room space: One piece, stainless-steel, with set screw.
b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish, with set screw.
c. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

3.11 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices.

B. Comply with requirements of Section 400529 – “Hangers and Supports for Process Piping” for pipe hanger and support devices within sanitary / GPM spaces.

C. Vertical Piping: MSS Type 8 or 42, clamps.

D. Individual, Straight, Horizontal Piping Runs:

1. 100 Feet or Less: MSS Type 1, adjustable, steel clevis hangers.
2. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.

E. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.

F. Base of Vertical Piping: MSS Type 52, spring hangers.

G. Support horizontal piping within 12 inches of each fitting and coupling.

H. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

I. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1/4: 60 inches with 3/8-inch rod.
2. NPS 3/8 and NPS 1/2 : 72 inches with 3/8-inch rod.
3. NPS 3/4: 84 inches with 3/8-inch rod.
4. NPS 1: 96 inches with 3/8-inch rod.
5. NPS 1-1/4: 108 inches with 3/8-inch rod.
6. NPS 1-1/2: 10 feet with 3/8-inch rod.
7. NPS 2: 11 feet with 3/8-inch rod.

8. NPS 2-1/2: 13 feet with 1/2-inch rod.
9. NPS 3: 14 feet with 1/2-inch rod.

J. Install supports for vertical copper tubing every 10 feet.

3.12 LABELING AND IDENTIFICATION

A. Install identifying labels and devices for general-service compressed-air piping, valves, and specialties. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.13 FIELD QUALITY CONTROL

A. Perform field tests and inspections.

B. Tests and Inspections:

1. Piping Leak Tests for Metal Compressed-Air Piping: Test new and modified parts of existing piping. Cap and fill general-service compressed-air piping with oil-free dry air or gaseous nitrogen to pressure of 50 psig above system operating pressure, but not less than 150 psig. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
2. Repair leaks and retest until no leaks exist.
3. Inspect filters and pressure regulators for proper operation.

C. Prepare test reports.

END OF SECTION 221513

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221519

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

GENERAL-SERVICE PACKAGED AIR COMPRESSORS AND RECEIVERS

ImmuCell

Portland, ME

Reviews / Approvals

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The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

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221519

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
221519	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 221519 - GENERAL-SERVICE PACKAGED AIR COMPRESSORS AND RECEIVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Oil-free, rotary-screw air compressors.
2. Receiver Tanks.
3. Final Filters.
4. Heatless Desiccant compressed-air dryers.
5. Pressure Regulator.
6. Dew Point Monitor.
7. Flow Meter.

1.3 DEFINITIONS

A. Actual Air: Air delivered from air compressors. Flow rate is delivered compressed air measured in acfm.

B. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

C. Standard Air: Free air at 68 deg F and 1 atmosphere (29.92 in. Hg) before compression or expansion and measured in scfm.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design compressed-air equipment mounting, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1. Wiring Diagrams: For power, signal, and control wiring.

B. Delegated-Design Submittal: For compressed-air equipment mounting indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of supports.
2. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.

C. Operation and Maintenance Data: For compressed-air equipment to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASME Compliance: Fabricate and label receivers to comply with ASME Boiler and Pressure Vessel Code.

1.7 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.8 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Air-Compressor, Inlet-Air-Filter Elements: Provide one spare filter set matching the installed filters.

PART 2 - PRODUCTS

2.1 Oil-Free, Rotary-Screw Air Compressors

A. Basis-of-Design Product: Subject to compliance with requirements, provide product Hitachi DSP-37VATN as indicated on Drawings or comparable product by one of the following:

1. Atlas Copco.
2. CompAir, Ltd.
3. Gardner Denver, Inc.
4. Ingersoll-Rand; Air Solutions Group.

B. Compressor(s): Oil-free, rotary-screw type with nonlubricated helical screws and lubricated gear box, and of construction that prohibits oil from entering compression chamber.

1. Air Intake Filter: The dry, paper type air intake filter is a replaceable element type that has a full life efficiency of 98.5% of ISO fine materials at 0.5 microns or larger.
2. Air End Module: The 1st and 2nd stage airend rotors are manufactured from stainless steel (SUS403 Equivalent).

    a. Casing: The cast iron rotor casing incorporates a coolant jacket in order to absorb the heat of compression generated by the airend. The rotor casing is grey cast iron (FC250 ASTM A48 equivalent).
    b. Gears: A pair of precisely finished timing gears is mounted on the ends of the screw rotor shafts. The timing gears are designed to keep a very small gap between the rotors and give them non-contacting rotation. The timing gears are an alloy steel construction (SCM415).
    c. Bearings: The high speed angular contact ball and cylinder bearing system is designed to compensate for the high thrust force generated by the force of the compressed air, the high radial force generated by the centrifugal force of the compressed air and the high speed of the running balls. The bearings are a vacuum degassed steel construction.
    d. Seals:The airend is designed to deliver a continuous flow of oil-free air; therefore a high quality sealing system is required. The precisely grounded low friction high durability carbon + stainless steel holder ring air seals are used to prevent the compressed air from leaking out of the compression chamber. The brass, internal square grooved visco-type seals are used to prevent the oil that lubricates the gears and bearings from entering the compression chamber. The visco-type seals generate a positive pressure to push the oil fumes back to the gear case.

3. Main Motor: High-efficient DCBL (IPM), TE motor.
4. Drive Assembly: The drive assembly shall employ a directly connected motor gear. The motor speed is increased up to the rated level by the step up gears in the gear case. The complete drive assembly is isolation mounted to prevent vibrations from transmitting into the package.
5. Variable Speed Drive: The air compressor employs a variable speed drive DCBL controller. The variable speed drive is designed to reduce or increase the motor speed as the compressed air demand decreases or increases, respectively. When the compressed air demand decreases, the air compressor purges any existing compressed air to atmosphere.
6. Cooling System: The air-cooled two stage air compressor incorporates a cooling system comprised of an intercooler and aftercooler.

    a. Hi-Precooler: The Hi-Pre-cooler is of stainless steel construction. The Hi-Pre-cooler is located between the 2nd stage airend and the aftercooler, and is used for cooling hot compressed air discharged by the airend prior to entering the aftercooler.
    b. Intercooler: The aircooled intercooler is of aluminum construction. The intake air is compressed to 27.5psig and heated by the 1st stage airend. The intercooler cools the heated air to an atmospheric temperature approx. 18-36oF and thereby separates the water vapor from the discharge air before the air flows to the 2nd stage airend.
    c. Aftercooler: The aircooled aftercooler is of aluminum construction. The aftercooler is located downstream the check valve. Its functions are to reduce the discharge air temperature with a CTD (Cold Temperature Difference) of 27oF and Separates the water vapor from the discharged air. The cooler assembly includes TEFC Cooling Fan Motor and fan: this assembly provides a static head allowance of 0.08” water.

7. Check Valve: The stainless steel check valve is located downstream of the 2nd stage airend and prevents the discharge air from flowing back through the air compressor.
8. Motorized Isolation Valve: The Motorized Isolation Valve, or MIV, for discharge air is located at close behind the discharged air outlet, outside of the air compressor package. The design of the MIV is to automatically close the compressed air discharge when the DSP air compressor turns off, in order to protect the internal components of the air compressor from the backflow of condensate.
9. Oil Lubrication System: The lubrication subsystem consists of the oil pump, the oil strainer, the oil filter, the air-cooled oil cooler, and the oil relief valve.

    a. Oil Filter: The cooling system is filtered by a $\beta 5(c) = 200$ (ISO16889) oil filter, before the oil is injected onto the bearings and gears for lubrication.
    b. Oil Pressure Adjustment Valve: A valve is supplied to adjust the oil pressure range of the oil lubrication system.

10. Air Relief Valve: A pressure relief valve is provided to prevent system over-pressure 138 psi.
11. Oil Mist Remover: The 99.99% efficient oil mist remover incorporates an ejector that uses the compressed air to generate a vacuum pressure, which maintains a negative pressure on the oil mist remover subsystem. This prevents the gear case internal pressure from rising due to a resistance of the element.
12. Enclosure: The air compressor shall have a complete sheet metal enclosure with bolts that can be easily removed for servicing. The front panel includes latches for easy access to common maintenance items.
13. Vibration Isolation: Vibration isolation rubbers are supplied under the gear case, motor etc to dampen pressure pulsations during operation.
14. Control Panel: The air compressor package includes an UL 508A control panel integrally mounted variable speed drive. This control panel is contained in a separate enclosure and includes the control circuit transformer, as well as the cooling fan motor starter and its branch circuit protection. The control panel shall be mounted, wired and tested as part of the complete air compressor package prior to shipment. Panel shall be NEMA 1 enclosure.
15. Instrument Panel: The air compressor shall include a micro-processing based system to provide starting logic, capacity control, operating control, and safety control of the air compressor. Automatic starting and stopping of air compressor, based on system needs, shall be provided. All control functions shall be managed and displayed from a liquid crystal display (LCD) control panel or a digital monitor. This microprocessor panel should be capable of providing information and adjustments to an operator or technician so that they may safely and intelligently initialize, adjust, and review the operating parameters of the air compressor.

C. Capacities and Characteristics: As indicated on drawings.

2.2 RECIEVER TANKS

A. Receiver (Wet Tank): ASME construction steel tank.

1. Arrangement: Vertical.
2. Capacity: 200 Gallons.
3. Interior Finish: Epoxy coating.

4. Pressure Rating: 150 psig.
5. Pressure Regulator Setting: 100 psig.
6. Pressure Storage Setting: 125 psig.
7. Pressure Relief Valve Setting: 138 psig.
8. Drain: Manual valve.

B. Receiver (Dry Tank): ASME construction steel tank.

1. Arrangement: Vertical.
2. Capacity: 400 Gallons.
3. Interior Finish: Epoxy coating.
4. Pressure Rating: 200 psig.
5. Pressure Regulator Setting: 100 psig.
6. Pressure Storage Setting: 125 psig.
7. Pressure Relief Valve Setting: 138 psig.
8. Drain: Manual valve.

2.3 FINAL FILTERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide S ullair FXH-240 (Air Filter) and FXC-240 (Carbon Filter) or comparable product:

1. Air filter: Ultra Filter, .01 Micron filtration, internals are anodized aluminum and dry powder epoxy coated for full corrosion protection. Integral differential pressure indicator included.
2. Carbon Filter: Activated carbon media to remove lubricant and hydrocarbon odors. Vapor content shall be less then .003ppm after filter. Internals are anodized aluminum and dry powder epoxy coated for full corrosion protection. Integral differential pressure indicator included.
3. Connection Size: 1-1/2”
4. Max scfm: 240
5. Max Operating Pressure: 290 psig
6. Max Operating Temp: 176 deg F
7. Minimum Operating Temp: 36 deg F

2.4 HEATLESS DESICCANT COMPRESSED-AIR DRYERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product SPX HHS-165 or comparable product by one of the following:

1. Air/Tak, Inc.
2. Domnick Hunter Limited; ZANDER, Inc.
3. Donaldson Company, Inc.; Donaldson Ultrafilter Co.
4. Hankison International.
5. Ingersoll-Rand; Air Solutions Group.
6. Van Air Systems, Inc.

B. Description: Twin-tower unit with purge system, mufflers, and capability to deliver air at -40 deg F dew point. Include dew point controlled purge, step-down transformers; disconnect switches, inlet and outlet pressure gages, thermometers, automatic controls, and filters.

C. Capacities and Characteristics:

1. Standard-Air Capacity of Each Compressed-Air Dryer: 165 scfm free air.
2. Maximum Working Pressure: 150 psig
3. Minimum Working Pressure: 60 psig
4. Leaving-Air Dew Point Temperature: -40 deg F.
5. Ambient-Air Temperature: 80-90 deg F.
6. Maximum Ambient Air Temp: 120 deg F
7. Maximum Air-Pressure Drop: Less than 5 psig.
8. Inlet Filter: .01 Micron .
9. Outlet Filter: 1 Mircron dust filter.
10. Electrical Characteristics:

    a. Volts: 120V
    b. Phase(s): Single.
    c. Hertz: 60 Hz.

2.5 PRESSURE REGULATOR

A. Basis-of-Design Product: Subject to compliance with requirements, provide S ullair SLF-250 flow pressure controller or comparable product.

1. Provide pressure controller with bypass option.
2. Connection Size: 1-1/2”
3. Max scfm: 250
4. Max Operating Pressure: 200 psig.
5. Max Operating Temp: 125 deg F

2.6 DEWPOINT MONITOR

A. Basis-of-Design Product: Subject to compliance with requirements, provide Metpoint DD081 dew point monitor or comparable product.

1. Dewpoint measurement utilizing capactive polymer sensors for accuracies within 0.9 deg F
2. One 4-20mA digital sensor input and 2 Relay alarms
3. Operating Temps: 14-140 deg F.
4. Electrical Characteristics:

    a. Volts: 110V
    b. Phase(s): Single.
    c. Hertz: 60 Hz.

2.7 FLOW METER

A. Basis-of-Design Product: Subject to compliance with requirements, provide CDI 5200 flow meter or comparable product.

1. Meter clamps onto pipe with two flow sensing probes projecting into the pipe through a 3/16 inch drilled holes. Seals directly to the pipe.
2. Meter measure flow by maintaining one prob warmer than the other.
3. Flow rate is displayed on a large 4 digit displat with a 4-20 mA output for BAS interface.
4. Accuracy: 5 percent of reading plus 1 percent of range for flows from 10 percent to 100 percent of indicated range at air temperatures between 20 and 120 degrees Fahrenheit
5. Range: 300 scfm in a 1-1/2” pipe.
6. Electrical Characteristics: 24V

2.8 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 22 Section "Common Motor Requirements for Plumbing Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Equipment Mounting: Install air compressors and air dryers on concrete bases using elastomeric mounts. Comply with requirements in Division 03 Section "Cast-in-Place Concrete."

1. Minimum Deflection: 1/4 inch.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.

B. Install compressed-air equipment anchored to substrate.

C. Arrange equipment so controls and devices are accessible for servicing.

D. Maintain manufacturer's recommended clearances for service and maintenance.

E. Install the following devices on compressed-air equipment:

1. Thermometer, Pressure Gage, and Safety Valve: Install on each compressed-air receiver.
2. Pressure Regulators: Install downstream from air compressors and dryers.
3. Automatic Drain Valves: Install on aftercoolers, receivers, and dryers. Discharge condensate over nearest floor drain.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Division 22 Section "General-Service Compressed-Air Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

3.3 IDENTIFICATION

A. Identify general-service air compressors and components. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check for lubricating oil in lubricated-type equipment.
3. Verify that air-compressor inlet filters and piping are clear.
4. Check for equipment vibration-control supports and flexible pipe connectors and verify that equipment is properly attached to substrate.
5. Check safety valves for correct settings. Ensure that settings are higher than air-compressor discharge pressure but not higher than rating of system components.
6. Drain receiver tanks.
7. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
8. Test and adjust controls and safeties.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air compressors and air dryers.

END OF SECTION 221519

CONFIDENTIAL DOCUMENT

223500

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

DOMESTIC WATER HEAT EXCHANGERS

ImmuCell
Portland, ME

Reviews / Approvals

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The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

223500

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
223500	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 223500 - DOMESTIC WATER HEAT EXCHANGERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following heat exchangers:

1. Heating-fluid-in-coil, instantaneous heat exchangers.
2. Compression tanks.
3. Heat-exchanger accessories.

1.3 SUBMITTALS

A. Product Data: For each type and size of heat exchanger indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Product Certificates: For each type of instantaneous circulating heat exchanger, signed by product manufacturer.

D. Source quality-control test reports.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For heat exchangers to include in emergency, operation, and maintenance manuals.

G. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain same type of heat exchangers through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of heat exchangers and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. ASME Compliance: Where ASME-code construction is indicated, fabricate and label heat-exchanger storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

E. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9" for all components that will be in contact with water.

1.5 COORDINATION

A. Coordinate size and location of concrete bases with Architectural and Structural Drawings.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of heat exchangers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including heat exchanger, storage tank, and supports.
b. Faulty operation of controls.
c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Period(s): From date of Substantial Completion:

a. Instantaneous Heat Exchangers:

1) Tube Coil and Shell: 3 year(s).
2) Controls and Other Components: One year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 INSTANTANEOUS HEAT EXCHANGERS

A. Heating-Fluid-in-Coil, Instantaneous Heat Exchangers:

1. Available Manufacturers:

    a. AERCO International, Inc.
    b. Patterson Kelly
    c. Cemline

2. Description: Packaged assembly of tank, heat-exchanger coils, controls, and specialties for heating domestic water with steam in heat-exchanger coils.
3. Construction: Water heater shall be constructed in accordance with ASME Code for working pressure of 150 psig. The packaged water heater shall be constructed with a vertical 316 stainless steel tank, with stainless threaded opening, ½" O.D. 316 Stainless Steel tubes, copper lined tub sheet, and steel coil head.

    a. Tappings: Factory fabricated of materials compatible with heat-exchanger shell. Attach tappings to shell before testing and labeling.

        1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
        2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.

    b. Insulation: Complying with ASHRAE/IESNA 90.1. Heater shall be insulated with foam in place insulation protected by an enameled metal jacket, 20 gauge minimum thickness.
    c. Heat-Exchanger Coils: Stainless-steel, helix-wound coils for heating fluid with pressure rating equal to or greater than heating-fluid supply pressure.
    d. Temperature Control: Adjustable thermostat that operates control valve and that is capable of maintaining outlet-water temperature within 4 deg F of setting.
    e. Safety Control: Automatic, high-temperature-limit cutoff device or system.
    f. Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3, for combination temperature and pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of heat exchanger. Select one relief valve with sensing element that extends into storage tank.

4. Miscellaneous Components for Steam Unit: Strainers, electric actuated steam-control valve, steam trap, valves, pressure gage, thermometer, circulator pump, and piping.
5. Stand: Factory fabricated for floor mounting.

6. Controller: Heater shall be supplied with solid-state control module with LED backlit LCD display and LED pilot lights to indicate on-off primary high limit, and secondary high limit. Solid-state control module shall be provided with a field programmable digital electronic PID controller allowing the owner to set operating and temperature limits on the display screen. Solid-state control module shall have red alarm light and alarm horn with built in alarm silence relay. Solid-state control module shall be supplied with dry contact closure outputs to indicate to building automation system (BAS) the occurrence of power on, primary high temperature, and secondary high temperature. The control module shall allow the BAS to turn the heater on or off through a remote relay suitable for 24 VAC, 1 amp. The control module shall allow the BAS to remotely set the temperature of the heater using a 4-20 mA input signal. The control module shall allow the BAS to remotely monitor the operating temperature. Control module shall be supplied with an on-off switch and shall be mounted in a NEMA 4 panel. All solenoids and limits shall be 24 VAC.
7. Capacity and Characteristics: As indicated on drawings

2.3 COMPRESSION TANKS

A. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.

1. Available Manufacturers:

   a. AMTROL Inc.
   b. Armstrong Pumps, Inc.
   c. Flexcon Industries.
   d. Honeywell Sparco.
   e. Myers, F. E.; Pentair Pump Group (The).
   f. Smith, A. O.; Aqua-Air Div.
   g. State Industries, Inc.
   h. Taco, Inc.
   i. Watts Regulator Co.
   j. Wessels Co.

2. Construction:

   a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
   b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
   c. Air-Charging Valve: Factory installed.

3. Capacity and Characteristics:

   a. Working-Pressure Rating: 150 psig.
   b. Capacity Acceptable: 10 gal. minimum.
   c. Air Precharge Pressure:.

2.4 HEAT-EXCHANGER ACCESSORIES

A. Combination Temperature and Pressure Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3. Include relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of heat exchanger. Select relief valves with sensing element that extends into heat-exchanger storage tank.

B. Pressure Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3. Include pressure setting less than working-pressure rating of heat exchanger.

C. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2.

D. Optional vacuum breaker shall be provided.

2.5 SOURCE QUALITY CONTROL

A. Test and inspect heat-exchanger storage tanks, specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test commercial heat-exchanger storage tanks before shipment to minimum of one and one-half times pressure rating.

C. Prepare test reports.

PART 3 - EXECUTION

3.1 HEAT-EXCHANGER INSTALLATION

A. Install heat exchangers on concrete bases.

1. Concrete base construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Install heat exchangers level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

C. Anchor heat exchangers to substrate.

D. Install temperature and pressure relief valves in top portion of storage tank shells of heat exchangers with domestic water storage. Use relief valves with sensing elements that extend into shells. Extend relief-valve outlet, with drain piping same as water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

E. Install heat-exchanger drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for heat exchangers that do not have tank drains. Refer to Division 22 Section "Domestic Water Piping Specialties" for hose-end drain valves.

F. Install thermometer on each heat-exchanger domestic-water inlet and outlet piping, and install thermometer on each heat-exchanger heating-fluid inlet and outlet piping. Refer to Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.

G. Install pressure gages on heat-exchanger heating-fluid piping. Refer to Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages.

H. Fill heat exchangers with water.

I. Charge compression tanks with air.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to heat exchangers to allow service and maintenance. Arrange piping for easy removal of heat exchangers.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, confirm proper operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace heat exchangers that do not pass tests and inspections and retest as specified above.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain heat exchangers. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 223500

CONFIDENTIAL DOCUMENT

224000

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

PLUMBING FIXTURES

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

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224000

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Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
224000	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 224000 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following conventional plumbing fixtures and related components:

1. Faucets for lavatories and sinks.
2. Flushometers.
3. Toilet seats.
4. Fixture supports.
5. Water closets.
6. Urinals.
7. Lavatories.
8. Kitchen sinks.
9. Service sinks.
10. Electric Water Cooler

B. Related Sections include the following:

1. Division 10 Section "Toilet Accessories."
2. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.
3. Division 22 Section "Emergency Plumbing Fixtures."

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.

D. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.

E. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

F. FRP: Fiberglass-reinforced plastic.

G. PMMA: Polymethyl methacrylate (acrylic) plastic.

H. PVC: Polyvinyl chloride plastic.

I. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.4 SUBMITTALS

A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.

B. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.

C. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.

1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities" for plumbing fixtures for people with disabilities.

D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:

1. Plastic Mop-Service Basins: ANSI Z124.6.
2. Stainless-Steel Residential Sinks: ASME A112.19.3.

3. Vitreous-China Fixtures: ASME A112.19.2M.
4. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
5. Water-Closet, Flushometer Tank Trim: ASSE 1037.

H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:

1. Faucets: ASME A112.18.1.
2. Hose-Connection Vacuum Breakers: ASSE 1011.
3. Hose-Coupling Threads: ASME B1.20.7.
4. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
5. NSF Potable-Water Materials: NSF 61.
6. Pipe Threads: ASME B1.20.1.
7. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
8. Supply Fittings: ASME A112.18.1.
9. Brass Waste Fittings: ASME A112.18.2.

I. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:

1. Atmospheric Vacuum Breakers: ASSE 1001.
2. Brass and Copper Supplies: ASME A112.18.1.
3. Plastic Tubular Fittings: ASTM F 409.
4. Brass Waste Fittings: ASME A112.18.2.
5. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.

J. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Flexible Water Connectors: ASME A112.18.6.
2. Floor Drains: ASME A112.6.3.
3. Hose-Coupling Threads: ASME B1.20.7.
4. Off-Floor Fixture Supports: ASME A112.6.1M.
5. Pipe Threads: ASME B1.20.1.
6. Plastic Toilet Seats: ANSI Z124.5.

1.6 WARRANTY

A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace components of whirlpools that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures of unit shell.
b. Faulty operation of controls, blowers, pumps, heaters, and timers.
c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Period for Commercial Applications: One year from date of Substantial Completion.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Faucet Washers and O-Rings: Equal to 25 percent of amount of each type and size installed.
2. Faucet Cartridges and O-Rings: Equal to **25**percent of amount of each type and size installed.
3. Flushometer Valve, Repair Kits: Equal to 2**5** percent of amount of each type installed, but no fewer than 1of each type.

PART 2 - PRODUCTS

2.1 LAVATORY FAUCETS

A. Lavatory Faucets:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

a. American Standard Companies, Inc.
b. Bradley Corporation.
c. Delta Faucet Company.
d. Eljer.
e. Elkay Manufacturing Co.
f. Fisher Manufacturing Co.
g. Just Manufacturing Company.
h. Kohler Co.
i. Moen, Inc.

2. Description: Single-control mixing valve. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.

a. Body Material: Commercial, solid brass.
b. Finish: Polished chrome plate.
c. Maximum Flow Rate: 1.5 gpm.
d. Centers: 4 inches, Single hole with trim plate.
e. Mounting: Deck, exposed
f. Valve Handle(s): Not applicable.
g. Inlet(s): NPS 1/2.
h. Spout: Rigid type.
i. Spout Outlet: Plain end, 0.5 gpm.
j. Operation: Sensor.
k. Drain: Grid.
l. Tempering Device: BDT Below Deck Thermostatic Mixing Valve.

2.2 SINK FAUCETS

A. Sink Faucets:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

    a. American Standard Companies, Inc.
    b. Bradley Corporation.
    c. Delta Faucet Company.
    d. Eljer.
    e. Elkay Manufacturing Co.
    f. Fisher Manufacturing Co.
    g. Kohler Co.
    h. Moen, Inc.
    i. T & S Brass and Bronze Works, Inc.
    j. Zurn Plumbing Products Group; Commercial Brass Operation.

2. Description: Service sink faucet with stops in shanks**,** Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.

    a. Body Material: General-duty, solid brass or copper .
    b. Finish: Polished chrome plate.
    c. Maximum Flow Rate: 2.5 gpm, unless otherwise indicated.
    d. Mixing Valve: Two-lever handle.
    e. Centers: 8 inches.
    f. Mounting: Back/wall, exposed.
    g. Handle(s): Lever.
    h. Inlet(s): NPS 1/2 male shank.
    i. Spout Type: Swivel gooseneck.
    j. Spout Outlet: ¾” Hose thread.
    k. Vacuum Breaker: Required.
    l. Operation: Compression, manual.
    m. Integral Check Valves: Required.
    n. Pail Hook: Required

3. Description: Kitchen sink faucet with stops in shanks**,** Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.

    a. Body Material: General-duty, solid brass or copper.
    b. Finish: Polished chrome plate.
    c. Maximum Flow Rate: 1.5 gpm.
    d. Mixing Valve: Two lever handle.
    e. Backflow Protection Device for Hose Outlet: Not required.
    f. Backflow Protection Device for Side Spray: Not Required.
    g. Centers: 8 inches
    h. Holes: 3
    i. Spout Type: Swivel gooseneck.
    j. Mounting: Deck, exposed.

k. Handle(s): 4” wristblades.
l. Inlet(s): NPS 1/2 male shank.
m. Spout Type: Rigid, solid brass.
n. Spout Outlet: Aerator.
o. Vacuum Breaker: Not Required.

2.3 FLUSHOMETERS

A. Flushometers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

a. Coyne & Delany Co.
b. Delta Faucet Company.
c. Sloan Valve Company.
d. Zurn Plumbing Products Group; Commercial Brass Operation.

2. Description: Flushometer for water-closet-type fixture. Include brass body with corrosion-resistant internal components control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.

a. Internal Design: Diaphragm or piston operation.
b. Style: Exposed Valve and recessed sensor.
c. Inlet Size: NPS 1-1/2”.
d. Trip Mechanism: Hard wired, sensor actuator.
e. Consumption: 1.28 gal./flush.
f. Trap: 3” integral.

3. Description: Flushometer for urinal type fixture. Include brass body with corrosion-resistant internal components control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.

a. Internal Design: Diaphragm or piston operation.
b. Style: Exposed valve and recessed sensor.
c. Inlet Size: NPS ¾”.
d. Trip Mechanism: Battery-operated sensor actuator.
e. Consumption: 0.125 gal./flush.
f. Trap: 2” integral.

2.4 TOILET SEATS

A. Toilet Seats:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. American Standard Companies, Inc.

b. Bemis Manufacturing Company.
c. Centoco Manufacturing Corp.
d. Church Seats.
e. Eljer.
f. Kohler Co.
g. Olsonite Corp.
h. Sanderson Plumbing Products, Inc.; Beneke Div.
i. Sperzel.

2. Description: Toilet seat for water-closet-type fixture.

a. Material: Molded, solid plastic with antimicrobial agent.
b. Configuration: Open front without cover.
c. Size: Elongated.
d. Hinge Type: CK, check.
e. Class: Standard commercial.
f. Color: White.

2.5 FIXTURE SUPPORTS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Josam Company.
2. MIFAB Manufacturing Inc.
3. Smith, Jay R. Mfg. Co.
4. Tyler Pipe; Wade Div.
5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
6. Zurn Plumbing Products Group; Specification Drainage Operation.

C. Water-Closet Supports:

1. Description: Combination carrier designed for accessible mounting height of wall-mounting, water-closet-type fixture. Include single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement; faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

D. Urinal Supports:

1. Description: Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture for wall-mounting, urinal-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

E. Lavatory Supports:

1. Description: Type II, lavatory carrier with concealed arms and tie rod] for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

F. Sink Supports:

1. Description: Deck mounted.

2.6 WATER CLOSETS

A. Water Closets:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

a. American Standard Companies, Inc.
b. Briggs Plumbing Products, Inc.
c. Capizzi.
d. Crane Plumbing, L.L.C./Fiat Products.
e. Eljer.
f. Kohler Co.
g. St. Thomas Creations.
h. TOTO USA, Inc.
i. Sloan

2. Description Accessible, wall-mounting, back-outlet, vitreous-china fixture designed for flushometer valve operation.

a. Style: Flushometer valve.

1) Bowl Type: Elongated design.
2) Design Consumption: 1.28 gal/flush.
3) Color: White.

2.7 URINALS

A. Urinals:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

a. American Standard Companies, Inc.
b. Briggs Plumbing Products, Inc.
c. Crane Plumbing, L.L.C./Fiat Products.
d. Eljer.
e. Kohler Co.
f. Mansfield Plumbing Products, Inc.
g. Peerless Pottery, Inc.

h. St. Thomas Creations.
i. TOTO USA, Inc.
j. Sloan

2. Description Accessible, wall-mounting, bottom-outlet, vitreous-china fixture designed for flushometer valve operation.

a. Type: Washout.
b. Strainer or Trapway: Separate removable strainer.
c. Design Consumption: 0.125 gal./flush.
d. Color: White.
e. Supply Spud Size: NPS 3/4.
f. Outlet Size: NPS 2".
g. Drain Piping: 2" internal trap

2.8 LAVATORIES

A. Lavatories:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

a. American Standard Companies, Inc.
b. Barclay Products, Ltd.
c. Briggs Plumbing Products, Inc.
d. Crane Plumbing, L.L.C./Fiat Products.
e. Eljer.
f. Gerber Plumbing Fixtures LLC.
g. Kohler Co.
h. Mansfield Plumbing Products, Inc.
i. Peerless Pottery, Inc.
j. Sterling Plumbing Group, Inc.
k. St. Thomas Creations.
l. TOTO USA, Inc.

2. Description: Wall-and-pedestal-mounting, vitreous-china fixture.

a. Type: Pedestal.
b. Size: 18 by 15 inches rectangular.
c. Faucet Hole Punching: 3 hole 4" on center.
d. Faucet Hole Location: Top.
e. Pedestal: Required.
f. Color: White.
g. Faucet: Lavatory Sensor.
h. Supplies: NPS 3/8 chrome-plated copper with stops.
i. Drain Piping: Schedule 40 PVCNPS 1-1/4 P-trap; NPS 1-1/4, tubular waste to wall; and wall escutcheon.

2.9 KITCHEN SINKS

A. Kitchen Sinks:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

    a. Eljer.
    b. Kohler Co.
    c. American Standard Companies, Inc.
    d. Mansfield Plumbing Products, Inc.
    e. Dayton Products, Inc.
    f. Elkay Manufacturing Co.
    g. Just Manufacturing Company.

2. Description: residential, counter-mounting, stainless-steel kitchen sink.

    a. Overall Dimensions: As shown on drawings
    b. Metal Thickness: 18 gauge
    c. Bowl: 1 or 2 basins as indicated on drawings
    d. Sink Faucet: as indicated on drawings

        1) Chrome finish with 4” wrist blade handle and 8” faucet holes. 1.5 GPM.
        2) Provide faucet with side sprayer.

    e. Supplies: NPS 1/2 chrome-plated copper with stops.
    f. Drain Piping: Schedule 40 PVC NPS 1-1/2 P-trap; tubular waste to wall; and wall escutcheon(s).
    g. Dishwasher Air-Gap Fitting: Required.

2.10 MOP SERVICE BASIN

A. Service Basin.

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

    a. American Standard Companies, Inc.
    b. Commercial Enameling Company.
    c. Eljer.
    d. Kohler Co.

2. Description: Floor-mounting, molded stone with 10” high walls not less than 1” wide.

    a. Size: 36 by 24 inches
    b. Color: White
    c. Service Faucet: Required
    d. Drain: 3” stainless steel drain body
    e. Hose Bracket: Required
    f. Mop Hanger: Required

2.11 ELECTRIC WATER COOLER

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

    a. American Standard Companies, Inc.
    b. Eljer.
    c. Kohler Co.
    d. Elkay

2. Description: Bi-level electric water cooler with bottle filling station.

    a. Vandal resistant push button
    b. Stainless steel with integral drain
    c. Stainless steel bottle filler construction.
    d. Vandal resistant bubbler is one piece.
    e. Meets ADA Requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.

B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.

1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.

C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.

D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

E. Install wall-mounting fixtures with tubular waste piping attached to supports.

F. Install floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.

G. Install fixtures level and plumb according to roughing-in drawings.

H. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

1. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

I. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

J. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.

K. Install toilet seats on water closets.

L. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

M. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.

N. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

O. Install traps on fixture outlets.

1. Exception: Omit trap on fixtures with integral traps.

P. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."

Q. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

3.4 FIELD QUALITY CONTROL

A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.

B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

E. Install fresh batteries in sensor-operated mechanisms.

3.5 ADJUSTING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.

C. Replace washers and seals of leaking and dripping faucets and stops.

D. Install fresh batteries in sensor-operated mechanisms.

3.6 CLEANING

A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:

1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
2. Remove sediment and debris from drains.

B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.7 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224000

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224500

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

EMERGENCY PLUMBING FIXTURES

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

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ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
224500	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 224500 - EMERGENCY PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following emergency plumbing fixtures:

1. Combination units.

B. Related Sections include the following:

1. Division 22 Section "Sanitary and Process Waste Piping Specialties" for floor drains.

1.3 DEFINITIONS

A. Accessible Fixture: Emergency plumbing fixture that can be approached, entered, and used by people with disabilities.

B. Plumbed Emergency Plumbing Fixture: Fixture with fixed, potable-water supply.

C. Self-Contained Emergency Plumbing Fixture: Fixture with flushing-fluid-solution supply.

D. Tepid: Moderately warm.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include flow rates and capacities, furnished specialties, and accessories.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Product Certificates: Submit certificates of performance testing specified in "Source Quality Control" Article.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For emergency plumbing fixtures to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. ANSI Standard: Comply with ANSI Z358.1, "Emergency Eyewash and Shower Equipment."

B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities" for plumbing fixtures for people with disabilities.

C. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

PART 2 - PRODUCTS

2.1 COMBINATION UNITS

A. Combination Units:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Haws, Model 8300-8309 or a comparable product by one of the following:

a. Bradley Corporation.
b. Guardian Equipment Co.
c. Speakman Company.

2. Description: Plumbed, accessible, freestanding, with emergency shower and eyewash equipment.

a. Piping: Galvanized steel

1) Unit Supply: NPS 1-1/4 minimum from side.
2) Unit Drain: Outlet at side near bottom.
3) Shower Supply: NPS 1 with flow regulator and stay-open control valve.
4) Eyewash Supply: NPS 1/2 with flow regulator and stay-open control valve.

b. Shower Capacity: Deliver potable water at rate not less than 20 gpm for at least 15 minutes.

1) Control-Valve Actuator: Pull rod.
2) Shower Head: 8-inch minimum diameter, chrome-plated brass.

c. Eyewash Equipment: With capacity to deliver potable water at rate not less than 0.4 gpm for at least 15 minutes.

1) Control-Valve Actuator: Paddle.
2) Receptor: Stainless-steel bowl.

d. Features

1) High visibility safety green and bright yellow stripes
2) High visibility universal safety sign.

2.2 SOURCE QUALITY CONTROL

A. Certify performance of plumbed emergency plumbing fixtures by independent testing agency acceptable to authorities having jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water piping systems to verify actual locations of piping connections before plumbed emergency plumbing fixture installation.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EMERGENCY PLUMBING FIXTURE INSTALLATION

A. Assemble emergency plumbing fixture piping, fittings, control valves, and other components.

B. Install fixtures level and plumb.

C. Fasten fixtures to substrate.

D. Install shutoff valves in water-supply piping to fixtures. Use ball, gate, or globe valve if specific type valve is not indicated. Install valves chained or locked in open position if permitted. Install valves in locations where they can easily be reached for operation. Valves are specified in Division 22 Section "General Duty Valves for Plumbing Piping."

1. Exception: Omit shutoff valve on supply to group of plumbing fixtures that includes emergency plumbing fixture.
2. Exception: Omit shutoff valve on supply to emergency equipment if prohibited by authorities having jurisdiction.

E. Install dielectric fitting in supply piping to fixture if piping and fixture connections are made of different metals. Dielectric fittings are specified in Division 22 Section "Common Work Results for Plumbing."

F. Install indirect waste piping to wall on drain outlet of fixture receptors that are indicated to be indirectly connected to drainage system. Drainage piping is specified in Division 22 Section "Sanitary and Process Waste and Vent Piping."

G. Install escutcheons on piping wall and ceiling penetrations in exposed, finished locations. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."

H. Install equipment nameplates or equipment markers on fixtures and equipment signs on water-tempering equipment. Identification materials are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect cold-water-supply piping to plumbed emergency plumbing fixtures not having water-tempering equipment.

C. Indirectly connect emergency plumbing fixture receptors without trapped drain outlet to sanitary or storm drainage piping.

3.4 FIELD QUALITY CONTROL

A. Mechanical-Component Testing: After plumbing connections have been made, test for compliance with requirements. Verify ability to achieve indicated capacities and temperatures.

B. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.

C. Report test results in writing.

3.5 ADJUSTING

A. Adjust or replace fixture flow regulators for proper flow.

B. Adjust equipment temperature settings.

END OF SECTION 224500

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ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

COMMON WORK RESULTS FOR HVAC

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

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ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

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0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
230500	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Mechanical sleeve seals.
3. Sleeves.
4. Escutcheons.
5. Grout.
6. Equipment installation requirements common to equipment sections.
7. Painting and finishing.
8. Concrete bases.
9. Supports and anchorages.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. CPVC: Chlorinated polyvinyl chloride plastic.
2. PE: Polyethylene plastic.
3. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Dielectric fittings.
2. Mechanical sleeve seals.
3. Escutcheons.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 23 piping Sections for pipe, tube, fitting materials, and joining methods.

2.4 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

1. Available Manufacturers:

a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Eclipse, Inc.
d. Epco Sales, Inc.
e. Hart Industries, International, Inc.

f. Watts Industries, Inc.; Water Products Div.
g. Zurn Industries, Inc.; Wilkins Div.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150 psig minimum working pressure as required to suit system pressures.

1. Available Manufacturers:

a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Epco Sales, Inc.
d. Watts Industries, Inc.; Water Products Div.

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Available Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.

2. Separate companion flanges and steel bolts and nuts shall have 150 psig minimum working pressure where required to suit system pressures.

F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

1. Available Manufacturers:

a. Calpico, Inc.
b. Lochinvar Corp.

G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

1. Available Manufacturers:

a. Perfection Corp.
b. Precision Plumbing Products, Inc.
c. Sioux Chief Manufacturing Co., Inc.
d. Victaulic Co. of America.

2.5 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Available Manufacturers:

    a. Advance Products & Systems, Inc.
    b. Calpico, Inc.
    c. Metraflex Co.
    d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Plastic. Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating or stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.6 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

    1. Underdeck Clamp: Clamping ring with set screws.

E. PVC Pipe: ASTM D 1785, Schedule 40.

2.7 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.

    1. Finish: Polished chrome-plated.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

    1. Finish: Polished chrome-plated.

E. One-Piece, Floor-Plate Type: Cast-iron floor plate.

2.8 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.

c. Insulated Piping: One-piece, stamped-steel type with spring clips.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece cast-brass type with polished chrome-plated finish.
f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
g. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

M. Sleeves are not required for core-drilled holes.

N. Permanent sleeves are not required for holes formed by removable PE sleeves.

O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.

1) Seal space outside of sleeve fittings with grout.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.

3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

T. Verify final equipment locations for roughing-in.

U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
4. PVC Nonpressure Piping: Join according to ASTM D 2855.

3.3 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.5 PAINTING

A. Painting of HVAC systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 6 inches larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 4,000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section “Cast-in-Place Concrete”

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.8 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.9 GROUTING

A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 230500

CONFIDENTIAL DOCUMENT

230501

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

CLEAN STEAM GENERATORS

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
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ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

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ImmuCell

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Design Specification

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Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
230501	0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Data Sheets

Data Sheet Number	Rev. Level	Revision Date	Revision Description
CSG-1	0	8/19/2016	Clean Steam Generator
VDR	0	8/19/2016	VDR and Inspection Checklist

Section 230501 - CLEAN STEAM GENERATORS

PART 1 - GENERAL

1.1 SUMMARY

A. This specification describes the requirements for design, materials, and fabrication of clean steam generators.

B. Data sheets are attached to define requirements for clean steam generators to be purchased.

1.2 SCOPE

A. Work Included

1. The clean steam generators and appurtenances, as noted in this specification and data sheets.

B. Work Not Included

1. External supports, gaskets, and hardware for external piping connections.

1.3 RELATED DOCUMENTS

A. 400513_19 Stainless Steel Process Piping,

B. 400513 Common Work Results for Process Piping,

C. 400529 Hangers and Supports for Process Piping,

D. 404200 Process Piping and Equipment Insulation.

1.4 QUALITY ASSURANCE

A. Pressure vessels included with the clean steam generators shall be designed and constructed in accordance with this specification and the requirements of the ASME Boiler & Pressure Vessel Code, Section VIII, Division 1, stamped with the ASME “U” or “UM” symbol, and registered with the National Board.

B. Clean steam generators shall comply with the requirements of ASME BPE and cGMP/FDA, and USP guidelines for Water -For-Injection (WFI).

C. All welding procedures and weld operators shall be certified in accordance with ASME Code, Section IX.

D. Nondestructive examination procedures shall conform to the requirements of ASME Code, Section V.

E. O-rings and gaskets in sanitary services must be fabricated from FDA-acceptable, USP Class VI material.

F. The Seller shall be responsible for the proper operation and performance of the clean steam generators during the warranty period, as indicated in the purchase documents.

G. Control panel shall be UL-approved.

1.5 SUBMITTALS

A. Seller shall provide all necessary documentation to support equipment/system validation in accordance with the attached "Drawings and Data Requirements" form.

B. Any deviations from the specifications and data sheets must be specifically addressed in the Seller's proposal under a heading of Exceptions and Clarifications.

C. After drawings and data have been approved by the Buyer, any modifications by the Seller will require the Buyer's prior approval before implementation.

1.6 DEFINITIONS

A. ASTM: American Society for Testing and Materials

B. ASME: American Society of Mechanical Engineers.

C. ASME BPE: ASME Bioprocessing Equipment Standard.

D. cGMP/FDA: Current Good Manufacturing Practices of the Food and Drug Administration, United States Department of Health and Human Services.

E. IBC: International Building Code of the International Code Council (ICC).

F. OSHA: Occupational Safety and Health Act.

G. PLC: Programmable Logic Controller

H. UL: Underwriters Laboratories.

I. USP: United States Pharmacopoeia.

PART 2 - PRODUCTS

2.1 GENERAL

A. The unit shall produce clean steam, such that when condensed, the subsequent condensate shall meet the most current standards of the USP guidelines for Water-For-Injection (WFI) when condensed. The generator shall produce this quality steam when supplied with the quality of feedwater as noted in the data sheets

B. The unit shall be fully assembled, prewired, prepiped, and mounted on a skid.

C. A clean steam condensate sample system shall be provided which continuously monitors the clean steam conductivity. The unit shall automatically shut down when the conductivity rises above the setpoint as noted in the data sheets.

D. The clean steam generator shall be fully drainable.

E. Seller shall include a feedwater booster pump system. The system shall be completely assembled including the motor starter, disconnect, overload protection, piping, valving, gauges, controls, and wiring for automatic operation. The pump shall either be located on the generator's skid or adjacent to the generator on its own skid.

F. A bottle of touch up paint shall be provided with the equipment.

G. Piping

1. All process and critical utility piping connections, and isolation valves shall be installed to minimize deadlegs. Refer to the ASME BPE Standards for deadleg limitations. If the Seller cannot achieve the minimum distances, they shall seek Buyer's approval. Seller shall state any exceptions to this requirement in the proposal.
2. Install clamps, unions or flanges at equipment connections to allow complete removal of the components without cutting the pipe.
3. Threaded connections are not permitted for components in contact with feedwater, steam or distillate.
4. Manual shut-off valves and pressure indicators shall be provided for plant steam, feedwater, cooling water supply and return, and control air lines. Temperature indicators shall be provided for feedwater, cooling water supply and return and drain lines.
5. Relief valves shall be provided on the generator as required by applicable pressure vessel codes.
6. Diaphragm valves, with the same material of construction and surface finish as their respective piping, shall be provided on all lines in contact with feedwater.
7. High point vents and low point drains shall be furnished to allow for complete drainage of the piping and equipment.

H. Insulation

1. A protective coating shall be applied to stainless steel surfaces exposed to insulation.
2. Seller shall furnish the Certificate of Compliance (CC) and the Material Safety Data Sheet (MSDS) for the insulation material.

3. When subjected to the maximum design temperatures, the insulation shall maintain the exterior sheathing surface temperature at or below 120 degrees F.
4. Insulation shall be chloride-free and non-asbestos. The maximum acceptable level of chloride ions in the insulation shall comply with ASTM C795 as tested per ASTM C871.

I. Controls and Instrumentation

1. Seller shall provide their standard control and instrumentation system provided it meets the requirements of this specification and data sheets.
2. The clean steam generator shall be controlled and monitored by a PLC located in a control panel on the skid.
3. Seller shall provide the minimum interlocks required for safe operation and maintain the required product quality.
4. A battery backup shall be provided which will store all memory data for a minimum of 48 hours.
5. The clean steam generator's PLC shall provide a signal for a remote operation of an automatic valve (supplied and installed by others) on the feedwater supply to the generator.
6. Dry, potential-free, relay contacts shall be furnished in order to provide a hardwire interface to the facility control system for the run status. Closed relay contacts shall indicate that the unit is active and running a cycle. Open relay contacts shall indicate that the unit is inactive and not running a cycle.
7. Dry, potential-free, relay contacts shall be furnished in order to provide a hardwire interface to the facility control system for the common trouble alarm. Relay contacts shall operate in a failsafe manner with open relay contacts indicating that one or more alarm conditions are active and closed relay contacts indicating that no alarm conditions are present.
8. A retransmitted 4-20mA DC isolated signal shall be furnished in order to provide a hardwire interface to the facility control system for monitoring the clean steam conductivity. The 24 VDC loop power for this signal shall be provided by the unit.
9. Seller shall provide an emergency stop button on the main control panels.

2.2 FABRICATION

A. Refer to the referenced specifications as listed in section 1.03 for additional fabrication requirements.

B. The Seller shall maintain orderly work areas free of debris. Only equipment and materials to be used on the clean steam generators shall be stored in the immediate work area. All storage and fabrication areas will be indoors.

C. The clean steam generators fabrication area shall be segregated from other areas so that the clean steam generators do not have the potential of contamination from other non-stainless steel materials. The Buyer shall review the shop floor operations to ensure segregation is achieved.

D. The clean steam generators fabrication work area shall be only dedicated for the clean steam generators.

E. Metallic tools used for fabrication shall have contact surfaces constructed of stainless steel.

2.3 INSPECTION AND TESTING

A. The Buyer reserves the right to inspect the equipment during production upon a 24-hour notice, and shall be given at least five days notice prior to shipment to allow for scheduling of a final inspection.

B. Inspection shall include, but shall not be limited to, the following:

1. Adherence to the Purchase Order.
2. Adherence to the Specification.
3. Adherence to Approved Drawings.
4. Adherence to fabrication procedures and surface finishes, as mandated by Code and/or specifications and drawings.
5. Fabrication within tolerances.
6. Visual inspection for overall workmanship.
7. Records of testing and examinations.

C. Seller shall be responsible for developing test procedures, performing and supervising the test, providing the facilities and utilities for the tests and documenting the test results.

D. Records of any inspections and examinations performed shall be made available upon request to the Buyer. The Buyer reserves the right to witness all factory acceptance tests. Buyer shall be given a five-day notice prior to testing.

E. After testing is complete all equipment and components shall be cleaned and dried of water, grit, grease, oil or other foreign matter.

F. Mechanical Tests

1. All pressure lines shall be tested per the requirements of the referenced piping specifications. Instrument lines shall be pneumatically tested.
2. Hydrostatic testing shall be in accordance with ASME B31.3 and shall be accomplished prior to passivation and insulation installation.
3. Pneumatic testing shall be in accordance with ASME B31.3.
4. A drainage test shall be performed to ensure complete drainage of the all equipment and piping.
5. After testing is complete all fluids shall be removed from the piping and equipment.

G. Functional Tests

1. Factory acceptance test protocols shall be developed by the Seller and submitted for Buyer approval. They shall include detailed test procedures sufficient to demonstrate the operation of the integrated system.
2. Approved factory acceptance tests shall be executed in the presence of the Buyer and/or Buyer's representative and completed with the Buyer approval prior to acceptance.

H. Performance Tests

1. Performance test protocols shall be developed by the Seller and submitted for Buyer approval. They shall include detailed test procedures sufficient to demonstrate the performance of the integrated system.

2. Approved performance tests shall be executed in the presence of the Buyer and/or Buyer's representative and completed with the Buyer approval prior to acceptance.

I. Once installation of the equipment is complete the Seller shall perform their standard site acceptance test. Start-up of the equipment shall be performed by the Seller. Training of operators and maintenance personnel shall be provided by the Seller.

2.4 PASSIVATION

A. Passivation requirements shall be noted in the data sheets. If required, the Seller shall submit with the proposal, a cleaning and passivation procedure for review, and shall further submit them for approval prior to the actual factory cleaning and passivation procedures.

B. If passivation is required, it shall be performed after all electropolishing is completed (electropolishing and spot electropolishing).

PART 3 - EXECUTION

3.1 NONE

END OF SECTION 230501

Stantec
3 Columbia Circle
Suite 6
Albany, NY 12203
Tel 518-452-4358 Fax 518-452-9234

Clean Steam Generators

Data Sheet
Specification Number: 230501

Immucell Corp.
ImmuCell MAST OUT Project
Project No.: 191504176

Tag Number	CSG-1
Equipment Name	Clean Steam Generator
P&ID Number	TBD
Inventory Number	

Rev. No.	Date	Description	By
0	8/19/2016	Interior Fit-Out - Issued for Construction	ABB

PROCESS DATA

Type	steam	Capacity Turndown Ratio	10 : 1 min
Clean Steam Capacity	1100 lbs/hr	Maximum Pres Fluctuations	+/-1.5 psig
Clean Steam Pressure	25 psig		

MECHANICAL DATA

Feedwater Pump Required	yes	Feedwater Preheater Required	yes
Pump Type	sanitary centrifugal	Removable Tubes	yes
Casing Drain Required	yes	Tube MOC	316L SS
Pump Connections	tri-clamp	Tube Finish	15 µin Ra EP
Pump Seal	single mechanical	Tubeside Connections	tri-clamp
Blowdown Cooler Required	yes	Maximum Skid Size	48" x 48"
Blowdown Cooler Type	quench	Ceiling Height	10'-0" to BOS 12'-0" BOD
Blowdown Discharge Temp.	60 deg C Max	Feedwater Analyzer	no
Passivation Required	yes	Clean Steam Sample Req.	yes
		Clean Steam Analyzer	yes

Materials of Construction

	Type	*Finish*
Column	316L SS	15 µin Ra EP
Evaporator	316L SS	15 µin Ra EP
Structural Frame	Carbon Steel	by seller
Sheathing	304 SS	by seller
Feedwater	316L SS	15 µin Ra EP
Clean Steam	316L SS	15 µin Ra EP
Plant Steam	by seller	by seller
Plant Condensate	by seller	by seller
Cooling Water	by seller	by seller
Feedwater Pump	316L SS	15 µin Ra EP

UTILITIES

Feedwater Medium	USP water	Cooling Water Medium	
Feedwater Conductivity	<1.3 µS/cm @ 25°C	Cooling Water Pressure	40 psig
Feedwater TOC Content	<0.5 mg/L	Cooling Water Temperature	3.3 C Supply / 10 C Return
Feedwater Temperature	25 °C	Instrument Air Medium	instrument air
Feedwater Pressure	40 psig - pump required	Instrument Air Temperature	ambient
Plant Steam Medium	plant steam	Instrument Air Pressure	100 psig
Plant Steam Pressure	100 psig	Available Electrical Supply	480V/3Ph/60Hz
Plant Steam Quality	saturated	Electric Area Classification	unclassified
		Electrical Enclosure	NEMA 4

CONTROLS

Required Interface Terminal	seller's standard
Required PLC	seller's standard
Recorder Required	yes
Required Recorder	seller's standard
Required Conductivity Probe	seller's standard
Required Conductivity Meter	seller's standard

Interface to Facility Control System
ethernet

Output to Facility Control System
run status, relay contacts
common alarm, relay contacts
clean steam conductivity

Remote Output from WFI Still
open feedwater supply valve (by others)

Alarms/Instrumentation

Local Alarms
high clean steam conductivity
high/low clean steam pressure
high/low plant steam pressure
low instrument air pressure
high column water level
low column water level
low feedwater pressure
high blowdown temperature

Recording
time/date
clean steam pressure
clean steam conductivity
plant steam pressure
alarm indication
column water level

NOTES

1. In case of conflict between the specification and the data sheet, Seller shall contact Buyer for resolution.
2. Seller is required to furnish the data indicated "by seller" and to verify the other data listed above after the equipment has been

VENDOR DATA REQUIREMENTS FORM

Client:	**Immucell Corporation**	**Rev.:**	**0**
Location:	**Portland, ME**	**Date:**	**19-Aug-16**
Project:	**Mast-Out**	**By:**	**Adam Brown, Stantec**

Stantec Proj. No.: **191504176**

Buyer Project No.:

PACKAGE TITLE:

Interior Fit Out - Clean Steam Generator

For Code item w/ # refer to notes at bottom. n/a implies no documentation required for item.

REV	CODE	DATA AND DRAWINGS REQUIRED	DATA REQ'D FOR COMM. Y / N	DATA REQ'D FOR DQ. Y / N	AS BUILT DOCs REQ'D Y / N	REQ'D IN VENDOR TOP Y / N	DATA FOR REVIEW/ APPROVAL DATE DUE QTY	DATA FOR REVIEW/ APPROVAL DATE DUE WKS ARO	CERTIFIED DATA DATE DUE QTY	CERTIFIED DATA DATE DUE WKS ARAD	DATA TO BE SUBMITTTED FOR INFO ONLY QTY	DATA TO BE SUBMITTTED FOR INFO ONLY DATE DUE
		6.1 DRAWINGS										
	D-1[1]	General Arrangements including Wts, Dimensions, Piping & Electrical Connection Sizes & Locations, Foundation & Anchor Bolt Locations	Y		Y	Y	1E	2	1E	1		
	D-2	Preliminary Flow Diagrams or Piping & Instrumentation Diagrams	N				1E	2				
	D-3	Final Flow Diagrams or Piping and Instrumentation Diagrams (Red Line)	Y		Y	Y			1E/1P	1 WK PS		
	D-4	Foundation Diagrams and Loading Requirements, incl. Seismic and Wind	n/a									
	D-5	Catalog Information, Cuts, Etc. (Inc. Sub-Vendors and Instruments)	N			Y	1E	4				
	D-6	Detail Drawings (Including Cross Sectional Drawings)	Y		Y	Y	1E	2	1E	1		
	D-7	Electrical Component Description	Y				1E	4	1E	1		
	D-8	Instrument Location Drawings	Y				1E	4	1E	1		
	D-9	Instrument / Segment Loop Drawings	Y		Y	Y	1E	4	1E	1		
	D-10[2]	Control Panel Drawings	Y		Y	Y	1E	4	1E	1		
	D-11	Wiring Schematics	Y		Y	Y	1E	4	1E	1		
	D-12	Instrument Installation Details	n/a									
	D-13	Skid Interconnection Details (includes Reassembly Plans)	Y		Y	Y			1E/1P	1 WK PS		
	D-14	3-D Detailed Arrangement of Piping and Equipment	N		Y	Y	1E/1P	@ FAT	1E/1P	1 WK PS		
		6.2 SCHEDULES										
	S-1	Preliminary Production Schedule	N								1E	WQ
	S-2	Final Production Schedule	N				1E	2	1E	2		
	S-3	Wt List of Fabricated Parts for Erection, Unit Shipping Wt,Erected Wt.	N								1E	2 WKS PS
	S-4	Shipping Schedule and Packing Lists	N								1E	2 WKS PS
		6.3 CALCULATIONS / DATA SHEETS										
	C-1	Utility Requirements	Y			Y	1E	2	1E	2		
	C-2	Allowable Forces and Moments on Nozzles	N								1E	2 WKS ARAD
	C-3	ASME Code Calculations	Y			Y	1E/1P	4	1E/1P	1 WK PS		
	C-4	Completed Equipment Data Sheets (WQ & As-Builts submitted with TOP)	Y		Y	Y	1E	WQ	1E	1		
	C-5[3]	Equipment Calculations as Noted	Y				1E	2	1E	1		
	C-6	Performance Curves	Y			Y	1E	2	1E	1		
	C-7	Unbalanced Forces and Moments	n/a									
	C-8	Instrument Spec. Sheets	Y		Y	Y	1E	2	1E	1		
	C-9	System Hold-up Volume	Y			Y	1E	2	1E	1		

VENDOR DATA REQUIREMENTS FORM

Client: Immucell Corporation | **Rev.:** 0
Location: Portland, ME | **Date:** 19-Aug-16 | **Stantec Proj. No.:** 191504176
Project: Mast-Out | **By:** Adam Brown, Stantec | **Buyer Project No.:**

PACKAGE TITLE:
Interior Fit Out - Clean Steam Generator

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		6.4 LISTS AND INDICES										
	L-1	Recommended Spare Parts for start-up and for 3 years Normal Maint.w/Prices	Y			Y					1E	2 WKS ARAD
	L-2	Detailed Parts List and Product Contact Materials Parts Lists	Y			Y						
	L-4	Instrument List / Index	Y		Y	Y	1E	2	1E	1	1E	WQ
	L-5	List of Special Tools for Maintenance	Y			Y					1E	WS
	L-6	Alarm and Interlock List	Y				1E	2	1E	2		
	L-7	Control System Inter-Processor Communication List	n/a									
	L-8	Valve List	Y			Y	1E	2	1E	1	1E	WQ
		6.5 MANUALS / REPORTS										
	R-1	Installation, Operation, Maintenance and Lubrication Manuals	Y			Y	1E/1P	3 WKS PS	1E/1P	1 WK PS		
	R-2	ASME Code Data Reports	Y			Y	1E/1P	3 WKS PS	1E/1P	1 WK PS		
	R-3	Hydrotest Data Reports	Y			Y	1E/1P	3 WKS PS	1E/1P	1 WK PS		
	R-4	Mill Test Certificates with Heat Number or Certificates of Compliance	Y			Y	1E/1P	3 WKS PS	1E/1P	1 WK PS		
	R-5	Instrument Calibration Sheets	Y		Y	Y	1E/1P	3 WKS PS	1E/1P	1 WK PS		
	R-6	Sequence of Operation/ Circuit Description	Y				1E/1P	3 WKS PS	1E/1P	1 WK PS		
	R-7	Progress Reports	N								1E	Biweekly
	R-8	Vendor / Sub-Vendor Quality Plan	n/a									
	R-9	Boroscope Inspection Report Documentation	Y			Y	1E/1P	3 WKS PS	1E/1P	1 WK PS		
	R-10	Welding Procedures	Y			Y	1E/1P	3 WKS PS	1E/1P	1 WK PS		
	R-11	Welding File Documentation	Y			Y	1E/1P	3 WKS PS	1E/1P	1 WK PS		
	R-12	Surface Finish Documentation Report	Y			Y	1E/1P	3 WKS PS	1E/1P	1 WK PS		
	R-13	As-Built Document Manual, including Dwgs (Submit separate AND with TOP)	Y			Y			1E/1P	1 WK PS	1E	2 WKS AS
	R-14	Turn Over Package (TOP) Documentation	Y		Y		1E/1P	3 WKS PS	1E/1P	1 WK PS		
		6.6 CONTROL SYSTEM DATA										
	V-1	Software Development Documentation	n/a									
	V-2	Software source codes	n/a									
	V-3	Software test protocols	Y	Y			1E	3 WKS PS	1E	3 WKS PS		
	V-4	Maintenance Manual	Y	Y		Y	1E	3 WKS PS	1E	3 WKS PS		
	V-5	Security system specification	Y	Y		Y					1E	4 WKS ARO
	V-6	Program structure	n/a									
	V-7	Calibration procedures	Y			Y	1E	4 WKS	1E	4 WKS		
	V-8	Preventive maintenance procedures	Y			Y					1E	3 WKS PS
	V-9	Operator / User manual	Y			Y					1E	2 WKS AS
	V-10	I/O schedule	Y			Y					1E	2 WKS ARAD
	V-11	Ladder Diagrams/Logic flow diagram	Y			Y					1E	4 WKS ARAD
	V-12	Control System Technical Literature	Y			Y					1E	2 WKS ARAD
	V-13	Hardware Configuration Diagram	Y			Y					1E	4 WKS ARAD
	V-14	Software Configuration Documentation	Y			Y					1E	4 WKS ARAD
	V-15	Software Licenses and Original Diskettes / CD ROM and Manuals	Y			Y			1E/1P	PS		
	V-16	Certification of Software Compliance with CFR Part 11	Y			Y					1E	2 WKS ARAD

VENDOR DATA REQUIREMENTS FORM

Client:	**Immucell Corporation**	**Rev.:**	**0**
Location:	**Portland, ME**	**Date:**	**19-Aug-16**
Project:	**Mast-Out**	**By:**	**Adam Brown, Stantec**

Stantec Proj. No.: **191504176**

Buyer Project No.:

PACKAGE TITLE:
Interior Fit Out - Clean Steam Generator

For Code item w/ # refer to notes at bottom. n/a implies no documentation required for item.

REV	CODE	DATA AND DRAWINGS REQUIRED	DATA REQ'D FOR COMM. Y / N	DATA REQ'D FOR DQ. Y / N	AS BUILT DOCs REQ'D Y / N	REQ'D IN VENDOR TOP Y / N	DATA FOR REVIEW/ APPROVAL DATE DUE QTY	DATA FOR REVIEW/ APPROVAL DATE DUE WKS ARO	CERTIFIED DATA DATE DUE QTY	CERTIFIED DATA DATE DUE WKS ARAD	DATA TO BE SUBMITTTED FOR INFO ONLY QTY	DATA TO BE SUBMITTTED FOR INFO ONLY DATE DUE
		6.7 MISCELLANEOUS										
	M-1	Passivation and Cleaning Procedures	Y			Y			1E	4	1E	3 WKS PS
	M-2	Passivation and Cleaning Certificates	Y			Y			1E/1P	PS	1E	3 WKS PS
	M-3	Surface Finish / Polish Samples / Coupons	Y			Y			1E/1P	PS	1E	3 WKS PS
	M-4	Weld Maps w/ Welder Identification	Y			Y			1E/1P	PS	1E	3 WKS PS
		6.8 SYSTEM, OPERATIONAL AND VALIDATION DOCUMENTATION										
	F-1	Inspection Schedule, Test Plans and Factory Acceptance Test Schedule	Y				1E	4 WKS PFAT				
	F-4[4]	Pre-FAT Testing and Documentation	N				1E	4 WKS PFAT				
	F-5[4]	Factory Acceptance Test Protocols and Testing Procedures	Y			Y					1E	2 WKS PFAT
	F-6[4]	Completed FAT Punch list	Y			Y			1E	PS		
	F-7	Site Acceptance Test Protocols and Procedures	Y			Y					1E	2 WKS PS

The "Required for Commissioning" and "Required for Design Qualification" columns are for Buyer use only.

A copy of all certified data is to be included in the final turnover package/manual.

Vendor has reviewed this Vendor Data Requirements Form and agrees to provide the data in the time frame requested.

Signature and date required in space provided below:

VENDOR _____ _____

Signature **Date**

NOTES:

1. Vendor to submit standard tube set drawing with quotation.
2. One-line diagrams required for any onboard junction boxes, controllers, etc.
3. Equipment Calculations include items noted as 'by seller' in package datasheets.
4. If equipment is a standard off the shelf system, Buyer will require either on site vendor qualification or an SAT depending on pricing breakdown in BOM.

LEGEND:

ARO = AFTER RECEIPT OF ORDER
ARAD = AFTER RETURN OF APPROVAL DWG.
TBD = TO BE DETERMINED
P = PRINT
AS = AFTER SHIPMENT
WQ = SUBMIT WITH QUOTATION
PFAT = PRIOR TO FAT
PS = PRIOR TO SHIPMENT
E = ELECTRONIC DISC

CONFIDENTIAL DOCUMENT

230513

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

230513

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
230513	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 500 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Energy efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Rotor: Random-wound, squirrel cage.

E. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

F. Temperature Rise: Match insulation rating.

G. Insulation: Class F

H. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
3. Inverter-Duty Motors: Class F temperature rise; Class H insulation. Provide with shaft ring grounding.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230513

CONFIDENTIAL DOCUMENT

230516

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
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The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

230516

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
230516	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 230516 - EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Alignment guides and anchors.
2. Flexible-hose expansion joints.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Delegated-Design Submittal: For each anchor and alignment guide, including analysis data, signed and sealed by a State of Maine qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
3. Alignment Guide Details: Detail field assembly and attachment to building structure.
4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For expansion joints to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.

B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

2.2 EXPANSION JOINTS

A. Flexible-Hose Expansion Joints:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Flex-Hose Co., Inc.
    b. Flexicraft Industries.
    c. Flex Pression Ltd.
    d. Metraflex, Inc.
    e. Unisource Manufacturing, Inc.

2. Expansion Joints for Copper Tubing: Copper-alloy fittings with solder end joint connection

    a. NPS 2 and smaller bronze hoses and double-braid bronze sheaths with 700 psig at 70 deg F and 250 psig at 400 deg F ratings.
    b. NPS 2-1/2 to NPS 4: Stainless – steel hoses and double-braid, stainless-steel sheaths with 420 psig at 70 deg F and 315 psig at 400 deg F ratings.

3. Expansion Joints for Steel Piping: Carbon-steel fittings with welded end connections for NPS 2 and smaller and welded end connection for NPS 2-1/2 and larger.

    a. NPS 2 and smaller: Stainless-steel hoses and single-braid, stainless-steel sheaths with 450 psig at 70 deg F and 325 psig at 600 deg F ratings.
    b. NPS 2-1/2 to NPS 6: Stainless-steel hoses and single-braid, stainless-steel sheaths with 700 psig at 70 deg F and 515 psig at 600 deg F ratings.
    c. NPS 8 to NPS 12: Stainless-steel hoses and single-braid, stainless-steel sheaths with 125 psig at 70 deg F and 90 psig at 600 deg F ratings.

B. Joints shall absorb or compensate for pipe movements in all six degrees of freedom (three coordinate axes, plus rotation about those axes simultaneously. Rated at a minimum of 4:1 bursting to working safety factor.

C. Joints shall be shipped with shipping bars to maintain lengths during shipping and installation.

D. Warranty shall be covered by 3-year full replacement warranty.

2.3 ALIGNMENT GUIDES AND ANCHORS

A. Alignment Guides:

1. Flex-Hose Co., Inc
2. Flexicraft Industries
3. Flex-Weld, Inc
4. Hyspan Precision Products, Inc
5. Mason Industries, Inc.
6. Metraflex Company (The)
7. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding slider for bolting to pipe.

B. Anchor Materials:

1. Steel Shapes and Plates: ASTM A 36/A 36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
3. Washers: ASTM F 844, steel, plain, flat washers.
4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.

    a. Stud: Threaded, zinc-coated carbon steel.
    b. Expansion Plug: Zinc-coated steel.
    c. Washer and Nut: Zinc-coated steel.

5. Chemical Fasteners: Insert-type stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.

    a. Bonding Material: ASTM C 881/C 881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
    b. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.
    c. Washer and Nut: Zinc-coated steel.

PART 3 - EXECUTION

3.1 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.

B. Install guides as indicated on Drawings.

C. Attach guides to pipe and secure guides to building structure.

D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

E. Anchor Attachments:

1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.

1. Anchor Attachment to Steel Structural Members: Attach by welding.
2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.

3.2 EXPANSION-JOINT INSTALLATION

A. Install manufactured, nonmetallic expansion joints according to FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."

B. Install expansion joints of sizes matching sizes of piping in which they are installed.

C. Install alignment guides to allow expansion and to avoid end-loading and torsional stress.

D. For schedule 80 condensate piping, provide an adaptor to schedule 40 for installation of flex loop.

END OF SECTION 230516

CONFIDENTIAL DOCUMENT

230519

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METERS AND GAUGES FOR HVAC PIPING

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
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230519

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Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
230519	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 230519 - METERS AND GAUGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Bimetallic-actuated thermometers.
2. Filled-system thermometers.
3. Liquid-in-glass thermometers.
4. Thermowells.
5. Dial-type pressure gauges.
6. Gauge attachments.
7. Test plugs.
8. Test-plug kits.
9. Sight flow indicators.
10. Turbine flowmeters.
11. Venturi flowmeters.
12. Vortex-shedding flowmeters.
13. Impeller-turbine, thermal-energy meters.
14. Ultrasonic, thermal-energy meters.

B. Related Sections:

1. Section 231123 "Facility Natural-Gas Piping" for gas meters.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of meter and gauge, from manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For meters and gauges to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 BIMETALLIC-ACTUATED THERMOMETERS

A. Manufacturers:

1. Ashcroft
2. Ernst Flow Industries
3. Marsh Bellofram
4. Miljoco Corporation
5. Nanmac Corporation
6. Noshok
7. Palmer Wahl Instrumentation
8. REOTEMP Instrument Corporation
9. Tel-Tru Manufacturing Company
10. Trerice, H. O. Company
11. Watts; a Watts Water Technologies
12. Weiss Instruments, Inc
13. Weksler Glass Thermometer
14. WIKA Instrument Corporation
15. Winters Instruments - U.S

B. Case: Liquid-filled and sealed type(s); stainless steel with 3-inch nominal diameter.

C. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F .

D. Connector Type(s): Union joint, adjustable angle and rigid, bottom , with unified-inch screw threads.

E. Connector Size: 1/2 inch, with ASME B1.1 screw threads.

F. Stem: 0.25 or 0.375 inch in diameter; stainless steel.

G. Window: Plain glass or plastic.

H. Ring: Stainless steel.

I. Element: Bimetal coil.

J. Pointer: Dark-colored metal.

K. Accuracy: Plus or minus 1 percent of scale range.

2.2 FILLED-SYSTEM THERMOMETERS

A. Direct-Mounted, Metal-Case, Vapor-Actuated Thermometers:

1. Manufacturers:

    a. Ashcroft
    b. Marsh Bellofram
    c. Miljoco Corporation
    d. Palmer Wahl Instrumentation
    e. REOTEMP Instrument Corporation
    f. Trerice, H. O. Company
    g. Weiss Instruments, Inc

2. Standard: ASME B40.200.
3. Case: Sealed type, cast aluminum or drawn steel 4-1/2-inch)nominal diameter.
4. Element: Bourdon tube or other type of pressure element.
5. Movement: Mechanical, dampening type, with link to pressure element and connection to pointer.
6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
7. Pointer: Dark-colored metal.
8. Window: Glass or plastic.
9. Ring: Metal or Stainless steel.
10. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device; with ASME B1.1 screw threads.
11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.

    a. Design for Air-Duct Installation: With ventilated shroud.
    b. Design for Thermowell Installation: Bare stem.

12. Accuracy: Plus or minus 1 percent of scale range.

B. Direct-Mounted, Plastic-Case, Vapor-Actuated Thermometers:

1. Ashcroft
2. Miljoco Corporation
3. REOTEMP Instrument Corporation
4. Standard: ASME B40.200.
5. Case: Sealed type, plastic 4-1/2-inch nominal diameter.
6. Element: Bourdon tube or other type of pressure element.
7. Movement: Mechanical, with link to pressure element and connection to pointer.
8. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
9. Pointer: Dark-colored metal.
10. Window: Glass or plastic.
11. Ring: Metal or plastic.
12. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device; with ASME B1.1 screw threads.

13. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.

    a. Design for Air-Duct Installation: With ventilated shroud.
    b. Design for Thermowell Installation: Bare stem.

14. Accuracy: Plus or minus 1 percent of scale range.

C. Remote-Mounted, Metal-Case, Vapor-Actuated Thermometers:

1. Ametek US Gauge
2. Ashcroft
3. Marsh Bellofram
4. Miljoco Corporation
5. Palmer Wahl Instrumentation
6. REOTEMP Instrument Corporation
7. Trerice, H. O. Company
8. Weiss Instruments, Inc
9. WIKA Instrument Corporation
10. Standard: ASME B40.200.
11. Case: Sealed type, cast aluminum or drawn steel; 4-1/2-inch nominal diameter with back flange and holes for panel mounting.
12. Element: Bourdon tube or other type of pressure element.
13. Movement: Mechanical, with link to pressure element and connection to pointer.
14. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
15. Pointer: Dark-colored metal.
16. Window: Glass or plastic.
17. Ring: Metal or Stainless steel.
18. Connector Type(s): Union joint, back; with ASME B1.1 screw threads.
19. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.

    a. Design for Air-Duct Installation: With ventilated shroud.
    b. Design for Thermowell Installation: Bare stem.

20. Accuracy: Plus or minus 1 percent of scale range.

D. Remote-Mounted, Plastic-Case, Vapor-Actuated Thermometers:

1. Ametek US Gauge
2. Ashcroft
3. Miljoco Corporation
4. REOTEMP Instrument Corporation
5. Trerice, H. O. Company
6. Standard: ASME B40.200.
7. Case: Sealed type, plastic; 4-1/2-inch nominal diameter with back flange and holes for panel mounting.
8. Element: Bourdon tube or other type of pressure element.
9. Movement: Mechanical, with link to pressure element and connection to pointer.

10. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
11. Pointer: Dark-colored metal.
12. Window: Glass or plastic.
13. Ring: Metal or plastic.
14. Connector Type(s): Union joint, threaded, back; with ASME B1.1 screw threads.
15. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.

    a. Design for Air-Duct Installation: With ventilated shroud.
    b. Design for Thermowell Installation: Bare stem.

16. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.3 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:

1. Trerice, H. O. Company
2. Standard: ASME B40.200.
3. Case: Cast aluminum; 6-inch (152-mm) nominal size.
4. Case Form: Back angle unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue or red organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
7. Window: Glass or plastic.
8. Stem: Aluminum or brass and of length to suit installation.

    a. Design for Air-Duct Installation: With ventilated shroud.
    b. Design for Thermowell Installation: Bare stem.

9. Connector: 3/4 inch, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

B. Plastic-Case, Compact-Style, Liquid-in-Glass Thermometers:

1. Fiofab Inc
2. Miljoco Corporation
3. Tel-Tru Manufacturing Company
4. Watts; a Watts Water Technology Company
5. Weiss Instruments, Inc
6. Weksler Glass Thermometer
7. WIKA Instrument Corporation
8. Standard: ASME B40.200.
9. Case: Plastic; 6-inch nominal size.
10. Case Form: Back angle unless otherwise indicated.
11. Tube: Glass with magnifying lens and blue or red organic liquid.

12. Tube Background: Nonreflective with permanently etched scale markings graduated in deg F.
13. Window: Glass or plastic.
14. Stem: Aluminum or brass and of length to suit installation.

    a. Design for Air-Duct Installation: With ventilated shroud.
    b. Design for Thermowell Installation: Bare stem.

15. Connector: 3/4 inch with ASME B1.1 screw threads.
16. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

C. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Fiofab Inc
2. Miljoco Corporation
3. Palmer Wahl Instrumentation
4. Tel-Tru Manufacturing Company
5. Watts; a Watts Water Technologies
6. Weiss Instruments, Inc
7. Weksler Glass Thermometer
8. WIKA Instrument Corporation
9. Standard: ASME B40.200.
10. Case: Cast aluminum; 7-inch nominal size unless otherwise indicated.
11. Case Form: Adjustable angle unless otherwise indicated.
12. Tube: Glass with magnifying lens and blue[or red] organic liquid.
13. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
14. Window: Glass or plastic.
15. Stem: Aluminum and of length to suit installation.

    a. Design for Air-Duct Installation: With ventilated shroud.
    b. Design for Thermowell Installation: Bare stem.

16. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
17. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

D. Plastic-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Ernst Flow Industries
2. Marsh Bellofram
3. Miljoco Corporation
4. Palmer Wahl Instrumentation
5. REOTEMP Instrument Corporation
6. Watts; a Watts Water Technologies
7. Weiss Instruments, Inc
8. Weksler Glass Thermometer
9. WIKA Instrument Corporation
10. Standard: ASME B40.200.

11. Case: Plastic; 7-inch nominal size unless otherwise indicated.
12. Case Form: Adjustable angle unless otherwise indicated.
13. Tube: Glass with magnifying lens and blue or red organic liquid.
14. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
15. Window: Glass or plastic.
16. Stem: Aluminum or Aluminum, brass, or stainless steel and of length to suit installation.

    a. Design for Air-Duct Installation: With ventilated shroud.
    b. Design for Thermowell Installation: Bare stem.

17. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
18. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.4 DUCT-THERMOMETER MOUNTING BRACKETS

A. Description: Flanged bracket with screw holes, for attachment to air duct and made to hold thermometer stem.

2.5 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Material for Use with Steel Piping: CRES CSA.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.6 PRESSURE GAUGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gauges:

1. Ametek US Gauge
2. Ashcroft
3. Ernst Flow Industries
4. FloFab Inc
5. Marsh Bellofram

6. Miljoco Corporation
7. Noshok
8. Palmer Wahl Instrumentation
9. REOTEMP Instrument Corporation
10. Tel-Tru Manufacturing Company
11. Trerice, H. O. Company
12. Watts; a Watts Water Technologies
13. Weiss Instruments, Inc
14. Weksler Glass Thermometer
15. WIKA Instrument Corporation
16. Winters Instruments - U.S
17. Standard: ASME B40.100.
18. Case: Liquid-filled Sealed Open-front, pressure relief Solid-front, pressure relief type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
19. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
20. Pressure Connection: Brass, with or NPS 1/2 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
21. Movement: Mechanical, with link to pressure element and connection to pointer.
22. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi .
23. Pointer: Dark-colored metal.
24. Window: Glass or plastic.
25. Ring: Metal, Brass or Stainless steel.
26. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

B. Direct-Mounted, Plastic-Case, Dial-Type Pressure Gauges:

1. Ametek US Gauge
2. Ashcroft
3. FloFab Inc
4. Marsh Bellofram
5. Miljoco Corporation
6. Noshok
7. Palmer Wahl Instrumentation
8. REOTEMP Instrument Corporation
9. Tel-Tru Manufacturing Company
10. Trerice, H. O. Company
11. Watts; a Watts Water Technologies
12. Weiss Instruments, Inc
13. Weksler Glass Thermometer
14. WIKA Instrument Corporation
15. Winters Instruments - U.S
16. Standard: ASME B40.100.
17. Case: Sealed type; plastic; 4-1/2-inch nominal diameter.
18. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
19. Pressure Connection: Brass, with NPS 1/4 NPS 1/4 or NPS 1/2 NPS 1/2 ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
20. Movement: Mechanical, with link to pressure element and connection to pointer.
21. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi .
22. Pointer: Dark-colored metal.
23. Window: Glass or plastic.
24. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

C. Remote-Mounted, Metal-Case, Dial-Type Pressure Gauges:

1. Ametek US Gauge
2. Ashcroft
3. FloFab Inc
4. Marsh Bellofram
5. Miljoco Corporation
6. Noshok
7. Palmer Wahl Instrumentation
8. REOTEMP Instrument Corporation
9. Tel-Tru Manufacturing Company
10. Trerice, H. O. Company
11. Watts; a Watts Water Technologies
12. Weiss Instruments, Inc
13. Weksler Glass Thermometer
14. WIKA Instrument Corporation
15. Winters Instruments - U.S
16. Standard: ASME B40.100.
17. Case: Liquid-filled, Sealed type; cast aluminum or drawn steel 4-1/2-inchnominal diameter with back flange and holes for panel mounting.
18. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
19. Pressure Connection: Brass, with NPS 1/4 NPS 1/4 or NPS 1/2 NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
20. Movement: Mechanical, with link to pressure element and connection to pointer.
21. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi .
22. Pointer: Dark-colored metal.
23. Window: Glass or plastic.
24. Ring: MetalStainless steel.
25. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

D. Remote-Mounted, Plastic-Case, Dial-Type Pressure Gauges:

1. Ametek US Gauge
2. Ashcroft
3. FloFab Inc
4. Miljoco Corporation
5. Noshok
6. Palmer Wahl Instrumentation
7. REOTEMP Instrument Corporation
8. Tel-Tru Manufacturing Company
9. Trerice, H. O. Company
10. Watts; a Watts Water Technologies
11. Weiss Instruments, Inc
12. Weksler Glass Thermometer
13. WIKA Instrument Corporation
14. Winters Instruments - U.S
15. Standard: ASME B40.100.
16. Case: Sealed plastic 4-1/2-inch nominal diameter with back flange and holes for panel mounting.
17. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.

18. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
19. Movement: Mechanical, with link to pressure element and connection to pointer.
20. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
21. Pointer: Dark-colored metal.
22. Window: Glass or plastic.
23. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.7 GAUGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2 ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.

B. Siphons: Loop-shaped section of brass stainless-steel pipe with NPS 1/4 or NPS 1/2 pipe threads.

C. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2), ASME B1.20.1 pipe threads.

2.8 TEST PLUGS

A. Manufacturer:

1. Flow Design Inc
2. Miljoco Corporation
3. Nexus Valve, Inc.
4. Peterson Equipment Co. Inc.
5. Sisco Manufacturing Company
6. Trerice, H. O. Company
7. Watts; a Watts Water Technologies
8. Weiss Instruments, Inc
9. Weksler Glass Thermometer

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F .

F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

2.9 TEST-PLUG KITS

A. Manufacturer:

1. Flow Design Inc
2. Miljoco Corporation

3. Nexus Valve, Inc.
4. Peterson Equipment Co. Inc.
5. Sisco Manufacturing Company
6. Trerice, H. O. Company
7. Watts; a Watts Water Technologies
8. Weiss Instruments, Inc

B. Furnish one test-plug kit(s) containing one thermometer(s), one pressure gauge and adapter, and carrying case. Thermometer sensing elements, pressure gauge, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.

C. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F.

D. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F.

E. Pressure Gauge: Small, Bourdon-tube insertion type with 2- to 3-inch- diameter dial and probe. Dial range shall be at least 0 to 200 deg F.

F. Carrying Case: Metal or plastic, with formed instrument padding.

2.10 SIGHT FLOW INDICATORS

A. Manufacturer:

1. ARCHON Industries, Inc.
2. Dwyer Instruments, Inc.
3. Emerson Process Management
4. Ernst Flow industries
5. John C. Ernst Co, Inc.
6. KOBOLD Instruments, Inc.
7. OPW Engineered Systems
8. Pentair Valves & Controls

B. Description: Piping inline-installation device for visual verification of flow.

C. Construction: Bronze or stainless-steel body, with sight glass and ball, flapper, or paddle wheel indicator, and threaded or flanged ends.

D. Minimum Pressure Rating: 150 psig

E. Minimum Temperature Rating: 200 deg End Connections for NPS 2 and Smaller: Threaded.

F. End Connections for NPS 2-1/2 and Larger: Flanged.

2.11 FLOWMETERS

A. Turbine Flowmeters: Basis of design – Onicon F-1200

1. ABB
2. EMCO Flow Systems
3. EDCO Engineering Corp
4. Hoffer Flow Controls, Inc.
5. Liquid Controls
6. McCrometer, Inc.
7. Meriam Process Technologies
8. Nexus Valve, Inc.
9. Preso Meters
10. TACO Inc.
11. Veris Inc.
12. Description: Flowmeter with sensor and indicator.
13. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
14. Sensor: Impeller turbine; for inserting into pipe fitting or for installing in piping and measuring flow directly in gallons per minute

    a. Design: Device or pipe fitting with inline turbine and integral direct-reading scale for water
    b. Construction: Bronze or stainless-steel body, with plastic turbine or impeller.
    c. Minimum Pressure Rating: 150 psig.
    d. Minimum Temperature Rating: 180 deg F.

15. Indicator: Hand-held meter; either an integral part of sensor or a separate meter.
16. Accuracy: Plus or minus 1-1/2 percent.
17. Display: Shows rate of flow, with register to indicate total volume in gallons
18. Operating Instructions: Include complete instructions with each flowmeter.

B. Vortex-Shedding Flowmeters:

1. ABB
2. Eastech Flow Controls
3. EMCO Flow systems
4. Emerson Process management
5. Endress + Hauser
6. ISTEC Corporation
7. Description: Flowmeter with sensor and indicator.
8. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
9. Sensor: Inline type; for installing between pipe flanges and measuring flow directly in gallons per minute.

    a. Design: Flow obstruction device, vortex-measurement type for liquids.
    b. Construction: Stainless-steel body, with integral transmitter and direct-reading scale.
    c. Minimum Pressure Rating: 1000 psig.
    d. Minimum Temperature Rating: 500 deg F.
    e. Integral Transformer: For low-voltage power operation.

10. Indicator: Hand-held meter; either an integral part of sensor or a separate meter.

11. Accuracy: Plus or minus 0.25 percent for liquids.
12. Display: Shows rate of flow, with register to indicate total volume in gallons.
13. Operating Instructions: Include complete instructions with each flowmeter.

2.12 THERMAL-ENERGY METERS

A. Impeller-Turbine, Thermal-Energy Meters:

1. Hoffer
2. Flow Controls, Inc.
3. ISTEC Corporation
4. ONICON Inc.
5. Veris industries
6. Description: System with strainer, flow sensor, temperature sensors, transmitter, indicator, and connecting wiring.
7. Flow Sensor: Impeller turbine with corrosion-resistant-metal body and transmitter; for installing in piping.

    a. Design: Total thermal-energy measurement.
    b. Minimum Pressure Rating: 150 psig.
    c. Minimum Temperature Range: 40 to 250 deg F.

8. Temperature Sensors: Insertion-type transducer.
9. Indicator: Solid-state, integrating-type meter with integral battery pack; for wall mounting.

    a. Data Output: Six-digit electromechanical counter with readout in kilowatts per hour or British thermal units
    b. Battery Pack: Five-year lithium battery.

10. Accuracy: Plus or minus 1 percent.
11. Display: Visually indicates total fluid volume in gallons and thermal-energy flow in kilowatts per hour or British thermal units
12. Strainer: Full size of main line piping.
13. Operating Instructions: Include complete instructions with each thermal-energy meter system.

2.13 INSTALLATION

A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.

G. Install duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.

H. Install direct-mounted pressure gauges in piping tees with pressure gauge located on pipe at the most readable position.

I. Install remote-mounted pressure gauges on panel.

J. Install valve and snubber in piping for each pressure gauge for fluids (except steam).

K. Install valve and syphon fitting in piping for each pressure gauge for steam.

L. Install test plugs in piping tees.

M. Install flow indicators in piping systems in accessible positions for easy viewing.

N. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters according to manufacturer's written instructions.

O. Install flowmeter elements in accessible positions in piping systems.

P. Install wafer-orifice flowmeter elements between pipe flanges.

Q. Install differential-pressure-type flowmeter elements, with at least minimum straight lengths of pipe, upstream and downstream from element according to manufacturer's written instructions.

R. Install permanent indicators on walls or brackets in accessible and readable positions.

S. Install connection fittings in accessible locations for attachment to portable indicators.

T. Mount thermal-energy meters on wall if accessible; if not, provide brackets to support meters.

U. Install thermometers in the following locations:

1. Inlet and outlet of each hydronic zone.
2. Inlet and outlet of each hydronic boiler.
3. Two inlets and two outlets of each chiller.
4. Inlet and outlet of each hydronic coil in air-handling units.
5. Two inlets and two outlets of each hydronic heat exchanger.
6. Inlet and outlet of each thermal-storage tank.
7. Outside-, return-, supply-, and mixed-air ducts.

V. Install pressure gauges in the following locations:

1. Discharge of each pressure-reducing valve.
2. Inlet and outlet of each chiller chilled-water connection.
3. Inlet and outlet of each heat exchanger hot-water connection.
4. Suction and discharge of each pump.

2.14 CONNECTIONS

A. Install meters and gauges adjacent to machines and equipment to allow service and maintenance of meters, gauges, machines, and equipment.

B. Connect flowmeter-system elements to meters.

C. Connect flowmeter transmitters to meters.

D. Connect thermal-energy meter transmitters to meters.

2.15 ADJUSTING

A. After installation, calibrate meters according to manufacturer's written instructions.

B. Adjust faces of meters and gauges to proper angle for best visibility.

2.16 THERMOMETER SCHEDULE

A. Thermometers at inlet and outlet of each hydronic zone shall be **one of** the following:

1. Sealed, bimetallic-actuated type.

B. Thermometers at inlet and outlet of each hydronic boiler shall be one of the following:

1. Sealed, bimetallic-actuated type.

C. Thermometers at inlets and outlets of each chiller shall be one of the following:

1. Sealed, bimetallic-actuated type.
2. Direct or Remote-mounted, metal or plastic-case, vapor-actuated type.
3. Compact Industrial-style, liquid-in-glass type.
4. Test plug with EPDM self-sealing rubber inserts.

D. Thermometers at inlet and outlet of each hydronic coil in air-handling units and built-up central systems shall be one of the following:

1. Sealed, bimetallic-actuated type.
2. Direct or Remote-mounted, metal or plastic-case, vapor-actuated type.
3. Compact Industrial-style, liquid-in-glass type.
4. Test plug with EPDM self-sealing rubber inserts.

E. Thermometers at outside-, return-, supply-, and mixed-air ducts shall be one of the following:

1. Sealed, bimetallic-actuated type.

F. Thermometer stems shall be of length to match thermowell insertion length.

2.17 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Chilled-Water Piping: Minus 40 to plus 160 deg F.

B. Scale Range for Heating, Hot-Water Piping: 0 to 250 deg F.

C. Scale Range for Air Ducts: Minus 40 to plus 110 deg F.

2.18 PRESSURE-GAUGE SCHEDULE

A. Pressure gauges at discharge of each pressure-reducing valve shall be one of the following:

1. Sealed Solid-front, pressure-relief direct-mounted, metal case.

B. Pressure gauges at inlet and outlet of each chiller chilled-water and condenser-water connection shall be one of the following:

1. Sealed solid-front, pressure-relief direct-mounted, metal case.
2. Sealed direct-mounted, plastic case.

C. Pressure gauges at suction and discharge of each pump shall be one of the following:

1. Sealed Solid-front, pressure-relief direct-mounted, metal case.
2. Sealed direct-mounted, plastic case.

2.19 PRESSURE-GAUGE SCALE-RANGE SCHEDULE

A. Scale Range for Chilled-Water Piping: 30 in. Hg to 15 psi.

B. Scale Range for Heating, Hot-Water Piping: 30 in. Hg to 15 psi.

2.20 FLOWMETER SCHEDULE

A. Flowmeters for Chilled-Water Piping: Turbine or Vortex-shedding type.

B. Flowmeters for Heating, Hot-Water Piping: Turbine or Vortex-shedding type.

2.21 THERMAL-ENERGY METER SCHEDULE

A. Thermal-Energy Meters for Chilled-Water Piping: Impeller-turbine or Ultrasonic type.

B. Thermal-Energy Meters for Heating, Hot-Water Piping: Impeller-turbine or Ultrasonic type..

END OF SECTION 230519

CONFIDENTIAL DOCUMENT

230523

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

VALVES

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

230523

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
230523	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 230523 - VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Bronze ball valves.
2. Iron ball valves.
3. High-performance butterfly valves.
4. Bronze swing check valves.
5. Iron, plate-type check valves.
6. Bronze gate valves.
7. Cast Steel gate valves.
8. Bronze globe valves.
9. Iron globe valves.
10. Cast steel globe valves.
11. Chainwheels.

B. Related Sections:

1. Division 23 HVAC piping Sections for specialty valves applicable to those Sections only.
2. Division 23 Section "Identification for HVAC Piping and Equipment" for valve tags and schedules.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Nonrising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

G. SWP: Steam working pressure.

1.4 SUBMITTALS

A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to HVAC valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
2. Handwheel: For valves other than quarter-turn types.
3. Handlever: For quarter-turn valves NPS 6 and smaller.
4. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. Gate Valves: With rising stem.
2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
3. Butterfly Valves: With extended neck.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Conbraco Industries, Inc.; Apollo Valves.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Hammond Valve.
d. Lance Valves; a division of Advanced Thermal Systems, Inc.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Stainless steel.

i. Ball: Stainless steel, vented.
j. Port: Full.

2.3 CAST STEEL BALL VALVES

A. Class 150, Carbon Steel Ball Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Nibco.

2. Description:

a. Standard: MSS SP-72.
b. Pressure Temperature Rating: 285 psi @ 100 deg. F.
c. Body Design: Split body.
d. Body Material: ASTM A 216, carbon steel.
e. Ends: Flanged.
f. Seats: Carbon filled PTFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel.
i. Port: Full.

B. Class 300, Carbon Steel Ball Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Nibco.

2. Description:

a. Standard: MSS SP-72.
b. Pressure Temperature Rating: 740 psi @ 100 deg. F.
c. Body Design: Split body.
d. Body Material: ASTM A 216, carbon steel.
e. Ends: Flanged.
f. Seats: Carbon filled PTFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel.
i. Port: Full.

2.4 HIGH-PERFORMANCE BUTTERFLY VALVES

A. Class 150, Single-Flange, High-Performance Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
    b. Bray Controls; a division of Bray International.
    c. Cooper Cameron Valves; a division of Cooper Cameron Corp.
    d. Crane Co.; Crane Valve Group; Flowseal.
    e. Crane Co.; Crane Valve Group; Stockham Division.
    f. DeZurik Water Controls.
    g. Hammond Valve.
    h. Jamesbury; a subsidiary of Metso Automation.
    i. Milwaukee Valve Company.
    j. NIBCO INC.
    k. Process Development & Control, Inc.
    l. Tyco Valves & Controls; a unit of Tyco Flow Control.

2. Description:

    a. Standard: MSS SP-68.
    b. Pressure Temperature Rating: 285 psig at 100 deg F.
    c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
    d. Body Material: Carbon steel, ductile iron, or stainless steel.
    e. Seat: Reinforced PTFE or metal.
    f. Stem: Stainless steel; offset from seat plane.
    g. Disc: Stainless steel.
    h. Service: Bidirectional.

B. Class 300, Single-Flange, High-Performance Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
    b. Bray Controls; a division of Bray International.
    c. Cooper Cameron Valves; a division of Cooper Cameron Corp.
    d. Crane Co.; Crane Valve Group; Flowseal.
    e. Crane Co.; Crane Valve Group; Stockham Division.
    f. DeZurik Water Controls.
    g. Hammond Valve.
    h. Jamesbury; a subsidiary of Metso Automation.
    i. Milwaukee Valve Company.
    j. NIBCO INC.
    k. Process Development & Control, Inc.
    l. Tyco Valves & Controls; a unit of Tyco Flow Control.

2. Description:

a. Standard: MSS SP-68.
b. Pressure Temperature Rating: 740 psi @ 100 deg. F.
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: Carbon steel, ductile iron, or stainless steel.
e. Seat: Reinforced PTFE or metal.
f. Stem: Stainless steel; offset from seat plane.
g. Disc: Stainless steel.
h. Service: Bidirectional.

2.5 BRONZE SWING CHECK VALVES

A. Class 150, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. American Valve, Inc.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Division.
e. Kitz Corporation.
f. Milwaukee Valve Company.
g. NIBCO INC.
h. Red-White Valve Corporation.
i. Zy-Tech Global Industries, Inc.

2. Description:

a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 300 psig.
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: Bronze.

2.6 IRON, PLATE-TYPE CHECK VALVES

A. Class 150, Iron, Dual-Plate Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. APCO Willamette Valve and Primer Corporation.
b. Crane Co.; Crane Valve Group; Crane Valves.

c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Val-Matic Valve & Manufacturing Corp.

2. Description:

a. Standard: API 594.
b. NPS 2-1/2 to NPS 12, CWP Rating: 300 psig.
c. NPS 14 to NPS 24, CWP Rating: 250 psig.
d. Body Design: Wafer, spring-loaded plates.
e. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
f. Seat: EPDM or NBR.

2.7 CAST STEEL GATE VALVES

A. Class 150, OS&Y, Cast Steel Gate Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Stockham Division.
c. Hammond Valve.
d. Milwaukee Valve Company.
e. NIBCO INC.
f. Powell Valves.
g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-70, Type I.
b. NPS 2-1/2 to NPS 12, CWP Rating: 500 psig.
c. Body Material: ASTM A 126, gray iron with bolted bonnet.
d. Ends: Flanged.
e. Trim: Bronze.
f. Disc: Solid wedge.
g. Packing and Gasket: Asbestos free.

2.8 BRONZE GLOBE VALVES

A. Class 150, Bronze Globe Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Hammond Valve.
c. Kitz Corporation.

d. Milwaukee Valve Company.
e. NIBCO INC.
f. Powell Valves.
g. Red-White Valve Corporation.
h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
i. Zy-Tech Global Industries, Inc.

2. Description:

a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 300 psig.
c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
d. Ends: Threaded.
e. Stem: Bronze.
f. Disc: PTFE or TFE.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron.

2.9 IRON GLOBE VALVES

A. Class 125, Iron Globe Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Hammond Valve.
e. Kitz Corporation.
f. Milwaukee Valve Company.
g. NIBCO INC.
h. Powell Valves.
i. Red-White Valve Corporation.
j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
k. Zy-Tech Global Industries, Inc.

2. Description:

a. Standard: MSS SP-85, Type I.
b. CWP Rating: 200 psig.
c. Body Material: ASTM A 126, gray iron with bolted bonnet.
d. Ends: Flanged.
e. Trim: Bronze.
f. Packing and Gasket: Asbestos free.

2.10 CAST STEEL GLOBE VALVES

A. Class 150, Cast Steel Globe Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Crane Co.; Crane Valve Group; Crane Valves.
    b. Crane Co.; Crane Valve Group; Jenkins Valves.
    c. Crane Co.; Crane Valve Group; Stockham Division.
    d. Hammond Valve.
    e. Milwaukee Valve Company.

2. Description:

    a. Standard: MSS SP-85, Type I.
    b. Pressure Temperature Rating: 285psi @ 100 deg. F.
    c. Body Material: ASTM A 216, carbon steel with bolted bonnet.
    d. Ends: Flanged or welded.
    e. Trim: Stainless steel.
    f. Packing and Gasket: Asbestos free.

B. Class 300, Cast Steel Globe Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Crane Co.; Crane Valve Group; Crane Valves.
    b. Crane Co.; Crane Valve Group; Jenkins Valves.
    c. Crane Co.; Crane Valve Group; Stockham Division.
    d. Hammond Valve.
    e. Milwaukee Valve Company.

2. Description:

    a. Standard: MSS SP-85, Type I.
    b. Pressure Temperature Rating: 740 psi @100 deg. F.
    c. Body Material: ASTM A 216, carbon steel with bolted bonnet.
    d. Ends: Flanged or welded.
    e. Trim: Stainless steel.
    f. Packing and Gasket: Asbestos free.

2.11 CHAINWHEELS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Babbitt Steam Specialty Co.
2. Roto Hammer Industries.
3. Trumbull Industries.

B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.

1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
2. Attachment: For connection to butterfly valve stems.
3. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve.
4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install chain-wheels on operators for butterfly and gate valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.

F. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Plate-Type Check Valves: In horizontal or vertical position, between flanges.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball or butterfly valves.
2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
3. Throttling Service except Steam: Globe valves.
4. Throttling Service, Steam: Globe valves.
5. Pump-Discharge Check Valves:

    a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
    b. NPS 2-1/2 and Larger: Dual disc check valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where brazed-joint valve-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Steel Piping, NPS 2 and Smaller: Threaded ends.
4. For Steel Piping, NPS 2-1/2 to NPS 18: Flanged ends.

3.5 CHILLED-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with brazed joint ends instead of threaded ends.
2. Ball Valves: Two piece, full port, bronze ball with stainless-steel trim.
3. Bronze Swing Check Valves: Class 150, bronze disc.
4. Bronze Globe Valves: Class 150, bronze disc.

B. Pipe NPS 2-1/2 and Larger:

1. High-Performance Butterfly Valves: Class 150, single flange.
2. Iron, Plate-Type Check Valves: Class 150, dual plate; resilient seat.
3. Iron Globe Valves: Class 125.

3.6 HEATING-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Two piece, full port, bronze ball with stainless-steel trim.
3. Bronze Swing Check Valves: Class 150, bronze disc.
4. Bronze Globe Valves: Class 150, bronze disc.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Ball Valves, NPS 2-1/2 to NPS 10: Class 150.
2. High-Performance Butterfly Valves: Class 150.
3. Iron, Plate-Type Check Valves: Class 150, dual plate; resilient seat.
4. Iron Globe Valves, NPS 2-1/2 to NPS 12: Class 125.

3.7 LOW-PRESSURE STEAM VALVE SCHEDULE (15 PSIG OR LESS)

A. Pipe NPS 2 and Smaller:

1. Ball Valves: Class 150, carbon steel.
2. Globe Valves: Class 150, cast steel.

B. Pipe NPS 2-1/2 and Larger:

1. Ball Valves, NPS 2-1/2: Class 150, carbon steel.
2. High-Performance Butterfly Valves: Class 150.
3. Gate Valves: Class 150, cast steel, OS&Y.
4. Globe Valves: Class 150, cast steel, OS&Y.

3.8 HIGH-PRESSURE STEAM VALVE SCHEDULE (MORE THAN 15 PSIG)

A. Pipe NPS 2 and Smaller:

1. Ball Valves: Class 150, carbon steel.
2. Globe Valves: Class 150, carbon steel body.

B. Pipe Sizes NPS 2-1/2 and Larger:

1. Ball Valves, NPS 2-1/2: Class 150, carbon steel.
2. High-Performance Butterfly Valves: Class 300, single flange.
3. Gate Valves: Cast steel, class 150, OS&Y.
4. Globe Valves: Cast steel, class 150, OS&Y.

3.9 LOW PRESSURE STEAM CONDENSATE AND PUMPED CONDENSATE VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Ball Valves: Class 300, carbon steel, welded connections.
2. Globe Valves: Class 300, cast steel, welded connections.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Ball Valves, NPS 2-1/2 to NPS 10: Class 300.
2. High-Performance Butterfly Valves: Class 300, single flange.

3.10 HIGH PRESSURE STEAM CONDENSATE VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Ball Valves: Class 300, carbon steel, welded connections.
2. Globe Valves: Class 300, carbon steel body, welded connections.

B. Pipe Sizes NPS 2-1/2 and Larger:

1. Ball Valves, NPS 2-1/2: Class 300, carbon steel.
2. High-Performance Butterfly Valves: Class 300, single flange.
3. Globe Valves: Cast steel, class 300, OS&Y.

END OF SECTION 230523

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ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
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The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

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ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
230529	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Equipment supports.

B. Related Sections:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 230516 "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
3. Section 230548.13 "Vibration Controls” for HVAC" for vibration isolation devices.
4. Section 233113 "Metal Ducts” for duct hangers and supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of the Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Pipe stands.
4. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of trapeze hangers.
2. Design Calculations: Calculate requirements for designing trapeze hangers.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.7 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.

4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

C. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
2. Standard: MFMA-4.
3. Channels: Continuous slotted steel channel with inturned lips.
4. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
6. Metallic Coating: Hot-dipped galvanized.

B. Non-MFMA Manufacturer Metal Framing Systems:

1. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
2. Standard: Comply with MFMA-4.
3. Channels: Continuous slotted steel channel with inturned lips.
4. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
6. Coating: Paint.

2.4 THERMAL-HANGER SHIELD INSERTS

A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength and vapor barrier.

B. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig minimum compressive strength.

C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened Portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened Portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.6 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

D. High-Type, Single-Pipe Stand:

1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
2. Base: Stainless steel.
3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand:

1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.

2. Bases: One or more; plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.7 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.8 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb.

G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

I. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

J. Install lateral bracing with pipe hangers and supports to prevent swaying.

K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

L. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

N. Insulated Piping:

1. Attach clamps and spacers to piping.

    a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
b. NPS 4: 12 inches long and 0.06 inch thick.
c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Section 099113 "Exterior Painting", Section 099123 "Interior Painting" and Section 099600 "High Performance Coatings."

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

F. Use stainless-steel pipe hangers attachments for hostile environment applications.

G. Use copper-plated pipe hangers and stainless-steel attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal-hanger shield inserts for insulated piping and tubing.

J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.

2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.

2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb
    b. Medium (MSS Type 32): 1500 lb
    c. Heavy (MSS Type 33): 3000 lb

13. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
14. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.

2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

Q. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 230529

CONFIDENTIAL DOCUMENT

23054813

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

VIBRATION CONTROLS FOR HVAC

ImmuCell
Portland, ME

Reviews / Approvals

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The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

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23054813

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
23054813	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 230548.13 - VIBRATION CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Isolation pads.
2. Isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Housed spring mounts.
5. Elastomeric hangers.
6. Spring hangers.
7. Restraining braces and cables.

1.3 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.4 PERFORMANCE REQUIREMENTS

A. Wind-Restraint Loading:

1. Basic Wind Speed: 90 mph.
2. Building Classification Category: II.
3. Minimum 20 lb/sq. ft. multiplied by the maximum area of the HVAC component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.

B. Delegated-Design Submittal: For vibration isolation details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, forces required to select vibration isolators, and for designing vibration isolation bases.

a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Division 22 Sections for equipment mounted outdoors.

2. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.

C. Qualification Data: For professional engineer.

D. Field quality-control test reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide by one of the following:

1. Ace Mountings Co., Inc.
2. Amber/Booth Company, Inc.
3. California Dynamics Corporation.
4. Isolation Technology, Inc.
5. Kinetics Noise Control.
6. Mason Industries.
7. Vibration Eliminator Co., Inc.
8. Vibration Isolation.

D. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.

1. Resilient Material: Oil- and water-resistant neoprene.

E. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.

1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

F. Spring Isolators: Freestanding, laterally stable, open-spring isolators.

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

G. Elastomeric Hangers: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.

H. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

2.2 FACTORY FINISHES

A. Finish: Manufacturer's standard prime-coat finish ready for field painting.

B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.
2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
3. Baked enamel or powder coat for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 VIBRATION-CONTROL DEVICE INSTALLATION

A. Install cables so they do not bend across edges of adjacent equipment or building structure.

B. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

C. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

D. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

E. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Remove and replace malfunctioning units and retest as specified above.

C. Prepare test and inspection reports.

3.4 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust active height of spring isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.5 VIBRATION ISOLATION EQUIPMENT BASES INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."

END OF SECTION 230548.13

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230553

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

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230553

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
230553	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Duct labels.
5. Valve tags.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: Black.
3. Background Color: White.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Red.

C. Background Color: White.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

2.4 DUCT LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: White.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

2.5 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware. Stainless steel tags shall be used within cleanroom space.
2. Fasteners: Brass wire-link or beaded chain; or S-hook. Stainless steel fasteners shall be used within cleanroom space.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Piping Color Coding: Painting of piping is specified in Division 09 Section "Interior Painting."

B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

C. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

D. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

E. Pipe Label Color Schedule:

1. Chilled-Water Piping: White letters on a safety-green background.
2. Heating Water Piping: White letters on a safety-green background.
3. Refrigerant Piping: White letters and a safety purple background.
4. Low-Pressure Steam Piping: White letters on a safety grey background.
5. High-Pressure Steam Piping: White letters on a safety grey background.
6. Steam Condensate Piping: White letters on a safety grey background.

3.4 DUCT LABEL INSTALLATION

A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:

1. Blue: For supply-air supply ducts.
2. Yellow: For return-air supply ducts.
3. Green: For exhaust-, outside-, and relief-air ducts.

B. Stenciled Duct Label Option: Stenciled labels showing service and flow direction may be provided instead of plastic-laminated duct labels, at Installer's option.

C. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.5 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering

hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Install tags after insulation is installed and verify that the tag is visible.

C. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

a. Chilled Water: 1-1/2 inches, round.
b. Heating Hot Water: 1-1/2 inches, round.
c. Potable Water: 1-1/2 inches, round
d. Gas: 1-1/2 inches, round.
e. Process 1-1/2 inches, round.

2. Valve-Tag Colors:

a. Toxic and Corrosive Fluids: Black letters on a safety-orange background.
b. Flammable Fluids: Black letters on a safety-yellow background.
c. Combustible Fluids: White letters on a safety-brown background.
d. Potable and Other Water: White letters on a safety-green background.
e. Compressed Air: White letters on a safety-blue background.
f. Defined by User: White letters on a safety-purple background, black letters on a safety-white background, white letters on a safety-gray background, and white letters on a safety-black background

3.6 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 230553

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230593

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

TESTING, ADJUSTING, AND BALANCING FOR HVAC

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

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230593

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
230593	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Balancing Air Systems:

    a. Constant-volume air systems.

2. Balancing Hydronic Piping Systems:

    a. Constant-flow hydronic systems.
    b. Variable-flow hydronic systems.
    c. Insure that glycol heating and chilled water systems are filled with 30% propylene glycol prior to proceeding with TAB work.

3. Testing, Adjusting, and Balancing Equipment:

    a. Heat exchangers.
    b. Motors.
    c. Chillers.
    d. Condensing units.
    e. Boilers.
    f. Heat-transfer coils.

4. Testing, adjusting, and balancing existing systems and equipment.
5. Sound tests.
6. Vibration tests.
7. Duct leakage tests.
8. Control system verification.

1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. BAS: Building automation systems.

C. NEBB: National Environmental Balancing Bureau.

D. TAB: Testing, adjusting, and balancing.

E. TABB: Testing, Adjusting, and Balancing Bureau.

F. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

G. TDH: Total dynamic head.

1.4 PREINSTALLATION MEETINGS

A. TAB Conference: If requested by the Owner, conduct a TAB conference at Project site after approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Provide a minimum of 14 days' advance notice of scheduled meeting time and location.

1. Minimum Agenda Items:

a. The Contract Documents examination report.
b. The TAB plan.
c. Needs for coordination and cooperation of trades and subcontractors.
d. Proposed procedures for documentation and communication flow.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

D. System Readiness Checklists: Within 30 days of Contractor's Notice to Proceed, submit system readiness checklists as specified in "Preparation" Article.

E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.

F. Certified TAB reports.

G. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.6 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC, NEBB, or TABB.

1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC, NEBB, or TABB.
2. TAB Technician: Employee of the TAB contractor and who is certified by AABC, NEBB, or TABB as a TAB technician.

B. TAB Conference: Meet with Construction Manager on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Require the participation of the TAB field supervisor and technicians. Provide seven days' advance notice of scheduled meeting time and location.

1. Agenda Items:

a. The Contract Documents examination report.
b. The TAB plan.
c. Coordination and cooperation of trades and subcontractors.
d. Coordination of documentation and communication flow.

C. Certify TAB field data reports and perform the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

D. TAB Report Forms: Use standard TAB contractor's forms approved by Construction Manager.

E. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.

B. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine equipment performance data including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

G. Examine test reports specified in individual system and equipment Sections.

H. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

I. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

J. Examine strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.

K. Examine control valves for proper installation for their intended function of throttling, diverting, or mixing fluid flows.

L. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

M. Examine system pumps to ensure absence of entrained air in the suction piping.

N. Examine operating safety interlocks and controls on HVAC equipment.

O. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes the following:

1. Equipment and systems to be tested.
2. Strategies and step-by-step procedures for balancing the systems.
3. Instrumentation to be used.
4. Sample forms with specific identification for all equipment.

B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. Airside:

a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
b. Duct systems are complete with terminals installed.
c. Volume, smoke, and fire dampers are open and functional.
d. Clean filters are installed.
e. Fans are operating, free of vibration, and rotating in correct direction.
f. Variable-frequency controllers' startup is complete and safeties are verified.
g. Automatic temperature-control systems are operational.
h. Ceilings are installed.
i. Windows and doors are installed.
j. Suitable access to balancing devices and equipment is provided.

2. Hydronics:

a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
b. Piping is complete with terminals installed.
c. Water treatment is complete.
d. Systems are flushed, filled, and air purged.
e. Strainers are pulled and cleaned.
f. Control valves are functioning per the sequence of operation.
g. Shutoff and balance valves have been verified to be 100 percent open.
h. Pumps are started and proper rotation is verified.
i. Pump gage connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
j. Variable-frequency controllers' startup is complete and safeties are verified.
k. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance and in this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230700 “Mechanical Systems Insulation.”

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units as directed by client.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.

d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

2. Measure fan static pressures as follows:

a. Measure static pressure directly at the fan outlet or through the flexible connection.
b. Measure static pressure directly at the fan inlet or through the flexible connection.
c. Measure static pressure across each component that makes up the air-handling system.
d. Report artificial loading of filters at the time static pressures are measured.

3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
4. Obtain approval from the Owner for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.

1. Measure airflow of submain and branch ducts.
2. Adjust submain and branch duct volume dampers for specified airflow.
3. Re-measure each submain and branch duct after all have been adjusted.

C. Adjust air inlets and outlets for each space to indicated airflows.

1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
2. Measure inlets and outlets airflow.
3. Adjust each inlet and outlet for specified airflow.
4. Re-measure each inlet and outlet after they have been adjusted.

D. Verify final system conditions.

1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
2. Re-measure and confirm that total airflow is within design.
3. Re-measure all final fan operating data, rpms, volts, amps, and static profile.
4. Mark all final settings.
5. Test system in economizer mode if applicable. Verify proper operation and adjust if necessary.
6. Measure and record all operating data.
7. Record final fan-performance data.

3.6 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports for pumps, coils, and heat exchangers. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required coil and heat exchanger flow rates with pump design flow rate.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. In addition to requirements in "Preparation" Article, prepare hydronic systems for testing and balancing as follows:

1. Check liquid level in expansion tank.
2. Check highest vent for adequate pressure.
3. Check flow-control valves for proper position.
4. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
5. Verify that motor starters are equipped with properly sized thermal protection.
6. Check that air has been purged from the system.

3.7 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

A. Adjust pumps to deliver total design gpm.

1. Measure total water flow.

    a. Position valves for full flow through coils.
    b. Measure flow by main flow meter, if installed.
    c. If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.

2. Measure pump TDH as follows:

    a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
    b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
    c. Convert pressure to head and correct for differences in gage heights.
    d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
    e. With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.

3. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

B. Adjust flow-measuring devices installed in mains and branches to design water flows.

1. Measure flow in main and branch pipes.
2. Adjust main and branch balance valves for design flow.
3. Re-measure each main and branch after all have been adjusted.

C. Adjust flow-measuring devices installed at terminals for each space to design water flows.

1. Measure flow at terminals.
2. Adjust each terminal to design flow.
3. Re-measure each terminal after it is adjusted.
4. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
5. Perform temperature tests after flows have been balanced.

D. For systems with pressure-independent valves at terminals:

1. Measure differential pressure and verify that it is within manufacturer's specified range.
2. Perform temperature tests after flows have been verified.

E. For systems without pressure-independent valves or flow-measuring devices at terminals:

1. Measure and balance coils by either coil pressure drop or temperature method.
2. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

F. Verify final system conditions as follows:

1. Re-measure and confirm that total water flow is within design.
2. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
3. Mark final settings.

G. Verify that memory stops have been set.

3.8 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals, and proceed as specified above for hydronic systems.

B. Adjust the variable-flow hydronic system as follows:

1. Verify that the differential-pressure sensor is located as indicated.
2. Determine whether there is diversity in the system.

C. For systems with no diversity:

1. Adjust pumps to deliver total design gpm.

a. Measure total water flow.

1) Position valves for full flow through coils.
2) Measure flow by main flow meter, if installed.
3) If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.

b. Measure pump TDH as follows:

1) Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
2) Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
3) Convert pressure to head and correct for differences in gage heights.
4) Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
5) With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.

c. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

2. Adjust flow-measuring devices installed in mains and branches to design water flows.

a. Measure flow in main and branch pipes.
b. Adjust main and branch balance valves for design flow.
c. Re-measure each main and branch after all have been adjusted.

3. Adjust flow-measuring devices installed at terminals for each space to design water flows.

a. Measure flow at terminals.
b. Adjust each terminal to design flow.
c. Re-measure each terminal after it is adjusted.
d. Position control valves to bypass the coil and adjust the bypass valve to maintain design flow.
e. Perform temperature tests after flows have been balanced.

4. For systems with pressure-independent valves at terminals:

a. Measure differential pressure and verify that it is within manufacturer's specified range.
b. Perform temperature tests after flows have been verified.

5. For systems without pressure-independent valves or flow-measuring devices at terminals:

a. Measure and balance coils by either coil pressure drop or temperature method.
b. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

6. Prior to verifying final system conditions, determine the system differential-pressure set point.
7. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion open discharge valve 100 percent and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.
8. Mark final settings and verify that all memory stops have been set.
9. Verify final system conditions as follows:

a. Re-measure and confirm that total water flow is within design.
b. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
c. Mark final settings.

10. Verify that memory stops have been set.

D. For systems with diversity:

1. Determine diversity factor.
2. Simulate system diversity by closing required number of control valves, as approved by the design engineer.
3. Adjust pumps to deliver total design gpm.

a. Measure total water flow.

1) Position valves for full flow through coils.
2) Measure flow by main flow meter, if installed.
3) If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.

b. Measure pump TDH as follows:

1) Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
2) Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
3) Convert pressure to head and correct for differences in gage heights.
4) Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
5) With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.

c. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

4. Adjust flow-measuring devices installed in mains and branches to design water flows.

a. Measure flow in main and branch pipes.
b. Adjust main and branch balance valves for design flow.
c. Re-measure each main and branch after all have been adjusted.

5. Adjust flow-measuring devices installed at terminals for each space to design water flows.

a. Measure flow at terminals.
b. Adjust each terminal to design flow.
c. Re-measure each terminal after it is adjusted.
d. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
e. Perform temperature tests after flows have been balanced.

6. For systems with pressure-independent valves at terminals:

    a. Measure differential pressure, and verify that it is within manufacturer's specified range.
    b. Perform temperature tests after flows have been verified.

7. For systems without pressure-independent valves or flow-measuring devices at terminals:

    a. Measure and balance coils by either coil pressure drop or temperature method.
    b. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

8. Open control valves that were shut. Close a sufficient number of control valves that were previously open to maintain diversity, and balance terminals that were just opened.
9. Prior to verifying final system conditions, determine system differential-pressure set point.
10. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion open discharge valve 100 percent and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.
11. Mark final settings and verify that memory stops have been set.
12. Verify final system conditions as follows:

    a. Re-measure and confirm that total water flow is within design.
    b. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
    c. Mark final settings.

13. Verify that memory stops have been set.

3.9 PROCEDURES FOR STEAM SYSTEMS

A. Measure and record upstream and downstream pressure of each piece of equipment.

B. Measure and record upstream and downstream steam pressure of pressure-reducing valves.

C. Check settings and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record final settings.

D. Check settings and operation of each safety valve. Record settings.

E. Verify the operation of each steam trap.

3.10 PROCEDURES FOR HEAT EXCHANGERS

A. Adjust water flow to within specified tolerances.

B. Measure inlet and outlet water temperatures.

C. Measure inlet steam pressure.

D. Check settings and operation of safety and relief valves. Record settings.

3.11 PROCEDURES FOR MOTORS

A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Phase and hertz.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter size and thermal-protection-element rating.
8. Service factor and frame size.

B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

3.12 PROCEDURES FOR CHILLERS

A. Balance water flow through each evaporator to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:

1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
2. For water-cooled chillers, condenser-water entering and leaving temperatures, pressure drop, and water flow.
3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
4. Power factor if factory-installed instrumentation is furnished for measuring kilowatts.
5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatts.
6. Capacity: Calculate in tons of cooling.
7. For air-cooled chillers, verify condenser-fan rotation and record fan and motor data including number of fans and entering- and leaving-air temperatures.

3.13 PROCEDURES FOR BOILERS

A. Steam Boilers:

1. Measure and record entering-water temperature.
2. Measure and record feed water flow.
3. Measure and record leaving-steam pressure and temperature.
4. Record relief valve pressure setting.

3.14 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each water coil:

1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop for major (more than 20 gpm) equipment coils, excluding unitary equipment such as reheat coils, unit heaters, and fan-coil units.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.

B. Measure, adjust, and record the following data for each electric heating coil:

1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

C. Measure, adjust, and record the following data for each steam coil:

1. Dry-bulb temperature of entering and leaving air.
2. Airflow.
3. Inlet steam pressure.

D. Measure, adjust, and record the following data for each refrigerant coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.

3.15 SOUND TESTS

A. After the systems are balanced and construction is Substantially Complete, measure and record sound levels at 10 locations as designated by the Owner.

B. Instrumentation:

1. The sound-testing meter shall be a portable, general-purpose testing meter consisting of a microphone, processing unit, and readout.
2. The sound-testing meter shall be capable of showing fluctuations at minimum and maximum levels, and measuring the equivalent continuous sound pressure level (LEQ).
3. The sound-testing meter must be capable of using 1/3 octave band filters to measure mid-frequencies from 31.5 Hz to 8000 Hz.
4. The accuracy of the sound-testing meter shall be plus or minus one decibel.

C. Test Procedures:

1. Perform test at quietest background noise period. Note cause of unpreventable sound that affects test outcome.
2. Equipment should be operating at design values.
3. Calibrate the sound-testing meter prior to taking measurements.

4. Use a microphone suitable for the type of noise levels measured that is compatible with meter. Provide a windshield for outside or in-duct measurements.
5. Record a set of background measurements in dBA and sound pressure levels in the eight un-weighted octave bands63 Hz to 8000 Hz (NC) with the equipment off.
6. Take sound readings in dBA and sound pressure levels in the eight un-weighted octave bands 63 Hz to 8000 Hz (NC) with the equipment operating.
7. Take readings no closer than 36 inches from a wall or from the operating equipment and approximately 60 inches from the floor, with the meter held or mounted on a tripod.
8. For outdoor measurements, move sound-testing meter slowly and scan area that has the most exposure to noise source being tested. Use A-weighted scale for this type of reading.

D. Reporting:

1. Report shall record the following:

   a. Location.
   b. System tested.
   c. dBA reading.
   d. Sound pressure level in each octave band with equipment on and off.

2. Plot sound pressure levels on NC worksheet with equipment on and off.

3.16 VIBRATION TESTS

A. After systems are balanced and construction is Substantially Complete, measure and record vibration levels on equipment having motor horsepower equal to or greater than **15**.

B. Instrumentation:

1. Use portable, battery-operated, and microprocessor-controlled vibration meter with or without a built-in printer.
2. The meter shall automatically identify engineering units, filter bandwidth, amplitude, and frequency scale values.
3. The meter shall be able to measure machine vibration displacement in mils of deflection, velocity in inches per second, and acceleration in inches per second squared.
4. Verify calibration date is current for vibration meter before taking readings.

C. Test Procedures:

1. To ensure accurate readings, verify that accelerometer has a clean, flat surface and is mounted properly.
2. With the unit running, set up vibration meter in a safe, secure location. Connect transducer to meter with proper cables. Hold magnetic tip of transducer on top of the bearing, and measure unit in mils of deflection. Record measurement, then move transducer to the side of the bearing and record in mils of deflection. Record an axial reading in mils of deflection by holding nonmagnetic, pointed transducer tip on end of shaft.
3. Change vibration meter to velocity (inches per second) measurements. Repeat and record above measurements.

4. Record CPM or rpm.
5. Read each bearing on motor, fan, and pump as required. Track and record vibration levels from rotating component through casing to base.

D. Reporting:

1. Report shall record location and the system tested.
2. Include horizontal-vertical-axial measurements for tests.
3. Verify that vibration limits follow Specifications, or, if not specified, follow the General Machinery Vibration Severity Chart or Vibration Acceleration General Severity Chart from the AABC National Standards. Acceptable levels of vibration are normally "smooth" to "good."
4. Include in report General Machinery Vibration Severity Chart, with conditions plotted.

3.17 DUCT LEAKAGE TESTS

A. Witness the duct pressure testing performed by Installer.

B. Verify that proper test methods are used and that leakage rates are within specified tolerances.

C. Report deficiencies observed.

3.18 CONTROLS VERIFICATION

A. In conjunction with system balancing, perform the following:

1. Verify temperature control system is operating within the design limitations.
2. Confirm that the sequences of operation are in compliance with Contract Documents.
3. Verify that controllers are calibrated and function as intended.
4. Verify that controller set points are as indicated.
5. Verify the operation of lockout or interlock systems.
6. Verify the operation of valve and damper actuators.
7. Verify that controlled devices are properly installed and connected to correct controller.
8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.

B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

3.19 TOLERANCES

A. Set HVAC system's airflow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 10 percent.
2. Air Outlets and Inlets: Plus 10 percent.
3. Heating-Water Flow Rate: Plus 10 percent.
4. Cooling-Water Flow Rate: Plus 10 percent.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.20 PROGRESS REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems balancing devices. Recommend changes and additions to systems balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: Prepare weekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.21 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.
3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB specialist.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.

11. Summary of contents including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:

    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Fan drive settings including settings and percentage of maximum pitch diameter.
    e. Inlet vane settings for variable-air-volume systems.
    f. Settings for supply-air, static-pressure controller.
    g. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:

    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Unit arrangement and class.
    g. Discharge arrangement.
    h. Sheave make, size in inches, and bore.
    i. Center-to-center dimensions of sheave and amount of adjustments in inches.
    j. Number, make, and size of belts.
    k. Number, type, and size of filters.

2. Motor Data:

    a. Motor make, and frame type and size.
    b. Horsepower and rpm.

c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Filter static-pressure differential in inches wg.
f. Preheat-coil static-pressure differential in inches wg.
g. Cooling-coil static-pressure differential in inches wg.
h. Heating-coil static-pressure differential in inches wg .
i. Outdoor airflow in cfm.
j. Return airflow in cfm.
k. Outdoor-air damper position.
l. Return-air damper position.
m. Vortex damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:

a. System identification.
b. Location.
c. Coil type.
d. Number of rows.
e. Fin spacing in fins per inch o.c.
f. Make and model number.
g. Face area in sq. ft.
h. Tube size in NPS.
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm.
b. Average face velocity in fpm.
c. Air pressure drop in inches wg.
d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
e. Return-air, wet- and dry-bulb temperatures in deg F.
f. Entering-air, wet- and dry-bulb temperatures in deg F.
g. Leaving-air, wet- and dry-bulb temperatures in deg F.
h. Water flow rate in gpm.
i. Water pressure differential in feet of head or psig.
j. Entering-water temperature in deg F.
k. Leaving-water temperature in deg F.
l. Refrigerant expansion valve and refrigerant types.
m. Refrigerant suction pressure in psig.

n. Refrigerant suction temperature in deg F.

G. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Center-to-center dimensions of sheave and amount of adjustments in inches.

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

H. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

a. System and air-handling-unit number.
b. Location and zone.
c. Traverse air temperature in deg F.
d. Duct static pressure in inches wg.
e. Duct size in inches.
f. Duct area in sq. ft..
g. Indicated airflow rate in cfm.
h. Indicated velocity in fpm.
i. Actual airflow rate in cfm.
j. Actual average velocity in fpm.
k. Barometric pressure in psig.

I. Air-Terminal-Device Reports:

1. Unit Data:

    a. System and air-handling unit identification.
    b. Location and zone.
    c. Apparatus used for test.
    d. Area served.
    e. Make.
    f. Number from system diagram.
    g. Type and model number.
    h. Size.
    i. Effective area in sq. ft..

2. Test Data (Indicated and Actual Values):

    a. Airflow rate in cfm.
    b. Air velocity in fpm.
    c. Preliminary airflow rate as needed in cfm.
    d. Preliminary velocity as needed in fpm.
    e. Final airflow rate in cfm.
    f. Final velocity in fpm.
    g. Space temperature in deg F.

J. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:

    a. System and air-handling-unit identification.
    b. Location and zone.
    c. Room or riser served.
    d. Coil make and size.
    e. Flowmeter type.

2. Test Data (Indicated and Actual Values):

    a. Airflow rate in cfm.
    b. Entering-water temperature in deg F.
    c. Leaving-water temperature in deg F.
    d. Water pressure drop in feet of head or psig.
    e. Entering-air temperature in deg F.
    f. Leaving-air temperature in deg F.

K. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:

    a. Unit identification.
    b. Location.
    c. Service.
    d. Make and size.
    e. Model number and serial number.

f. Water flow rate in gpm.
g. Water pressure differential in feet of head or psig.
h. Required net positive suction head in feet of head or psig.
i. Pump rpm.
j. Impeller diameter in inches.
k. Motor make and frame size.
l. Motor horsepower and rpm.
m. Voltage at each connection.
n. Amperage for each phase.
o. Full-load amperage and service factor.
p. Seal type.

2. Test Data (Indicated and Actual Values):

a. Static head in feet of head or psig.
b. Pump shutoff pressure in feet of head or psig.
c. Actual impeller size in inches.
d. Full-open flow rate in gpm.
e. Full-open pressure in feet of head or psig.
f. Final discharge pressure in feet of head or psig.
g. Final suction pressure in feet of head or psig.
h. Final total pressure in feet of head or psig.
i. Final water flow rate in gpm.
j. Voltage at each connection.
k. Amperage for each phase.

L. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.22 VERIFICATION OF TAB REPORT

A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of the Construction Manager.

B. Construction Manager shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

E. If TAB work fails, proceed as follows:

1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.
3. If the second verification also fails, Owner may contact AABC Headquarters regarding the AABC National Performance Guarantee.

F. Prepare test and inspection reports.

3.23 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

CONFIDENTIAL DOCUMENT

230700

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

MECHANICAL SYSTEMS INSULATION

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

230700

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

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SECTION 230700 – MECHANICAL SYSTEMS INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Insulation Materials:

    a. Flexible elastomeric.
    b. Melamine.
    c. Mineral fiber.

2. Fire-rated insulation systems.
3. Insulating cements.
4. Adhesives.
5. Mastics.
6. Sealants.
7. Factory-applied jackets.
8. Field-applied fabric-reinforcing mesh.
9. Field-applied jackets.
10. Tapes.
11. Securements.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

B. Shop Drawings:

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.

7. Detail application at linkages of control devices.
8. Detail field application for each equipment type.

C. Qualification Data: For qualified Installer.

D. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

E. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Aeroflex USA Inc.; Aerocel.
b. Armacell LLC; AP Armaflex.
c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

G. Melamine Insulation: Flexible, non-fibrous, open cell foam. Comply with ASTM C-1410. Factory applied white PVC jacket.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Techlite, SSL 879.

H. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type II with factory-applied vinyl jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. CertainTeed Corp.; Duct Wrap.
    b. Johns Manville; Microlite.
    c. Knauf Insulation; Duct Wrap.
    d. Manson Insulation Inc.; Alley Wrap.
    e. Owens Corning; All-Service Duct Wrap.

I. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. For equipment applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. CertainTeed Corp.; Commercial Board.
    b. Fibrex Insulations Inc.; FBX.
    c. Johns Manville; 800 Series Spin-Glas.
    d. Knauf Insulation; Insulation Board.
    e. Manson Insulation Inc.; AK Board.
    f. Owens Corning; Fiberglas 700 Series.

J. High-Temperature, Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type III, without factory-applied jacket.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Fibrex Insulations Inc.; FBX.
    b. Johns Manville; 1000 Series Spin-Glas.
    c. Owens Corning; High Temperature Industrial Board Insulations.
    d. Rock Wool Manufacturing Company; Delta Board.
    e. Roxul Inc.; Roxul RW.
    f. Thermafiber; Thermafiber Industrial Felt.

K. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Fibrex Insulations Inc.; Coreplus 1200.
    b. Johns Manville; Micro-Lok.
    c. Knauf Insulation; 1000 Pipe Insulation.
    d. Manson Insulation Inc.; Alley-K.
    e. Owens Corning; Fiberglas Pipe Insulation.

2. Type II, 1000 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type II, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

L. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASK jacket complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. CertainTeed Corp.; CrimpWrap.
b. Johns Manville; MicroFlex.
c. Knauf Insulation; Pipe and Tank Insulation.
d. Manson Insulation Inc.; AK Flex.
e. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Insulco, Division of MFS, Inc.; Triple I.
b. P. K. Insulation Mfg. Co., Inc.; Super-Stik.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. P. K. Insulation Mfg. Co., Inc.; Thermal-V-Kote.

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Insulco, Division of MFS, Inc.; SmoothKote.
b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
c. Rock Wool Manufacturing Company; Delta One Shot.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Aeroflex USA Inc.; Aeroseal.
b. Armacell LCC; 520 Adhesive.
c. Foster Products Corporation, H. B. Fuller Company; 85-75.
d. RBX Corporation; Rubatex Contact Adhesive.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Products, Division of ITW; CP-82.
b. Foster Products Corporation, H. B. Fuller Company; 85-20.
c. ITW TACC, Division of Illinois Tool Works; S-90/80.
d. Marathon Industries, Inc.; 225.
e. Mon-Eco Industries, Inc.; 22-25.

D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Products, Division of ITW; CP-82.
b. Foster Products Corporation, H. B. Fuller Company; 85-20.
c. ITW TACC, Division of Illinois Tool Works; S-90/80.
d. Marathon Industries, Inc.; 225.
e. Mon-Eco Industries, Inc.; 22-25.

E. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Dow Chemical Company (The); 739, Dow Silicone.
b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
c. P.I.C. Plastics, Inc.; Welding Adhesive.
d. Speedline Corporation; Speedline Vinyl Adhesive.

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Products, Division of ITW; CP-35.
b. Foster Products Corporation, H. B. Fuller Company; 30-90.
c. ITW TACC, Division of Illinois Tool Works; CB-50.
d. Marathon Industries, Inc.; 590.
e. Mon-Eco Industries, Inc.; 55-40.
f. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
5. Color: White.

2.5 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Products, Division of ITW; CP-76-8.
b. Foster Products Corporation, H. B. Fuller Company; 95-44.
c. Marathon Industries, Inc.; 405.
d. Mon-Eco Industries, Inc.; 44-05.
e. Vimasco Corporation; 750.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.

B. ASJ Flashing Sealants, and Vinyl, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Products, Division of ITW; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.

3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.7 FIELD-APPLIED JACKETS

A. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Johns Manville; Zeston.
    b. P.I.C. Plastics, Inc.; FG Series.
    c. Proto PVC Corporation; LoSmoke.
    d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

    a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

5. Factory-fabricated tank heads and tank side panels.

B. Metal Jacket:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Products, Division of ITW; Metal Jacketing Systems.
b. PABCO Metals Corporation; Surefit.
c. RPR Products, Inc.; Insul-Mate.

2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.

a. Sheet and roll stock ready for shop or field sizing.
b. Finish and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper.
d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
e. Factory-Fabricated Fitting Covers:

1) Same material, finish, and thickness as jacket.
2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) Tee covers.
4) Flange and union covers.
5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.

a. Sheet and roll stock ready for shop or field sizing.
b. Material, finish, and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper.
d. Factory-Fabricated Fitting Covers:

1) Same material, finish, and thickness as jacket.
2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) Tee covers.
4) Flange and union covers.
5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.8 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
    b. Compac Corp.; 104 and 105.
    c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
    d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
    b. Compac Corp.; 110 and 111.
    c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
    d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
    b. Compac Corp.; 130.
    c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
    d. Venture Tape; 1506 CW NS.

2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
    b. Compac Corp.; 120.
    c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
    d. Venture Tape; 3520 CW.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.9 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Childers Products; Bands.
    b. PABCO Metals Corporation; Bands.
    c. RPR Products, Inc.; Bands.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304; 0.015 inch wide with wing or closed seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 1/2 inch wide with wing or closed seal.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch diameter shank, length to suit depth of insulation indicated.

    a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

        1) AGM Industries, Inc.; CWP-1.
        2) GEMCO; CD.
        3) Midwest Fasteners, Inc.; CD.
        4) Nelson Stud Welding; TPA, TPC, and TPS.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

    a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) AGM Industries, Inc.; CWP-1.
2) GEMCO; Cupped Head Weld Pin.
3) Midwest Fasteners, Inc.; Cupped Head.
4) Nelson Stud Welding; CHP.

3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
2) GEMCO; Perforated Base.
3) Midwest Fasteners, Inc.; Spindle.

b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch diameter shank, length to suit depth of insulation indicated.
d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) AGM Industries, Inc.; RC-150.
2) GEMCO; R-150.
3) Midwest Fasteners, Inc.; WA-150.
4) Nelson Stud Welding; Speed Clips.

b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch wide, stainless steel or Monel.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above ambient services, do not install insulation to the following:

1. Vibration-control devices.

2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

1. Comply with requirements in Division 07 Section "Penetration Firestopping" firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves

and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.

2. Pipe: Install insulation continuously through floor penetrations.
3. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
3. Protect exposed corners with secured corner angles.
4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:

    a. Do not weld anchor pins to ASME-labeled pressure vessels.
    b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
    c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
    d. Do not overcompress insulation during installation.
    e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
    f. Impale insulation over anchor pins and attach speed washers.
    g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
7. Stagger joints between insulation layers at least 3 inches.
8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.

10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.

1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
2. Seal longitudinal seams and end joints.

C. Insulation Installation on Pumps:

1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
2. Fabricate boxes from aluminum, at least 0.040 inch thick.
3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

3.6 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable

insulation cover. For below ambient services, provide a design that maintains vapor barrier.

6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gauges, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.7 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

E. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not overcompress insulation during installation.
    e. Impale insulation over pins and attach speed washers.
    f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.

b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

F. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

   a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
   b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
   c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
   d. Do not overcompress insulation during installation.
   e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
   b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.9 MELAMINE INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of polyolefin pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.10 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.

2. Embed glass cloth between two 0.062-inch thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

E. Where PVDC jackets are indicated, install as follows:

1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
2. Wrap factory-presized jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
3. Continuous jacket can be spiral wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. The 33-1/2-inch circumference limit allows for 2-inch overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.11 FINISHES

A. Duct, Equipment, and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Owner. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.12 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Inspect ductwork, randomly selected by Owner, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
2. Inspect field-insulated equipment, randomly selected by Owner, by removing field-applied jacket and insulation in layers in reverse order of their installation.
3. Inspect pipe, fittings, strainers, and valves, randomly selected by Owner, by removing field-applied jacket and insulation in layers in reverse order of their installation.

B. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.13 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, exposed supply and return air.
2. Outdoor, exposed supply and return.

B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Factory-insulated flexible ducts.
3. Factory-insulated plenums and casings.
4. Flexible connectors.
5. Vibration-control devices.
6. Factory-insulated access panels and doors.

3.14 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Exposed return-air duct insulation shall be the following:

1. Mineral-Fiber Board: 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.

B. Exposed supply-air duct insulation shall be the following:

1. Mineral-Fiber Board: 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.

3.15 ABOVEGROUND, OUTDOOR DUCT INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a duct system, selection from materials listed is Contractor's option.

B. Outdoor duct insulation shall be the following:

1. Mineral-Fiber Board: 3 inches (75 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.

3.16 EQUIPMENT INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.

B. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.

C. Heat-exchanger (water-to-water for cooling service) insulation shall be the following:

1. Flexible Elastomeric: 1 inch thick.

D. Steam-to-hot-water converter insulation shall be the following:

1. Mineral-Fiber Board: 2 inches thick.

E. Chilled-water pump insulation shall be the following:

1. Flexible elastomeric: 1 inch thick.

F. Heating-hot-water pump insulation shall be the following:

1. Mineral-Fiber Board: 2 inches thick.

G. Steam condensate pump and boiler feedwater pump insulation shall be the following:

1. None.

H. Chilled-water expansion/compression tank insulation shall be the following:

1. Flexible Elastomeric: 1 inch thick.

I. Chilled water buffer tank insulation shall be the following:

1. Flexible Elastomeric: 1 1/2 inch thick.

J. Heating-hot-water expansion/compression tank insulation shall be the following:

1. None.

K. Heat-recovery expansion/compression tank insulation shall be the following:

1. None.

L. Chilled-water air-separator insulation shall be one of the following:

1. Flexible Elastomeric: 1 inch thick.
2. Mineral-Fiber Board: 1 inch thick.

M. Heating-hot-water air-separator insulation shall be the following:

1. Mineral-Fiber Board: 2 inches thick.

N. Heat-recovery air-separator insulation shall be the following:

1. None.

O. Deaerator insulation shall be the following:

1. Mineral-Fiber Board: 2 inches thick.

P. Steam flash-tank, flash-separator, and blow-off-tank insulation shall be the following:

1. Mineral-Fiber Board: 2 inches thick.

Q. Piping system filter-housing insulation shall be the following:

1. Mineral-Fiber Board: 1 inch thick.

3.17 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

3.18 INDOOR PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation shall be the following:

a. Flexible Elastomeric: 3/4 inch thick.

B. Chilled Glycol:

1. NPS ½ to 1-inch: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe, Type II: 1 1/2-inch thick.

b. Melamine: 1 1/2-inch thick (GMP space).

2. NPS 1 ½ to 14-inch: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe, Type II: 2- inch thick.
b. Melamine: 1 1/2-inch thick (GMP space).

C. Heating-Hot-Glycol Supply and Return, 200 Deg F and below:

1. NPS ½ to 1 ½ -inch: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe, Type II: 1 1/2-inch thick.

2. Larger than NPS 1 ½ to 2 1/2-inch: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe, Type II: 2- inch thick.
3. NPS 3-inch: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe, Type II: 2 1/2- inch thick.

4. NPS 4 to 6-inch: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe, Type II: 3- inch thick.

D. Steam and Steam Condensate, 350 Deg F and below:
1. NPS 1.5-inch and smaller: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe, Type II: 2-inch thick.

b. Melamine: 2-inch thick (GMP space).

2. NPS 2” inch and larger-inch: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe, Type II: 4- inch thick.

b. Melamine: 4-inch thick (GMP space).

E. Heat-Recovery Piping:

1. All Pipe Sizes: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type II: 1.5 inch thick.

F. Hot Service Drains:

1. All Pipe Sizes: Insulation shall be the following:

   a. Mineral-Fiber, Preformed Pipe, Type I or II: 1 inch thick.

G. Hot Service Vents:

1. Mineral-Fiber, Preformed Pipe, Type I or II: 1 inch thick.

3.19 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Provide one inch (1”) additional thickness to scheduled thickness listed above.

3.20 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Ducts and Plenums, Concealed:

1. None.

D. Ducts and Plenums Exposed (Mechanical Rooms, Equipment Mezzanine):

1. None.

E. Ducts and Plenums, Exposed (Non GMP Spaces):

1. PVC, 30 mils thick.

F. Equipment, Concealed:

1. None.

G. Equipment, Exposed:

1. None.

H. Piping, Concealed:

1. None.

I. Piping, Exposed (Mechanical Rooms, Equipment Mezzanine):

1. None.

J. Piping, Exposed (GMP Spaces):

1. Stainless Steel, Type 304: 0.016 inch thick.

K. Piping, Exposed (Non GMP Spaces):

1. PVC: 30 mils thick.

3.21 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Ducts and Plenums, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:

1. Aluminum, Smooth: 0.020 inch thick

B. Piping, Exposed:

1. Aluminum, Smooth: 0.020 inch thick

END OF SECTION 230700

CONFIDENTIAL DOCUMENT

230800

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

COMMISSIONING OF HVAC

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

230800

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
230800	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 230800 - COMMISSIONING OF HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes commissioning process requirements for the following HVAC&R systems, assemblies, and equipment:

1. Energy supply systems, including gas supply.
2. Heat generation systems, including [steam boilers] [.
3. Cooling generation systems, including chilled-water systems.
4. Distribution systems, including air distribution (heating and cooling) system s] [steam distribution systems] [hot-water distribution systems glycol chilled-water distribution systems exhaust systems air-handling units.
5. Terminal and packaged units, including unit ventilators unit heaters fan-coil units, and packaged units.
6. Vibration and sound systems, including sound attenuation vibration isolation devices.
7. Controls and instrumentation, including BAS energy monitoring and control system.
8. Systems testing and balancing verification, including heating-water piping systems, chilled-water piping systems, domestic hot-water circulating systems, supply-air systems, return-air systems, exhaust-air systems.

1.3 DEFINITIONS

A. BAS: Building automation system.

B. DDC: Direct digital controls.

C. HVAC&R: Heating, Ventilating, Air Conditioning, and Refrigeration.

D. "Systems," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

E. TAB: Testing, adjusting, and balancing.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For BAS and HVAC&R Testing Technician.

B. Construction Checklists: See related Sections for technical requirements for the following construction checklists:

1. Vibration controls for HVAC&R piping and equipment.
2. Instrumentation and control for HVAC&R.
3. Heating-water piping and accessories.
4. Cooling-water piping and accessories.
5. Steam and condensate piping and accessories.
6. Refrigerant piping.
7. Metal ducts and accessories.
8. Fans.
9. Particulate air filtration.
10. Air-handling units.
11. Computer-room air conditioners.
12. Boilers.
13. Chillers.
14. Pumps.

1.5 QUALITY ASSURANCE

A. BAS Testing Technician Qualifications: Technicians to perform BAS construction checklist verification tests, construction checklist verification test demonstrations, commissioning tests, and commissioning test demonstrations shall have the following minimum qualifications:

1. Journey-level or equivalent skill level with knowledge of BAS, HVAC&R, electrical concepts, and building operations.
2. Minimum three years of experience installing, servicing, and operating systems manufactured by approved manufacturer.
3. International Society of Automation (ISA) Certified Control Systems Technician (CCST) Level I.

B. HVAC&R Testing Technician Qualifications: Technicians to perform HVAC&R construction checklist verification tests, construction checklist verification test demonstrations, commissioning tests, and commissioning test demonstrations shall have the following minimum qualifications:

1. Journey-level or equivalent skill level. Vocational School four-year program graduate or an Associates degree in mechanical systems, air conditioning, or similar field. Degree may be offset by three years' experience in servicing mechanical systems in the HVAC industry. Generally, required knowledge includes HVAC&R systems, electrical concepts, building operations, and application and use of tools and instrumentation to measure performance of HVAC&R equipment, assemblies, and systems.
2. Minimum three years of experience installing, servicing, and operating systems manufactured by approved manufacturer.

3. One of the following:

a. National Environmental Balancing Bureau (NEBB) Certified Testing, Adjusting, and Balancing Technician.

b. Associated Air Balance Council (AABC) Certified Test and Balance Technician.
c. Owner retains the right to waive NEBB or AABC Certification.

C. Testing Equipment and Instrumentation Quality and Calibration: For test equipment and instrumentation required to perform HVAC&R commissioning work, perform the following:

1. Submit test equipment and instrumentation list. For each equipment or instrument, identify the following:

a. Equipment/instrument identification number.
b. Planned commissioning application or use.
c. Manufacturer, make, model, and serial number.
d. Calibration history, including certificates from agencies that calibrate the equipment and instrumentation.

2. Test equipment and instrumentation shall meet the following criteria:

a. Capable of testing and measuring performance within the specified acceptance criteria.
b. Be calibrated at the manufacturer's recommended intervals with current calibration tags permanently affixed to the instrument being used.
c. Be maintained in good repair and operating condition throughout the duration of use on this Project.
d. Be recalibrated/repaired if dropped or damaged in any way since last calibrated.

D. Proprietary Test Instrumentation and Tools:

1. Equipment Manufacturer's Proprietary Instrumentation and Tools: For installed equipment included in the commissioning process, test instrumentation and tools manufactured or prescribed by equipment manufacturer to service, calibrate, adjust, repair, or otherwise work on its equipment or required as a condition of equipment warranty, perform the following:

a. Submit proprietary instrumentation and tools list. For each instrument or tool, identify the following:

1) Instrument or tool identification number.
2) Equipment schedule designation of equipment for which the instrument or tool is required.
3) Manufacturer, make, model, and serial number.
4) Calibration history, including certificates from agencies that calibrate the instrument or tool, where appropriate.

b. Include a separate list of proprietary test instrumentation and tools in the operation and maintenance manuals.
c. HVAC&R proprietary test instrumentation and tools become the property of Owner at the time of Substantial Completion.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 GENERAL TESTING REQUIREMENTS

A. Certify that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents and approved Shop Drawings and submittals.

B. Certify that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents and approved Shop Drawings and submittals, and that pretest set points have been recorded.

C. Certify that TAB procedures have been completed and that TAB reports have been submitted, discrepancies corrected, and corrective work approved.

D. Set systems, subsystems, and equipment into operating mode to be tested according to approved test procedures (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

E. Measure capacities and effectiveness of systems, assemblies, subsystems, equipment, and components, including operational and control functions to verify compliance with acceptance criteria.

F. Test systems, assemblies, subsystems, equipment, and components operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and response according to acceptance criteria.

G. Construction Checklists: Prepare and submit detailed construction checklists for HVAC&R systems, subsystems, equipment, and components.

1. Contributors to the development of construction checklists shall include, but are not limited to, the following:

a. HVAC&R systems and equipment installers.
b. TAB technicians.
c. HVAC&R instrumentation and controls installers.

H. Perform tests using design conditions, whenever possible.

1. Simulated conditions may, with approval of Owner, be imposed using an artificial load when it is impractical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by Commissioning Coordinator and document simulated conditions and methods of simulation. After tests, return configurations and settings to normal operating conditions.

2. Commissioning test procedures may direct that set points be altered when simulating conditions is impractical.
3. Commissioning test procedures may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are impractical.

I. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to Owner. After deficiencies are resolved, reschedule tests.

J. If seasonal testing is specified, complete appropriate initial performance tests and documentation and schedule seasonal tests.

K. Coordinate schedule with, and perform the following activities at the direction of, Commissioning Coordinator.

L. Comply with construction checklist requirements, including material verification, installation checks, start-up, and performance tests requirements specified in Sections specifying HVAC systems and equipment.

M. Provide technicians, instrumentation, tools, and equipment to complete and document the following:

1. Performance tests.
2. Demonstration of a sample of performance tests.
3. Commissioning tests.
4. Commissioning test demonstrations.

3.2 TAB COMMISSIONING TESTS

A. TAB Verification:

1. Prerequisites: Completion of "Examination" Article requirements and correction of deficiencies, as specified in Section 230593 "Testing, Adjusting, and Balancing for HVAC."
2. Completion of "Preparation" Article requirements for preparation of a TAB plan that includes strategies and step-by-step procedures, and system-readiness checks and reports, as specified in Section 230593 "Testing, Adjusting, and Balancing for HVAC."
3. Scope: HVAC&R air systems and hydronic piping systems.
4. Purpose: Differential flow relationships intended to maintain air pressurization differentials between the various areas of Project.
5. Conditions of the Test:

    a. Commissioning Test Demonstration Sampling Rate: As specified in "Inspections" Article in Section 230593 "Testing, Adjusting, and Balancing for HVAC."
    b. Systems operating in full heating mode with minimum outside-air volume.
    c. Systems operating in full cooling mode with minimum outside-air volume.
    d. For measurements at air-handling units with economizer controls; systems operating in economizer mode with 100 percent outside air.

6. Acceptance Criteria:

    a. Under all conditions, rechecked measurements comply with "Inspections" Article in Section 230593 "Testing, Adjusting, and Balancing for HVAC."
    b. Additionally, no rechecked measurement shall differ from measurements documented in the final report by more than two times the tolerances allowed.
    c. Under all conditions, where the Contract Documents indicate a differential in airflow between supply and exhaust and/or return in a space, the differential relationship shall be maintained.

3.3 HEATING CONTROL SYSTEM COMMISSIONING TESTS

A. Heating-Water Supply Temperature Control:

1. Prerequisites: Installation verification of the following:

    a. Startup of steam to hot-water converter.
    b. Startup of heating-water pump(s)
    c. TAB of heating-water flow and pressure.
    d. Input Device: Heating-water supply temperature; thermistor temperature sensor or resistance temperature sensor.
    e. Output Device: Control valve .
    f. Display the following at the operator's workstation:

        1) Heating-water supply temperature.
        2) Heating-water supply temperature set point.
        3) Control-valve position.

2. Scope: Heating-water system.
3. Purpose: Control of heating-water supply temperature at input device
4. Conditions of the Test:

    a. Minimum heating-water flow to approximate half point.
    b. Midrange Heating-Water Flow: 50 to 60 percent of maximum.
    c. Approximate half flow to Maximum heating-water flow.

5. Acceptance Criteria: Under all conditions, heating-water supply temperature is within plus or minus 2.0 deg F of set point.

B. Heating-Water Supply Temperature Reset:

1. Prerequisites: Installation verification of the following:

    a. Startup of boiler.
    b. Startup of heating-water pump(s).
    c. TAB of heating-water flow and pressure.
    d. Input Device: Heating-water supply temperature; thermistor temperature sensor or resistance temperature sensor.
    e. Input Device: Outdoor-air temperature; outdoor-air sensor.
    f. Output Device: Control valve.

g. Display the following at the operator's workstation:

1) Outdoor-air temperature.
2) Heating-water supply temperature.
3) Heating-water supply temperature set point.
4) Control-valve position.

2. Scope: Heating-water system.
3. Purpose: Control of heating-water supply temperature at heating-water supply temperature input device in response to variable outdoor-air temperature input; outdoor-air sensor.
4. Conditions of the Test: Outdoor-air temperature input value may be overridden for this test.

a. Low Temperature: Outdoor-air temperature between minus 10 and 0 deg F.
b. Midrange Temperature: Outdoor-air temperature between 0 and 45 deg F.
c. High Temperature: Outdoor-air temperature above 65 deg F.

5. Acceptance Criteria: Heating-water supply temperature resets in straight-line relationship with outdoor-air temperature for the following reset schedule. Under all conditions, heating-water supply temperature is within 2.0 deg F of set point.

a. 180 deg F heating water when outdoor-air temperature is minus 10 deg F.
b. 120 deg F heating water when outdoor-air temperature is 65 deg F.
c. Under all conditions, heating-water supply temperature is within plus or minus 2.0 deg F of set point.

C. Control Primary Circulating Pump(s):

1. Prerequisites: Installation verification of the following:

a. Startup of heating-water pump(s
b. Input Device: Outdoor-air temperature; outdoor-air sensor.
c. Output Device: Heating-water pump; DDC system command to starter relay.
d. Display the following at the operator's workstation:

1) Outdoor-air temperature.
2) Operating status of primary circulating pump(s).

2. Scope: Heating-water pump(s) and associated controls.
3. Purpose: On-off control of heating-water pump(s) in response to variable outdoor-air temperature input; outdoor-air sensor.
4. Conditions of the Test:

a. High Temperature: Outdoor-air temperature above65 deg F.
b. Low Temperature: Outdoor-air temperature below 65 deg F.

5. Acceptance Criteria:

a. High Temperature: Pump(s) are off when outside-air temperature is above 65 deg F.

b. Low Temperature: Pump(s) are on when outside-air temperature is below 65 deg F.

3.4 CENTRAL REFRIGERATION SYSTEM COMMISSIONING TESTS

A. Start and Stop Chilled-Water Pump(s):

1. Prerequisites: Installation verification of the following:

a. Startup of chilled-water pump(s).
b. Input Device: Flow switch in water circuit .
c. Output Device: DDC system command to starter relay.
d. Display of the following at the operator's workstation:

1) Chilled-water flow indication.
2) Chilled-water pump(s) on-off status.
3) Chilled-water pump(s) on-off indication.

2. Scope: Chilled-water system, including chilled-water pump(s), associated controls, and chiller controls.
3. Purpose:

a. Chilled-water pump(s) start.
b. Chilled-water pump(s) shutdown.

4. Conditions of the Test:

a. Verify Start: Start with chilled-water pump enable-input device in the "disable" state to prevent pump start. Place the enable-input device in the "enable" state.
b. Verify Shutdown: Start with the enable-input device in the "enable" state to allow the pump(s) to run. Then place the enable-input device to the "disable" state.

5. Acceptance Criteria:

a. Start: Chilled-water pump(s) start when and only when the enable-input device is in the "enable" state.
b. Shutdown: The enable-input device stops the chilled-water pump(s) when placed in the "disable" state.

B. Alternative Chiller(s):

1. Prerequisites: Installation verification of the following:

a. Input Device: DDC system software.
b. Output Device: Chiller DDC system command to chiller terminal strip.
c. Display:

1) Chiller(s) on-off indication.
2) Chiller failure alarm.

2. Scope:

    a. Chilled-water system and associated controls.

3. Purpose:

    a. Adding and dropping chillers as follows: per Sequence of Operations
    b. Replacement of failed chiller in add/drop sequence.
    c. Chiller failure alarm initiation.

4. Conditions of the Test:

    a. Add/Drop Sequence - Increasing Demand: Increase chilled-water demand incrementally to observe the corresponding addition of chillers. Increase demand gradually as the load approached the set point for adding the next chiller to permit observation of the actual load at the time the next chiller is enabled.
    b. Add/Drop Sequence - Decreasing Demand: Decrease chilled-water demand incrementally to observe the corresponding dropping of chillers. Decrease demand gradually as the load approached the set point for dropping the next chiller to permit observation of the actual load at the time the next chiller is disabled.
    c. Add/Drop Sequence - Operating Chiller Fail:
    d. Add/Drop Sequence - Chiller Start Fail:

5. Acceptance Criteria:

    a. Add/Drop Sequence - Increasing Demand: Chillers are added at the specified load set point, plus or minus 5 percent. Chilled-water supply temperature remains stable within plus or minus 2.0 deg F of set point.
    b. Add/Drop Sequence - Decreasing Demand: Chillers are dropped at the specified load set point, plus or minus 5 percent. Chilled-water supply temperature remains stable within plus or minus 2.0 deg F of set point.
    c. Add/Drop Sequence - Operating Chiller Fail: When an operating chiller fails, the next chiller in sequence starts and a chiller failure alarm is initiated for the failed chiller.
    d. Add/Drop Sequence - Chiller Start Fail: When a chiller fails to start, the next chiller in sequence starts in its place, and a chiller failure alarm is initiated for the failed chiller.

3.5 AIR-HANDLING SYSTEM COMMISSIONING TESTS

A. Supply Fan(s) Variable-Volume Control:

1. Prerequisites: Installation verification of the following:
    a. Volume Control Input Device: Static pressure-transmitter sensing supply-duct static pressure referenced to conditioned-space static pressure.
    b. Volume Control Output Device: DDC system analog output to motor speed controller. Set variable-speed drive to minimum speed when fan is stopped.
    c. High-Pressure Input Device: Static-pressure transmitter sensing supply-duct static pressure referenced to static pressure outside the duct.

d. High-Pressure Output Device: DDC system binary output to alarm panel.
e. Display the following at the operator's workstation:

1) Supply-fan-discharge static-pressure indication.
2) Supply-fan-discharge static-pressure set point.
3) Supply-fan airflow rate.
4) Supply-fan speed

2. Scope: Variable-air-volume supply fan units and associated controls.
3. Purpose:

a. Supply-air discharge static pressure control.
b. Response to excess supply-air discharge static pressure condition.

4. Conditions of the Test:

a. Minimum supply-air flow.
b. Midrange Supply-Air Flow: 50 to 60 percent of maximum.
c. Maximum supply-air flow.
d. Excess supply-air discharge static pressure.

5. Acceptance Criteria:

a. At all supply-air flow rates, and during changes in supply-air flow, discharge air static pressure is at set point plus or minus 2 percent.
b. Fan stops and an alarm is initiated at the operator's workstation when supply-air discharge static pressure is at the excess static pressure plus or minus 2 percent.

B. Air-Handler Mixed-Air Control:

1. Prerequisites: Installation verification of the following:

a. Minimum Position Input Device: DDC system time schedule
b. Output Device: DDC system analog output to modulating damper actuator(s).
c. Heating Reset Input Device: DDC system software.
d. Supply Air Temperature Input Device: Duct-mounted electronic temperature sensor.
e. Cooling Reset Input Device: Outdoor- and return-air, duct-mounted electronic temperature sensors.
f. Display the following at the operator's workstation:

1) Mixed-air-temperature indication.
2) Mixed-air-temperature set point.
3) Mixed-air damper position.

2. Scope: Air handler with mixed-air control and associated controls.
3. Purpose:

a. Occupied time control.
b. Minimum damper position control.
c. Heating reset control.

d. Supply air temperature control.
e. Cooling reset control.
f. Unoccupied time control.

4. Conditions of the Test:

a. Occupied Time Control: Start in unoccupied schedule. Advance to occupied schedule time.
b. Minimum Damper Position Control: Command system to mode in which minimum damper position is required.
c. Heating Reset Control: Create a call for heating.
d. Supply Air Temperature Control: Override supply air temperature set point to a value 2°F above current supply air temperature.
e. Cooling Reset Control: Override outdoor-air enthalpy to a value that exceeds return-air enthalpy.
f. Unoccupied Time Control: Advance to unoccupied schedule time.
g. Control Data Trend Log: Set up a data trend log of the following input device values and output device commands. Record data at hourly intervals. Submit trend data for 48 hour periods in which natural conditions require heating reset control, supply-air temperature control, and cooling reset control.

1) Minimum position input device.
2) Heating reset input device.
3) Supply-air temperature input device.
4) Cooling reset input device.

5. Acceptance Criteria:

a. Occupied Time Control: Mixed-air control is active in occupied mode.
b. Minimum Damper Position Control: Controller positions outdoor-air dampers to minimum position.
c. Heating Reset Control: Controller sets outdoor air damper to minimum position.
d. Supply Air Temperature Control: Controller modulates outdoor-, return-, and relief-air dampers to maintain temporary supply air temperature set point plus or minus 1°F.
e. Cooling Reset Control: Controller sets outdoor-air dampers to minimum position when outdoor-air enthalpy exceeds return-air enthalpy.
f. Unoccupied Time Control: Controller positions outdoor- and relief-air dampers closed and return-air dampers open.
g. Control Data Trend Log: Data verifies control according to sequence of control.

END OF SECTION 230800

CONFIDENTIAL DOCUMENT

230900

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

INSTRUMENTATION AND CONTROL FOR HVAC

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
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The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

230900

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
230900	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 230900 - INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

B. Control System Description: A new Siemens APOGEE Building Automation System (BAS) will be installed to control and monitor HVAC equipment in the new Mast-Out facility at ImmuCell.

C. Siemens will provide all labor for BAS design, programming, point database, start-up, alarming, RENO alarming, and graphics.

D. Related Sections include the following:

1. Division 23 Section "Meters and Gauges for HVAC Piping" for measuring equipment that relates to this Section.
2. Division 23 Section "Sequence of Operations for HVAC Controls" for requirements that relate to this Section.

1.3 DEFINITIONS

A. DDC: Direct digital control.

B. I/O: Input/output.

C. MS/TP: Master slave/token passing.

D. PC: Personal computer.

E. PID: Proportional plus integral plus derivative.

F. RTD: Resistance temperature detector.

1.4 SYSTEM PERFORMANCE

A. Comply with the following performance requirements:

1. Graphic Display: Display graphic with minimum 20 dynamic points with current data within 10 seconds.
2. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 8 seconds.
3. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.
4. Object Scan: Transmit change of state and change of analog values to control units or workstation within six seconds.
5. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations must receive alarms within five seconds of each other.
6. Program Execution Frequency: Run capability of applications as often as five seconds, but selected consistent with mechanical process under control.
7. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.
8. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:

    a. Water Temperature: Plus or minus 1 deg F.
    b. Water Pressure: Plus or minus 2 percent of full scale.
    c. Space Temperature: Plus or minus 1 deg F.
    d. Ducted Air Temperature: Plus or minus 1 deg F.
    e. Outside Air Temperature: Plus or minus 1 deg F.
    f. Relative Humidity: Plus or minus 2 percent.
    g. Airflow (Pressurized Spaces): Plus or minus 3 percent of full scale.
    h. Airflow (Measuring Stations): Plus or minus 5 percent of full scale.
    i. Airflow (Terminal): Plus or minus 10 percent of full scale.
    j. Air Pressure (Space): Plus or minus 0.01-inch wg.
    k. Air Pressure (Ducts): Plus or minus 0.1-inch wg.
    l. Carbon Monoxide: Plus or minus 5 percent of reading.
    m. Electrical: Plus or minus 5 percent of reading.

1.5 SEQUENCE OF OPERATION

A. Refer to Specification 230993.11, Sequence of Operations for HVAC Controls.

1.6 SUBMITTALS

A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.

1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.
2. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
3. Wiring Diagrams: Power, signal, and control wiring.
4. Details of control panel faces, including controls, instruments, and labeling.
5. Schedule of dampers including size, leakage, and flow characteristics.
6. Schedule of valves including flow characteristics.
7. DDC System Hardware:

    a. Wiring diagrams for control units with termination numbers.
    b. Schematic diagrams and floor plans for field sensors and control hardware.
    c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.

8. Controlled Systems:

    a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
    b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
    c. Written description of sequence of operation including schematic diagram.
    d. Points list.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Maintenance instructions and lists of spare parts for each type of control device and compressed-air station.
2. Interconnection wiring diagrams with identified and numbered system components and devices.
3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
5. Calibration records and list of set points.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.8 DELIVERY, STORAGE, AND HANDLING

A. System Software: Update to latest version of software at Project completion.

1.9 COORDINATION

A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

B. Coordinate equipment with Division 28 Section "Fire Detection and Alarm" to achieve compatibility with equipment that interfaces with that system.

C. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.

D. Coordinate equipment with Division 26 Section "Electrical Power Monitoring and Control" to achieve compatibility of communication interfaces.

E. Coordinate equipment with Division 26 Section "Panelboards" to achieve compatibility with starter coils and annunciation devices.

F. Coordinate equipment with Division 26 Section "Motor-Control Centers" to achieve compatibility with motor starters and annunciation devices.

G. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."

1.10 EXTRA MATERIALS

A. None Required.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 CONTROL SYSTEM

A. Manufacturers:

1. Siemens Building Technologies, Inc. or approved equal.

B. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. An operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.

2.3 DDC EQUIPMENT

A. Operator Workstation: Locate in Mechanical Room #209 (Selected as placeholder, coordinate final location with Owner).

B. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:

1. Output ripple of 5.0 mV maximum peak to peak.
2. Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.
3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.

2.4 ELECTRONIC SENSORS

A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.

B. Thermistor Temperature Sensors and Transmitters:

1. Accuracy: Plus or minus 1.0 deg F at calibration point.
2. Wire: Twisted, shielded-pair cable.
3. Insertion Elements in Ducts: Single point, 18 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft.
4. Averaging Elements in Ducts: 72 inches long, flexible; use where prone to temperature stratification or where ducts are larger than 10 sq. ft.
5. Room Sensor Cover Construction: Covers matching existing.
    a. Set-Point Adjustment: Concealed.
    b. Set-Point Indication: Concealed.
    c. Thermometer: Concealed.
    d. Color: Matching existing.
    e. Orientation: Vertical.
6. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.

C. RTDs and Transmitters:

1. Accuracy: Plus or minus 0.2 percent at calibration point.
2. Wire: Twisted, shielded-pair cable.

3. Insertion Elements in Ducts: Single point, 8 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft..
4. Averaging Elements in Ducts: 48 inches long, rigid; use where prone to temperature stratification or where ducts are larger than 9 sq. ft.; length as required.
5. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches.
6. Room Sensor Cover Construction: Manufacturer's standard locking covers.

    a. Set-Point Adjustment: Concealed.
    b. Set-Point Indication: Concealed.
    c. Thermometer: Concealed.
    d. Color: Matching existing.
    e. Orientation: Vertical.

7. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
8. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.

D. Humidity Sensors: Bulk polymer sensor element.

1. Manufacturers:

    a. Vaisala.

2. Accuracy: 2 percent full range with linear output.
3. Duct Sensor: 20 to 80 percent relative humidity range with element guard and mounting plate.
4. Outside-Air Sensor: 20 to 80 percent relative humidity range with mounting enclosure, suitable for operation at outdoor temperatures of 32 to 120 deg F.
5. Duct and Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.

E. Pressure Transmitters/Transducers:

1. Available Manufacturers:

    a. Ashcroft.
    b. Air Monitor Corp.

2. Duct Static-Pressure Transmitter: Ashcroft, Model DP DX3F0110ST.

    a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
    b. Output: 4 to 20 mA.
    c. Duct Static-Pressure Range: 0- to 5-inch wg.

3. Room Static-Pressure Probe: Air Monitor Corp, shielded static SS probe.

    a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
    b. Output: 4 to 20 mA.
    c. Building Static-Pressure Range: 0- to 0.25-inch wg.

4. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure and tested to 300-psig; linear output 4 to 20 mA.
5. Pressure Transmitters: Direct acting for gas or liquid service; range suitable for system; linear output 4 to 20 mA.

F. Control Signal Splittter: Acromag, Model 633T 0500.

2.5 STATUS SENSORS

A. Status Inputs for Fans: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg.

B. Status Inputs for Pumps: Differential-pressure switch with pilot-duty rating and with adjustable pressure-differential range of 8 to 60 psig, piped across pump.

C. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.

D. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.

E. Power Monitor: 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4- to 20-mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.

F. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.

G. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.

2.6 ACTUATORS

A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.

1. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
2. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
3. Spring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running and breakaway torque of 150 in. x lbf.
4. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.

5. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf.

2.7 CONTROL VALVES

A. Manufacturers:

1. Siemens Building Technologies, Inc. or approved equal.

B. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.

C. Hydronic system globe valves shall have the following characteristics:

1. NPS 2 and Smaller: Class 250 bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with backseating capacity repackable under pressure.
2. NPS 2-1/2 and Larger: Class 125 iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.
3. Internal Construction: Replaceable plugs and stainless-steel or brass seats.

    a. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom.

4. Sizing: As follows:

    a. Two or Three-way Modulating Valves: Pressure drop as indicated on Drawing schedules.
    b. Two Position: Line size.

5. Flow Characteristics: As indicated on Drawing Schedule.
6. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of total system (pump) head for two-way valves and 100 percent of pressure differential across valve or 100 percent of total system (pump) head.

D. Butterfly Valves: 150-psig maximum pressure differential, ASTM A 126 cast-iron or ASTM A 536 ductile-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals.

1. Body Style: Lug.
2. Disc Type: Nickel-plated ductile iron or Aluminum bronze.
3. Sizing: Line size.

E. Terminal Unit Control Valves: Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends.

1. Rating: Class 125 for service at 125 psig operating conditions.
2. Sizing: As indicated on Drawing schedules.
3. Flow Characteristics: As indicated on Drawing schedules.

2.8 CONTROL DAMPERS

A. Available Manufacturers:

1. Greenheck, Model VCD-33 or equivalent.

B. Performance: Test in accordance with AMCA 500.

C. Frames: Flanged, welded or riveted with corner reinforcement for duct mounting. Material as specified for ductwork.

D. Blades: Maximum blade size 8 inches wide, 48 inches long, attached to minimum 1/2 inch shafts with set screws. Material as specified for ductwork. Provide opposed blades for modulating and mixing applications.

E. Blade Seals: Synthetic elastomeric or neoprene, mechanically attached, field replaceable.

F. Jamb Seals: Stainless steel.

G. Leakage: Class 1A.

H. Maximum Pressure Differential: 8 inch w.g.

I. Temperature Limits: Minus 40 to plus 200 degrees F.

2.9 CONTROL CABLE

A. Electronic and fiber-optic cables for control wiring are specified in Division 27 Section "Communications Horizontal Cabling."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation.

B. Connect and configure equipment and software to achieve sequence of operation specified.

C. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches above the floor.

1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

D. Install guards on thermostats in the following locations:

1. Entrances.

2. Public areas.
3. Where indicated.

E. Install automatic dampers according to Division 23 Section "Air Duct Accessories."

F. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.

G. Install labels and nameplates to identify control components according to Division 23 Section "Identification for HVAC Piping and Equipment."

H. Install hydronic instrument wells, valves, and other accessories according to Division 23 Section "Hydronic Piping."

I. Install refrigerant instrument wells, valves, and other accessories according to Division 23 Section "Refrigerant Piping."

J. Install duct volume-control dampers according to Division 23 Sections specifying air ducts.

K. Install electronic and fiber-optic cables according to Division 27 Section "Communications Horizontal Cabling."

3.2 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. Install raceways, boxes, and cabinets according to Division 26 Section "Raceway and Boxes for Electrical Systems."

B. Install building wire and cable according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

C. Install signal and communication cable according to Division 27 Section "Communications Horizontal Cabling."

1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
2. Install exposed cable in raceway.
3. Install concealed cable in raceway.
4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
7. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.

D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.

E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
2. Test and adjust controls and safeties.
3. Test each point through its full operating range to verify that safety and operating control set points are as required.
4. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
5. Test each system for compliance with sequence of operation.
6. Test software and hardware interlocks.

C. DDC Verification:

1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
2. Check instruments for proper location and accessibility.
3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
4. Check instrument tubing for proper fittings, slope, material, and support.
5. Check installation of air supply for each instrument.
6. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
7. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
8. Check temperature instruments and material and length of sensing elements.
9. Check control valves. Verify that they are in correct direction.
10. Check air-operated dampers. Verify that pressure gauges are provided and that proper blade alignment, either parallel or opposed, has been provided.
11. Check DDC system as follows:

    a. Verify that DDC controller power supply is from emergency power supply, if applicable.
    b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
    c. Verify that spare I/O capacity has been provided.
    d. Verify that DDC controllers are protected from power supply surges.

D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.4 ADJUSTING

A. Calibrating and Adjusting:

1. Calibrate instruments.
2. Make three-point calibration test for both linearity and accuracy for each analog instrument.
3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
4. Control System Inputs and Outputs:

    a. Check analog inputs at 0, 50, and 100 percent of span.
    b. Check analog outputs using milliampere meter at 0, 50, and 100 percent output.
    c. Check digital inputs using jumper wire.
    d. Check digital outputs using ohmmeter to test for contact making or breaking.
    e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.

5. Flow:

    a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
    b. Manually operate flow switches to verify that they make or break contact.

6. Pressure:

    a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
    b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.

7. Temperature:

    a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
    b. Calibrate temperature switches to make or break contacts.

8. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
9. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
10. Provide diagnostic and test instruments for calibration and adjustment of system.
11. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.

B. Adjust initial temperature and humidity set points.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Training shall be recorded and turned over to owner upon completion of training.

END OF SECTION 230900

CONFIDENTIAL DOCUMENT

23099311

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

SEQUENCE OF OPERATIONS FOR HVAC DDC

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

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ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
23099311	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 230993.11 - SEQUENCE OF OPERATIONS FOR HVAC DDC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes control sequences for DDC for HVAC systems, subsystems, and equipment.

B. Related Requirements:

1. Section 230900 “Instrumentation and Control for HVAC” for control equipment.

1.3 DEFINITIONS

A. Analog Output: Proportional output signal (zero- to 10-V dc, 4 to 20 mA).

B. Binary Output: On/Off output signal or contact closure.

C. DDC: Direct digital control.

D. Digital Output: Data output that must be interpreted digitally.

E. AMS: Airflow Measuring Station

F. BAS: Building Automation System

G. OAT: Outdoor Air Temperature

H. VSD: Variable speed drive

1.4 ACTION SUBMITTALS

A. Product Data:

1. An instrumentation list for each controlled system. Label each element of the controlled system in table format. Show, in the table element name, type of device, manufacturer, model number, and control device product data sheet number.
2. A complete description of the operation of the control system, including sequences of operation. Include and reference a schematic diagram of the controlled system.

B. Shop Drawings:

1. Riser diagrams showing control network layout, communication protocol, and wire types.
2. Schematic diagram of each controlled system. Include all control points labeled with point names shown or listed. Show the location of control elements in the system.
3. Wiring diagram for each controlled system. Show all control elements labels. Where a control element is the same as that shown on the control system schematic, label with the same name. Label all terminals.
4. Remaining articles below are examples of operation sequences, which are presented in the following order: central plant equipment, distribution systems and subsystems, terminal heating-and-cooling units, and ventilation. The sequences are written in the form of performance requirements, without specifying the devices needed to accomplish the performance. Revise the operation sequences and add others if necessary to suit Project.
5. If applying for LEED certification, or intending to comply with ASHRAE standards, review the applicable requirements and revise the operation sequences accordingly.

1.5 STEAM GENERATION SYSTEM

A. General: The BAS shall control the Steam Generation System and equipment, and provide monitoring and diagnostic information for management purposes.

1. Boilers shall be set to generate steam at a set point pressure of 105 psig.
2. All set points shall be adjustable through the BAS.
3. Primary / standby boiler status shall be controllable through the BAS.

B. Steam Boiler Operation (B-1 and B-2):

1. Enable: Boilers shall be enabled through the BAS when the following criteria are met:

    a. System manually enabled by the operator.
    b. Outdoor air intake louver is confirmed open.

2. Boilers will operate from their burner management system (BMS) in a primary/ standby arrangement. The BAS shall interface with the BMS to achieve full control and monitoring of boilers.
3. Whenever the system is enabled the primary boiler shall run continuously.
4. Failure of the primary boiler shall result in:

    a. An alarm shall be annunciated at the BAS.
    b. The standby boiler shall start.

5. BMS shall modulate burner fuel system to maintain boiler steam pressure set point.
6. The BAS shall automatically rotate primary boiler status on a monthly basis.
7. The BAS shall record accumulated runtime of each boiler.
8. An alarm shall be generated when primary boiler pressure drops below 90 psig.
9. An alarm shall be generated when primary boiler pressure is greater than 115 psig.

C. Deaerator Control (DA-1):

1. Enable: Deaerators shall be enabled through the BAS when the following criteria are met:

   a. System manually enabled by the operator.

2. Whenever the deaerator is enabled the following shall occur:

   a. Each boiler feedwater pump shall run intermittently when the boiler requires feed water.

3. Failure of either boiler feed water pump shall result in:

   a. An alarm shall be annunciated at the BAS.
   b. The standby pump will be manually opened and the primary pump shall be manually isolated. The standby pump will then be set to operate.

4. Deaerator self-contained steam valves shall modulate as follows:

   a. Deaerator Compartment: Pressure regulating valves to maintain set point of 5 psig.

5. A low deaerator tank pressure alarm shall be generated if a pressure less than 2 psig is measured for a period greater than 2 minutes.

D. Condensate Pump Unit Control (CPU-1):

1. The duplex condensate pump unit shall operate from its controller to maintain tank condensate level.
2. Unit controller shall alternate primary pump after each run cycle.
3. Unit controller shall start standby pump if the primary pump fails to start.
4. An alarm shall be generated during a high level condition.
5. An alarm shall be generated if a pump fails.

E. General System Control and Alarms:

1. The 15 psig pressure reducing station shall alarms at the following conditions:

   a. Low pressure alarm at pressures less than 10 psig or a high pressure alarm at pressures greater than 25 psig.

F. Operator Station Display: Indicate the following on operator workstation display terminal:

1. DDC system graphics.
2. Burner Management System interface:

   a. Boiler on-off status.
   b. Boiler pressure (at steam header).
      Low primary boiler pressure alarm.
   c. Low water level alarm.

d. High water Level alarm.
e. High steam pressure alarm.
f. Gas high pressure alarm.
g. Low gas pressure alarm.
h. Boiler general alarm.

3. Deaerator tank level.
4. Deaerator tank low level alarm.
5. Deaerator tank high level alarm.
6. Deaerator boiler feedwater pump on-off status.
7. Deaerator tank pressure.
8. Deaerator tank low pressure alarm.
9. Condensate unit high level alarm.
10. Condensate unit pump failure alarm.
11. Boiler steam flow (PPH).
12. Boiler accumulated steam production (1000lbs)
13. Incoming natural gas pressure.
14. 15 psig Pressure reducing station pressure.
15. 15 psig Pressure reducing station low pressure alarm.
16. 15 psig Pressure reducing station high pressure alarm.
17. Carbon monoxide high level alarm.

1.6 STEAM TO HOT WATER GENERATION SYSTEM (HW-SKD-1)

A. Overview:

1. The new heating hot water skid supplies hot water to the HVAC equipment at the facility. The new heating system shall be a variable flow type system. The system will vary the flow of the primary pumps, modulate the steam control valve serving the heat exchanger and reset the hot water header temperature based on outside air temperature to satisfy the facility heating load.
2. System Dynamic Limitations:
3. During part load conditions, the boilers shall provide hot water as required by Hot Water Reset Schedule.
4. During the maximum design load, the heat exchanger shall produce 180 °F hot water supply (adjustable).

B. The system components include:

1. Two heat exchangers with one able to handle the full design load and the second as back up:

a. Two new hot water pumps each with a new variable frequency drive and with a single inlet and outlet.
b. New pressure differential transmitter PDT installed across the major hot water supply and returns distribution headers and located as indicated on plans.
c. New Minimum Flow Bypass Control Valve (MBPV).
d. New hot glycol flow meter (FE).

C. The description of the sequence is described in the following order:

1. Startup from Shutdown Condition:

   a. The hot water system control is manually or automatically commanded to be enabled.
   b. Hot Water Pump Startup Control- Original Condition: The minimum flow bypass control valve (MBPV) is fully closed. All pumps are shut down. No alarms are enabled. The lead hot water pump's variable speed drive will ramp up the pump speed to meet the boiler plant minimum flow of 25 GPM (adjustable). This will continue until the hot water piping pressure difference transmitter (PDT) set point is met. MBPV will modulate open to allow for the minimum hot water flow to pass through the system. When the minimum flow rate is exceeded, Minimum Bypass Valve (MBPV) will modulate close.
   c. The pump speed will then be adjusted to meet the normal design PDT set point.
   d. Outdoor Air Temp Reset - the ambient outdoor air temperature from the BAS will reset the hot water supply header temperature per Hot Water Reset Schedule.

2. Heating Load Increases Condition:

   a. Lead Hot Water Pump increase in speed sequence. As the end user heating load increases (the heating coil control valves of the air handling units begin to open) the branch pressure difference values (from the PDT) decreases. MBPV remains closed.
   b. The Lead hot water pump will increase in speed to maintain the branch PDT set point and will supply more hot water flow.
   c. If the lead pump's amp reading increases to 100% the lag hot water pump will be added. The variable speed drives will increase to meet the pressure differential set point measured by PDT.

3. Heating Load Decreases Condition:

   a. Both Hot Water Pumps decrease in speed sequence
   b. As the end user heating load decreases (the heating coil control valves of the air handling units begin to close) the pressure difference value (from PDT) increases.
   c. MBPV remains closed.
   d. Both hot water pumps will decrease in speed to maintain the PDT set point and will supply less hot water flow.
   e. When the flow of both the hot water pump amp reading decreases below 60% (adjustable), the sequence for lag pump shutdown will be enabled. The lead pump variable frequency drive will increase pump speed to satisfy the system pressure differential measured at PDT.

4. Low heating load with minimum flow bypass:

   a. Lead Pump operating at minimum flow
   b. As the pressure differential measured by PDT decreases due to the closing of HVAC coil control valves, the lead pump variable frequency drive will continue to decrease the hot water flow rate.

c. Flow meter FT will measure the hot water system slow rate. When the flow rate is 40 GPM (adjustable) minimum flow bypass valve MBPV will open to maintain the minimum flow rate.

5. Pump Failure:

a. If amp reading on any pump goes to zero, the pump will be de-energized and the standby pump will be energized. The BAS will determine which pump is lead, lag or standby. BAS will cycle the lead, lag and standby pumps to evenly distribute duty.
b. Variable speed drive on standby pump will increase speed to satisfy pump duty point.

6. Heat Exchanger Isolation and Control Valve:

a. The system shall include a duty and standby heat exchanger arrangement. Each heat exchanger shall have its own steam modulating control valve and hot glycol isolation control valve (open/close).
b. The lead head exchanger shall have its own hot glycol isolation valve open at all times and the lag heat exchanger shall have its hot glycol isolation valve closed.
c. The lead heat exchanger steam control valve shall modulate as required to maintain the supply temperature set point.
d. The following conditions must occur before the steam control valve will open.

1) Pump minimum flow is confirmed.
2) A call for heating from one of the building zones.

e. Heat Exchanger rotation: When the operator enables a rotation sequence though the BAS the follow shall occur.

1) The pumps shall cycle off.
2) The steam control valves shall shut.
3) Once a no flow condition is detected by the flow sensor and the steam control valve is closed then the standby isolation valve shall open.
4) Once the standby isolation valve is open then the pump start up sequence shall occur.
5) Once minimum flow is confirmed and a call for heating is received then the standby steam control valve shall modulate as required to maintain the supply temperature set point.

D. Notes:

1. Pressure Difference Transmitter Alarms (typical): When the pressure difference rises above its high alarm setpoint or below its low alarm setpoint, after a time delay (adj.) an alarm will be signaled at the BAS operator work station with the appropriate description (High Pressure difference alarm; Low Pressure difference alarm). Disable the alarms when the system is shut down.
2. Pump Status: When the current measured by the variable speed drive indicates a drop in current below minimum setpoint, an alarm will be signaled to the BAS operator work station. Operator must confirm failure visually. The standby pump will be automatically energized and VFD will soft start the pump motor.

3. Pump VFD Status: When the VFD trouble alarm is signaled an alarm will be signaled to the BAS operator work stations.

Point Description	Mode(s)	Setpoint (adj.)
Hot Water Pressure Difference	Heating	7 PSID
Hot Water Temperature Setpoint (part load)	Heating	120°F Varies
Hot Water Temperature Setpoint (design load)	Heating	180° Maximum

* Note that all setpoints are starting points and are to be field adjusted to suit site conditions.

E. Additional Functions:

1. Whenever the hot water system is enabled the BAS system shall maintain the hot water supply temperature to the building inversely with respect to outdoor air temperature. The initial and adjustable reset schedule shall be 120 deg. Hot water at 70 deg outdoor air and 180 deg. Hot water at -10 deg outdoor air. All settings shall be fully adjustable from the host computers.

F. The following minimum points shall be monitored, trended and alarmed at the host computers.

1. System hot water supply and return temperature
2. System hot water flow rate (GPM)
3. All Pump power KW
4. System hot water supply and return pressure differential
5. Individual hot water pump status

G. Energy Monitoring:

1. Through the hot water pump's VFD communication interface provide points and trending as indicated in the attached points list.
2. Provide monitoring of all other system points as indicated on the attached point list and other system parameters as needed for operator control.

H. Indicate the following on the operator's workstation display terminal:

1. Outdoor-air temperature.
2. Room temperatures.
3. Circulating pump(s) on-off status (enabled or disabled).
4. Circulating pump(s) on-off indication (operating or not operating).
5. Circulating pump(s) alarm pressure differential.
6. Circulating pump(s) alarm pressure differential set point.
7. Alarm (circulating pump(s) failure).
8. Circulating pump(s) speed pressure differential.
9. Circulating pump(s) speed pressure differential set point.
10. Circulating pump(s) speed.

11. Heating-glycol supply temperature.
12. Heating-glycol return temperature.
13. Heating-glycol isolation valve position for HTX-1.
14. Heating-glycol isolation valve position for HTX-2.
15. Steam modulating control valve position for HTX-1.
16. Steam modulating control valve position for HTX-2.
17. Heating-water supply temperature set point.
18. Heating-water control-point output valve.
19. Heat exchanger rotation sequence enabled.

1.7 HEAT RECOVERY RUN AROUND LOOP

A. General: The BAS shall control the Heat Recovery System and equipment, and provide monitoring and diagnostic information for management purposes.

1. All set points shall be adjustable.
2. Enable: The system shall be enabled through the BAS when the following criteria are met:

    a. System manually enabled by the operator.
    b. Outside air temperature is lower than the exhaust air temperature by 5 deg F (adj).
    c. Outside air temperature is higher than the exhaust air temperature by 5 deg F (adj).

B. Pump Control:

1. Whenever the system is enabled the pump shall run continuously.
2. BAS shall monitor on-off status of the pump.
3. Failure of the pump to run shall generate an alarm.

C. Operator Station Display: Indicate the following on operator workstation display terminal:

1. Pump on-off status.
2. Pump on-off indication.
3. Circulation pump run failure alarm.
4. Glycol loop recovery coil entering temperature.
5. Glycol loop exhaust coil leaving temperature.
6. Exhaust air plenum entering air temperature.
7. Exhaust air plenum leaving air temperature.
8. Outdoor air temperature.
9. Air handling unit heat recovery coil leaving air temperatures.
10. System heat recovery mbh.

1.8 CENTRAL CHILLED-WATER SYSTEM SEQUENCES

A. New Air-Cooled Chillers and Variable Primary Pumping System Overview:

1. The new air-chilled water system supplies chilled water to the HVAC equipment at the Facility. The system is designed as a primary Flow type system. The system will vary the flow at the chillers matching the point of use flow to satisfy the cooling loads.

a. System Dynamic Limitations:

1) Do not allow the chilled water flow for each chiller to drop below its minimum GCHW flow limit and not exceed its maximum GCHW flow limit.
2) The other key is not to allow the rate of change of decreasing the GCHW flow to exceed the chiller's maximum rate of change (verify with certified Trane chiller documentation).

b. The system components include:

1) Two new Trane 200 Ton rotary screw chillers with variable speed drives controllers. For each chiller the manufacturer's requirements are (verify with Trane):

a) Minimum flow: 200 GPM
b) Maximum flow: 600 GPM
c) Maximum rate of cooling load change: 10% per minute (verify with Trane)

2) New chilled water pumps (CGP-1 and CGP-2, each with a new variable frequency drive) piped into a common header.
3) New pressure differential transmitter installed across the major chilled water supply and return distribution headers.
4) New Minimum Flow Bypass Control Valve
5) Motorized isolation valves on the chilled water supply on each chiller
6) New chilled glycol flow meter (FE)

c. The description of the sequence is described in the following order:

1) Startup from Shutdown Condition

a) Chilled Water Pump Startup Control
b) Chiller Operation Startup Control
c) Normal Chiller Operation Control

2) Cooling Load Increases Condition

a) Lead Chiller Pump increase in speed sequence
b) Lag Chiller Pump to start

3) Cooling Load Decreases Condition

a) Both Chiller Pumps decrease in speed sequence
b) Lag Chiller Pump to Shut Down

4) Chilled water pump failure
5) Chiller failure

2. Startup from Shutdown Condition: The chilled water system control is manually commanded to be enabled by operator.

a. Chilled Water Pump Startup Control

1) Original Condition: The minimum flow bypass control valve is fully closed. All pumps are shut down. No alarms are enabled.
2) The lead chiller motorized isolation valve will open.
3) The lead chiller pump's variable speed drive will slowly ramp up the pump speed to meet the chiller minimum flow rate setpoint (adj., from a conversion of the chiller evaporator coil pressure difference sensor reading) while not exceeding the chiller flow maximum rate of change (see chiller manufacturer). This will continue until the chilled water piping pressure difference transmitter set point is met.
4) If the end-of-loop pressure difference is met but the chiller flow is lower than the chiller flow low limit, then MBPV will modulate open to maintain the minimum flow across the respective chiller.
5) The pump speed will then be adjusted slowly (to avoid exceeding the chiller flow maximum rate of change) to meet the normal design PDT setpoint (adj.).

b. Chiller Operation Startup Control

1) All the chillers are initially shut down. No alarms are enabled.

2) After the chilled water pumps have been enabled and the chilled water flow through the chiller reaches 10% above the minimum GCHW flow requirement measured using the chiller evaporator pressure difference transmitter, the lead chiller's control is enabled (when the chiller's minimum flow setpoint permits it to). The chiller will then use its packaged control to maintain the chilled water supply temperature setpoint as long as the chilled water flow is within the chilled water flow high and low limits.

c. Normal Chiller Operation Control

1) When the chilled water flow through the chiller is 10% or more above the minimum GCHW flow requirement the lead chiller's control will maintain the chilled water supply temperature setpoint.

3. Cooling Load Increases Condition:

a. Lead Chiller Pump increase in speed sequence.

1) As the end user cooling load increases (the cooling coil control valves of the air handling units begin to open) the end of loop pressure differential transmitter PDT measures the decrease in pressure.
2) BPV remains closed.
3) The Lead chiller pump will increase in speed to maintain the critical branch loop PDT setpoint and will supply more chilled water flow.
4) When the lead chiller's amps increases to 90 % of the respective chiller's maximum limit (verify with manufacturer) or cannot maintain the critical PDT set point, or the lead chiller cannot maintain the GCHW supply temperature, the sequence to add the lag chiller pump and respective chiller will be enabled.

b. Lag Chiller Pump to start

1) When the sequence to add the lag chiller pump is enabled, the following shall occur:
2) The lead chiller's GCHW supply temperature setpoint will be reset 2 to 4°F (adj.) higher than the normal setpoint one to three minutes before the lag chiller is started.
3) The lag chiller motorized isolation valve will open.
4) The lag chiller pump is then started and will ramp up in speed to match the lead chiller pump speed. Chilled water will flow through the lag chiller when the lag chiller pump speed increases so that the pump pressure increase matches the lead pump's pressure drop.
5) When the end of chiller loop pressure difference increases to 7-psig (adj.) above pressure difference set point, BPV will modulate open to maintain 7-psig above the end-of-chiller loop pressure difference set point.
6) The lag chiller's cooling control is enabled. When the lag chiller's GCHW flow is above the chiller flow low limit and the minimum flow pressure differential permits it, the chiller will begin cooling slowly with variable speed drive.
7) Both chiller pumps slowly in unison vary in speed until either the low limit chiller flow is reached or the critical end-of-chiller loop PDT is met.
8) If the chillers' flow low limit is reached and critical PDT begins to increase above the setpoint, modulate BPV to maintain the chiller minimum flow rate setpoint.

4. Cooling Load Decreases Condition

a. Both Chiller Pumps decrease in speed sequence

1) As the end user cooling load decreases (the cooling coil control valves of the air handling units begin to close) the branch pressure difference values (from PDT) increases.
2) BPV remains closed.
3) Both chiller pumps will decrease in speed to maintain the critical PDT setpoint and will supply less chilled water flow.
4) If the chillers' flow low limit is reached and critical PDT is still higher by 5-psig (adj.), modulate BPV to maintain the chiller minimum flow rate setpoint (212 GPM).

b. Lag Chiller Pump to Shut Down

1) When the sequence to shut down the lag chiller pump is enabled, the following shall occur.
2) Increase chilled water flow rate to 533 GPM.
3) After 2 minutes de-energize lag chiller and close associated motorized isolation valve.
4) After delaying 2 minutes, release lead pump to normal operation.

5. Winter Chiller Operation (Economizer)

    a. If the outdoor air temperature is less than 45 deg F (adj) then Chiller 1 (CH-1) shall be the lead chiller as to allow for economizer capability. The operator can override this function if they choose to run Chiller 2 (CH-2).

6. Chilled water pump failure

    a. If the BAS does not read any current from the lead chilled water pump variable speed drive, the pump will be de-energized.
    b. The lag chilled water pump will be energized and the pump variable speed drive will ramp up to required speed.

7. Chiller failure

    a. If BAS does not read current from the lead chiller, the chiller will be de-energized.
    b. The BAS will energize the lag chiller and ramp the variable speed drive to meet system load.

8. Alternating Lead and Lag Chiller Designation: The designation of the lead and lag chiller will be automatically alternated between the two chillers once a month (adj.).
9. Temperature Transmitter Alarms (typical): When the chilled water supply temperature rises above its high alarm limit (adj.) or below its low alarm limit(adj.), after a time delay (adj.) an alarm will be signaled at the BAS operator work station with the appropriate description (High GCHW Supply temperature alarm; Low GCHW Supply temperature alarm). Disable the alarms when the system is shut down.
10. Pressure Difference Transmitter Alarms (typical): When the pressure difference rises above its high alarm setpoint or below its low alarm setpoint, after a time delay (adj.) an alarm will be signaled at the BAS operator work station with the appropriate description (High Pressure difference alarm; Low Pressure difference alarm). Disable the alarms when the system is shut down.
11. Pump VFD Status: When the VFD trouble alarm is signaled an alarm will be signaled to the Chiller plant automation system and BAS operator work stations.
12. Chiller and Pump Flow: The pressure difference transmitter measuring the pressure difference across the chiller evaporator will indicate the chilled water flow using calculations based on the chiller manufacturer's data of flow versus evaporator pressure drop and values from the balancing contractor.

    $Q1 = Q2 \times (dP1/dP2)^2$

B. General Monitoring and Status

1. Serial Connections for communicating the following:

    a. Serial Connections for communicating the following:

        1) Start/stop signal relay (digital output)
        2) Speed command output (analog output)
        3) VFD General Trouble Alarm (digital input)
        4) Current (amps) monitoring with high and low limit alarms (analog input)

2. Chillers:

   a. Hardwired connections for the:

      1) Start/stop signal relay (digital output)
      2) Load limiting command output (analog output)
      3) Chiller General Trouble Alarm (digital input)
      4) Chilled Water Supply Temperature Set point reset (analog output).

   b. Current chiller status and operating conditions shall be monitored through its communications interface port. The following points shall be monitored, trended and alarmed through the chiller BAS interface as follows:

      1) Chiller and all GCHW & Chilled Water Pump Power (kW)
      2) Chilled Water Supply Temp Setpoint
      3) Operating Hours
      4) Chilled Water Supply Temperature
      5) Chilled Water Return Temperature
      6) Evaporator Refrigerant Pressure
      7) Condenser Refrigerant Pressure
      8) Oil Differential Pressure
      9) Oil Temp
      10) Chiller Status
      11) Chilled Water Flow Status
      12) All diagnostic warning and fault information

3. Chiller Plant System Set points Table*

Point Description	**Mode(s)**	**Set point (adj.)**
Chilled Water Pressure Difference (8” pipe)	Cooling	12 psid
Chilled Water Temperature Set point	Cooling	38°F

***** Note that all set points are starting points and are to be field adjusted to suit site conditions.

C. Chiller Control Interface

1. All Chilled Water Plant System functions shall be monitored and alarmed by the BAS system via the chiller control panel BACnet communications cable.

D. Central Chilled-Water System Time Schedule:

1. Occupied Time Schedule: 24- hours a day, seven days a week.

E. Indicate the following on the operator's workstation display terminal:

1. Outdoor temperature.
2. Cooling (software) demand indication.
3. Time and time schedule.
4. Chilled-glycol pump(s) on-off status (enabled or disabled).
5. Chilled-glycol pump(s) on-off indication (operating or not operating).
6. Chilled-glycol flow indication.
7. Refrigeration machine on-off indication (operating or not operating).
8. Chilled-glycol supply temperature.
9. Chilled-glycol return temperature.
10. Chilled-glycol return temperature before the buffer tanks.
11. Chilled-water temperature control-point adjustment.
12. Chiller(s) on-off status (enabled or disabled).
13. Chiller(s) on-off indication (operating or not operating).
14. Chiller "failure-to-start" indication.
15. Chiller(s) power input (instantaneous).
16. Chilled-glycol pressure drop through chiller.
17. Chilled-glycol flow through chiller.
18. System capacity in tons.

1.9 AIR COMPRESSOR (ACP-1)

A. General: When engaged the air compressor shall run to maintain the required set point of 125 psig. The compressor pump will modulate it’s VFD to maintain this pressure.

B. The following points to the BAS are installed for monitoring purposes.

1. Discharge pressure after the regulator set at 100 psig.
2. Low pressure alarm 90 psig or less (adjustable).
3. High pressure alarm 115 psig or less (adjustable).
4. Dewpoint monitor after the regulator.
5. High dew point alarm -20 deg F or above (adjustable).
6. Flow monitoring.

1.10 CLEAN STEAM GENERATOR (CSG-1)

A. General: When engaged the clean steam generator shall run to maintain the clean steam pressure set point of 25 psig. The generator will modulate the plat steam control valve as needed.

B. The following point to the BAS are installed for monitoring purposes

1. Pure Steam Pressure
2. Pure Steam Conductivity
3. On/Off Status
4. Remote Start/Stop
5. Remote Alarm Reset
6. Feed Water Valve Position
7. Pure Steam Conductivity High

1.11 AIR HANDLING UNIT AHU-1 CONTROL SEQUENCE

A. General

1. This Air Handling Unit serves the main Recovery/Formulation area with 15% of outside air. This system is equipped with a supply fan, variable frequency drives, cooling coil, and unit mounted humidifier. The Recovery/Formulation room shall be equipped with a product transfer exhaust system. The operation of this system will be tied with the operation of the outside air damper of AHU-1. EF-3 will serve as the mean of exhaust for AHU-1, the sequence for this fan will be defined separately.
2. The system provides 2 modes of operation: Off mode and normal mode. HVAC operators will have full control of the system at the OWS.
3. This air handling unit will be controlled by a dedicated DDC controller.
4. The fan status (supply, return and exhaust) will be monitored by the BAS system. If after being commanded to start by the BAS system, the fans fail to indicate a run condition after a 30 second delay, an alarm will be sent to the BAS.
5. The current switches for each fan shall be adjusted to read "on" at 25% of the fan's assigned RPM.
6. Smoke detectors shall be provided and wired by others. The control contractor will wire the shutdown contact to the fan starter. The fire alarm contractor will provide a signal (dry contact) to the AHU system DDC controller for monitoring and alarming.
7. When the unit is de-energized, valves and dampers shall go to their fail safe condition.
8. All setpoints and time delays shall be adjustable at the DDC system OWS (operator work station).
9. The BAS contractor shall provide differential pressure transmitters for monitoring and alarming of all AHU filter differential pressures.
10. Fan VFDs will be provided with HOA switches and bypass functionality. Controls shall be configured so that the AHU is capable of operating in manual mode or bypass mode with all safety circuits and dampers still operational.

B. AHU Fan Control/Start Up and Shutdown

1. Off Mode (during maintenance or safety shutdown only):

    a. Supply, return and exhaust fans will de-energize.
    b. Outdoor air damper, return air damper and discharge air dampers closed.
    c. Cooling coil valves close.

2. On Mode/Startup (System will typically operate 7 day a week/ 24 hours a day):

    a. On command to start the system, the discharge air and return air dampers shall be energized.
    b. The supply, return and exhaust fans shall start after proof of return air and discharge air damper position is confirmed via damper end switches (in addition to low temp safeties and fire alarm safeties).
    c. The supply, return and exhaust fans shall then ramp up to setpoint (see Fan Control). Once the supply fan current switch proves status "on", the temperature control loops (see below) shall be enabled. Upon proof of supply fan operation, the outside air damper shall be enabled and control to setpoint.

3. AHU Supply Fan Control:

    a. The airflow volume for the supply fan will be monitored for static pressure via a duct mounted pressure sensor (provided by BAS).
    b. Following proof of "On" status from the fan current switch, the supply fan VFD will modulate fan speed to maintain a constant supply static pressure approximately 2/3 down the main supply duct.
    c. Upon a call to energize the product transfer exhaust system, the supply air fan shall freeze at its current set-point for 30s (adjustable). The fan shall resume normal operation after this time period has passed. Upon a call to de-energize the process exhaust system, the exhaust fan shall freeze at its current set-point for 30s (adjustable).

C. Air Temperature Control

1. Cooling Mode:

    a. When Outside air temperature is above 55 F (adjustable), preheat coil valve closes. The BAS shall modulate the cooling coil valve to maintain a space air temperature setpoint. On a rise above setpoint, the valve modulates open; on a fall below setpoint, the valve modulates closed.

2. Temperature Control, Heating Mode:

    a. When the outside air temperature is below 55 F, the cooling coil valves close. The return air temperature sensor modulates the heating coil valves to maintain setpoint. On a rise above setpoint, the valve modulates closed; on a fall below setpoint, the valve modulates open.

D. Air Humidity Control

1. Humidifier Control

    a. The humidifier control valve shall modulate open if the dew point of the mixed air falls below 46°F (adjustable). The humidifier control valve shall modulate closed if the dew point of the mixed air is above 46°F (adjustable). If a call for dehumidification is received while the dew point is above 46°F (adjustable), then the cooling cool shall reset the leaving temperature to 45°F (adjustable).

E. Mixing box/ Outside Air Damper Sequence: The analog output for the mixing box dampers shall utilize the following sequence from highest to lowest priority

1. If the supply fan flow status is off, or the unit is in unoccupied mode, the outside air damper shall be closed.
2. If the supply fan status is on and the unit is in occupied mode, the outside air damper shall be set to the minimum scheduled CFM
3. Upon a call to energize the product transfer exhaust system, the outside air damper shall be set to the maximum scheduled CFM.

F. Safeties

1. Any of the following conditions will disable/shutdown the AHU and exhaust fans:

   a. Failure of outdoor air damper or discharge air damper to maintain "open" status when commanded to open.
   b. Failure of supply or exhaust fans to prove "run" status following its delay when commanded to run.
   c. Upon a signal from the fire alarm system, the AHU and exhaust fans will be de-energized.

1.12 AIR HANDLING UNIT AHU-2 CONTROL SEQUENCE

A. General

1. This Air Handling Unit serves the spaces requiring once thru-air. This system is equipped with a supply fan, associated variable frequency drive, pre-heat coil, energy recovery coil, cooling coil, and unit-mounted humidifier. EF-1 will operate in conjunction with this unit, the control sequence for this fan will be defined is a separate sequence.
2. The system provides 2 modes of operation: Off mode and normal mode. HVAC operators will have full control of the system at the OWS.
3. This air handling unit will be controlled by a dedicated DDC controller.
4. The fan status (supply and exhaust) will be monitored by the BAS system. If after being commanded to start by the BAS system, the fans fail to indicate a run condition after a 30 second delay, an alarm will be sent to the BAS.
5. The current switches for each fan shall be adjusted to read "on" at 25% of the fan's assigned RPM.
6. Smoke detectors shall be provided and wired by others. The control contractor will wire the shutdown contact to the fan starter. The fire alarm contractor will provide a signal (dry contact) to the AHU system DDC controller for monitoring and alarming.
7. When the unit is de-energized, valves and dampers shall go to their fail safe condition.
8. All setpoints and time delays shall be adjustable at the DDC system OWS (operator work station).
9. The BAS contractor shall provide differential pressure transmitters for monitoring and alarming of all AHU filter differential pressures.
10. Fan VFDs will be provided with HOA switches and bypass functionality. Controls shall be configured so that the AHU is capable of operating in manual mode or bypass mode with all safety circuits and dampers still operational.

B. AHU Fan Control/Start Up and Shutdown

1. Off Mode (during maintenance or safety shutdown only):

   a. Supply fans will de-energize.
   b. Outdoor air damper and discharge air dampers closed.
   c. Cooling coil valves close.
   d. If the outside air temperature is below 43°F, pre-heating valve will modulate to maintain a 55°F (adjustable) case temperature.
   e. If freezestat is activated, preheat coil valve will open to 100% open.

2. On Mode/Startup (System will typically operate 7 day a week/ 24 hours a day):

    a. On command to start the system, the discharge air, and outside air damper shall be energized.
    b. The supply fans shall start after discharge air damper position is confirmed via damper end switches (in addition to low temp safeties and fire alarm safeties).
    c. The supply fans shall then ramp up to setpoint (see Fan Control). Once the supply fan current switch proves status "on", the temperature control loops (see below) shall be enabled. Upon proof of supply fan operation, the outside air damper shall control to set-point.

3. AHU Supply Fan Control:

    a. The airflow volume for the supply fan will be monitored for static pressure via a duct mounted pressure sensor (provided by BAS).
    b. Following proof of "On" status from the fan current switch, the supply fan VFD will modulate fan speed to maintain a constant supply static pressure approximately 2/3 down the main supply duct.

C. Air Temperature Control

1. Cooling Mode:

    a. When Outside air temperature is above 55 F (adjustable), preheat coil valve closes. The BAS shall modulate the cooling coil valve to maintain a supply air temperature setpoint. On a rise above setpoint, the valve modulates open; on a fall below setpoint, the valve modulates closed.

2. Temperature Control, Heating Mode:

    a. When the outside air temperature is below 50°F (adjustable), the preheat coil valve shall modulate to maintain a 55°F (adjustable).

D. Energy Recovery Coil Control:

1. When the unit is in a heating mode, if the exhaust air temperature is 5°F (adjustable) greater than the outside air temperature, the coil control valve shall modulate open.
2. When the unit is in a cooling mode, if the exhaust air temperature is 5°F (adjustable) less than the outside air temperature, the coil control valve shall modulate open.
3. If none of the above conditions are met, the control valve shall modulate closed.

E. Air Humidity Control

1. Humidifier Control

    a. The humidifier control valve shall modulate open if the dew point of the mixed air falls below 46°F (adjustable). The humidifier control valve shall modulate closed if the dew point of the mixed air is above 46°F (adjustable). If a call for dehumidification is received while the dew point is above 46°F (adjustable), then the cooling cool shall reset the leaving temperature to 45°F (adjustable).

F. Outside Air Damper Sequence: The analog output for the mixing box dampers shall utilize the following sequence from highest to lowest priority

1. If the supply fan flow status is off, or the unit is in unoccupied mode, the outside air damper shall be closed.
2. If the supply fan status is on and the unit is in occupied mode, the outside air damper shall be set to the scheduled CFM

G. Safeties

1. Any of the following conditions will disable/shutdown the AHU and exhaust fans:

a. Failure of outdoor air damper or discharge air damper to maintain "open" status when commanded to open.
b. Freezestat in mixing box trips on low limit. The freezestat shall automatically reset when the temperature in the mixing box returns to normal.
c. Failure of supply, return or exhaust fans to prove "run" status following its delay when commanded to run.
d. Upon a signal from the fire alarm system, the AHU and exhaust fans will be de-energized.

1.13 AIR HANDLING UNIT AHU-3 CONTROL SEQUENCE

A. General

1. This Air Handling Unit serves the first floor CNC and NC spaces with 15% of outside air. This system is equipped with a supply fan, return fan, variable frequency drives, cooling coil, and unit mounted humidifier. EF-2 shall operate in conjunction with this unit, the control sequence for this fan will be defined in a separate section.
2. The system provides 2 modes of operation: Off mode and normal mode. HVAC operators will have full control of the system at the OWS.
3. This air handling unit will be controlled by a dedicated DDC controller.
4. The fan status (supply, return and exhaust) will be monitored by the BAS system. If after being commanded to start by the BAS system, the fans fail to indicate a run condition after a 30 second delay, an alarm will be sent to the BAS.
5. The current switches for each fan shall be adjusted to read "on" at 25% of the fan's assigned RPM.
6. Smoke detectors shall be provided and wired by others. The control contractor will wire the shutdown contact to the fan starter. The fire alarm contractor will provide a signal (dry contact) to the AHU system DDC controller for monitoring and alarming.
7. When the unit is de-energized, valves and dampers shall go to their fail safe condition.
8. All setpoints and time delays shall be adjustable at the DDC system OWS (operator work station).
9. The BAS contractor shall provide differential pressure transmitters for monitoring and alarming of all AHU filter differential pressures.
10. Fan VFDs will be provided with HOA switches and bypass functionality. Controls shall be configured so that the AHU is capable of operating in manual mode or bypass mode with all safety circuits and dampers still operational.

B. AHU Fan Control/Start Up and Shutdown

1. Off Mode (during maintenance or safety shutdown only):

   a. Supply, return and exhaust fans will de-energize.
   b. Outdoor air damper, return air damper and discharge air dampers closed.
   c. Cooling coil valves close.

2. On Mode/Startup (System will typically operate 7 day a week/ 24 hours a day):

   a. On command to start the system, the discharge air and return air dampers shall be energized.
   b. The supply, return and exhaust fans shall start after proof of return air and discharge air damper position is confirmed via damper end switches (in addition to low temp safeties and fire alarm safeties).
   c. The supply, return and exhaust fans shall then ramp up to setpoint (see Fan Control). Once the supply fan current switch proves status "on", the temperature control loops (see below) shall be enabled. Upon proof of supply fan operation, the outside air damper shall be enabled and control to setpoint.

3. AHU Supply Fan Control:

   a. The airflow volume for the supply fan will be monitored for static pressure via a duct mounted pressure sensor (provided by BAS).
   b. Following proof of "On" status from the fan current switch, the supply fan VFD will modulate fan speed to maintain a constant supply static pressure approximately 2/3 down the main supply duct.

4. AHU Return Fan Control:

   a. The airflow volume for the supply fan will be monitored for static pressure via a duct mounted pressure sensor (provided by BAS).
   b. Following proof of "On" status from the fan current switch, the supply fan VFD will modulate fan to maintain a constant return static pressure (setpoint to be identified by the balancer).

C. Air Temperature Control

1. Cooling Mode:

   a. When Outside air temperature is above 55 F (adjustable), preheat coil valve closes. The BAS shall modulate the cooling coil valve to maintain a space air temperature setpoint. On a rise above setpoint, the valve modulates open; on a fall below setpoint, the valve modulates closed.

2. Temperature Control, Heating Mode:

   a. When the outside air temperature is below 55 F, the cooling coil valves close. The return air temperature sensor modulates the heating coil valves to maintain setpoint. On a rise above setpoint, the valve modulates closed; on a fall below setpoint, the valve modulates open.

D. Air Humidity Control

1. Humidifier Control

a. The humidifier control valve shall modulate open if the dew point of the mixed air falls below 46°F (adjustable). The humidifier control valve shall modulate closed if the dew point of the mixed air is above 46°F (adjustable). If a call for dehumidification is received while the dew point is above 46°F (adjustable), then the cooling cool shall reset the leaving temperature to 45°F (adjustable).

E. Mixing box/ Outside Air Damper Sequence: The analog output for the mixing box dampers shall utilize the following sequence from highest to lowest priority

1. If the supply fan flow status is off, or the unit is in unoccupied mode, the outside air damper shall be closed.
2. If the supply fan status is on and the unit is in occupied mode, the outside air damper shall be set to the scheduled CFM.

F. Safeties

1. Any of the following conditions will disable/shutdown the AHU and exhaust fans:

a. Failure of outdoor air damper or discharge air damper to maintain "open" status when commanded to open.
b. Failure of supply or exhaust fans to prove "run" status following its delay when commanded to run.
c. Upon a signal from the fire alarm system, the AHU and exhaust fans will be de-energized.

1.14 AIR HANDLING UNIT AHU-4 CONTROL SEQUENCE

A. General

1. This Air Handling Unit serves the second floor office areas with a minimum of 15% outside air. The system is equipped with a full economizer mode of operation. The system is comprised of supply fans, return fans, cooling coils, and variable frequency drives.
2. The system provides 2 modes of operation: Off mode and normal mode. HVAC operators will have full control of the system at the OWS.
3. This air handling unit will be controlled by a dedicated DDC controller.
4. The fan status (supply, return and exhaust) will be monitored by the BAS system. If after being commanded to start by the BAS system, the fans fail to indicate a run condition after a 30 second delay, an alarm will be sent to the BAS.
5. The current switches for each fan shall be adjusted to read "on" at 25% of the fan's assigned RPM.
6. Smoke detectors shall be provided and wired by others. The control contractor will wire the shutdown contact to the fan starter. The fire alarm contractor will provide a signal (dry contact) to the AHU system DDC controller for monitoring and alarming.
7. When the unit is de-energized, valves and dampers shall go to their fail safe condition.

8. All setpoints and time delays shall be adjustable at the DDC system OWS (operator work station).
9. The BAS contractor shall provide differential pressure transmitters for monitoring and alarming of all AHU filter differential pressures.
10. Fan VFDs will be provided with HOA switches and bypass functionality. Controls shall be configured so that the AHU is capable of operating in manual mode or bypass mode with all safety circuits and dampers still operational.

B. AHU Fan Control/Start Up and Shutdown

1. Off Mode (during maintenance or safety shutdown only):

   a. Supply, return and exhaust fans will de-energize.
   b. Outdoor air damper, return air damper and discharge air dampers closed.
   c. Cooling coil valves close.

2. On Mode/Startup (System will typically operate 7 day a week/ 24 hours a day):

   a. On command to start the system, the discharge air and return air dampers shall be energized.
   b. The supply, return and exhaust fans shall start after proof of return air and discharge air damper position is confirmed via damper end switches (in addition to low temp safeties and fire alarm safeties).
   c. The supply, return and exhaust fans shall then ramp up to setpoint (see Fan Control). Once the supply fan current switch proves status "on", the temperature control loops (see below) shall be enabled. Upon proof of supply fan operation, the outside air damper shall be enabled and control to setpoint.

3. AHU Supply Fan Control:

   a. The airflow volume for the supply fan will be monitored for static pressure via a duct mounted pressure sensor (provided by BAS).
   b. Following proof of "On" status from the fan current switch, the supply fan VFD will modulate fan speed to maintain a constant supply static pressure approximately 2/3 down the main supply duct.

4. AHU Return Fan Control:

   a. The airflow volume for the supply fan will be monitored for static pressure via a duct mounted pressure sensor (provided by BAS).
   b. Following proof of "On" status from the fan current switch, the supply fan VFD will modulate fan to maintain a constant return static pressure (setpoint to be identified by the balancer).

C. Air Temperature Control

1. Cooling Mode:

a. When Outside air temperature is above 55 F (adjustable), preheat coil valve closes. The BAS shall modulate the cooling coil valve to maintain a space air temperature setpoint. On a rise above setpoint, the valve modulates open; on a fall below setpoint, the valve modulates closed.

2. Temperature Control, Heating Mode:

a. When the outside air temperature is below 55 F, the cooling coil valves close. The return air temperature sensor modulates the heating coil valves to maintain setpoint. On a rise above setpoint, the valve modulates closed; on a fall below setpoint, the valve modulates open.

D. Mixing box/ Outside Air Damper Sequence: The analog output for the mixing box dampers shall utilize the following sequence from highest to lowest priority

1. If the supply fan flow status is off, or the unit is in unoccupied mode, the outside air damper shall be closed.
2. If the supply fan status is on and the unit is in occupied mode, the outside air damper shall be set to the minimum scheduled CFM
3. The outside air damper set point shall vary in occupied mode according to the Economizer sequence as detailed below.

a. Economizer Sequence:

1) The Economizer control damper shall open, the return air damper shall close, and the outside damper shall open fully whenever:

a) Outside air temperature is less than 65°F (adjustable) and there is a call for cooling.
b) The supply fan status is on.

2) The Economizer damper shall close, the return air damper shall open and the outside air damper shall close whenever:

a) The freezestat is on.
b) Or loss of fan status.
c) Or if the unit is commanded off.

E. Safeties

1. Any of the following conditions will disable/shutdown the AHU and exhaust fans:

a. Failure of outdoor air damper or discharge air damper to maintain "open" status when commanded to open.
b. Failure of supply or exhaust fans to prove "run" status following its delay when commanded to run.
c. Upon a signal from the fire alarm system, the AHU and exhaust fans will be de-energized.

1.15 EF-1 & EF-5 EXHAUST FAN CONTROL SEQUENCE

A. General

1. These Exhaust fans serve AHU-2 as the means of providing exhaust air from the space. EF-5 serves as a hazardous exhaust fan for Solvent Storage. EF-1 serves all other spaces under AHU-2. The system is composed of a centrifugal blower/fume exhaust fan and a variable frequency drive.
2. The system provides 2 modes of operation: Off mode and normal mode. HVAC operators will have full control of the system at the OWS.
3. These exhaust fans will be controlled by the AHU-2 DDC.
4. The fans status will be monitored by the BAS system. If after being commanded to start by the BAS system, the fans fail to indicate a run condition after a 30 second delay, an alarm will be sent to the BAS.
5. The current switches for each fan shall be adjusted to read "on" at 25% of the fan's assigned RPM.
6. Smoke detectors shall be provided and wired by others. The control contractor will wire the shutdown contact to the fan starter. The fire alarm contractor will provide a signal (dry contact) to the AHU system DDC controller for monitoring and alarming.
7. When the unit is de-energized, valves and dampers shall go to their fail safe condition.
8. All setpoints and time delays shall be adjustable at the DDC system OWS (operator work station).
9. Fan VFDs will be provided with HOA switches and bypass functionality. Controls shall be configured so that the AHU is capable of operating in manual mode or bypass mode with all safety circuits and dampers still operational.

B. Fan Control/Start Up and Shutdown

1. Off Mode (during maintenance or safety shutdown only):

   a. Exhaust fan will de-energize.
   b. Backdraft air damper will close.

2. On Mode/Startup (System will typically operate 7 day a week/ 24 hours a day):

   a. On command to start the system, the backdraft air dampers shall be energized.
   b. The exhaust fans shall start after proof of backdraft air damper position is confirmed via damper end switches.
   c. The exhaust fans shall then ramp up to setpoint.

3. Exhaust Fan Control:

   a. The airflow volume for the supply fan will be monitored for static pressure via a duct mounted pressure sensor (provided by BAS).
   b. Following proof of "On" status from the fan current switch, the exhaust fan VFD will modulate fan speed to maintain a constant supply static pressure set-point (as determined by balancer).

C. Safeties

1. Any of the following conditions will disable/shutdown the exhaust fan:

a. Failure of backdraft air damper to maintain "open" status when commanded to open.
b. Failure of exhaust fan to prove "run" status following its delay when commanded to run.
c. Upon a signal from the fire alarm system, the exhaust fan will be de-energized.

1.16 EF-2 EXHAUST FAN CONTROL SEQUENCE

A. General

1. This Exhaust fan serves the first floor restrooms, as a part of AHU-3. The system is composed of a rooftop mounted exhaust fan.
2. The system provides 2 modes of operation: Off mode and normal mode. HVAC operators will have full control of the system at the OWS.
3. This exhaust fan will be controlled by the AHU-3 DDC.
4. The fan status will be monitored by the BAS system. If after being commanded to start by the BAS system, the fans fail to indicate a run condition after a 30 second delay, an alarm will be sent to the BAS.
5. The current switches for each fan shall be adjusted to read "on" at 25% of the fan's assigned RPM.

B. Fan Control/Start Up and Shutdown

1. Off Mode (during maintenance or safety shutdown only):

a. Exhaust fan will de-energize.
b. Backdraft air damper will close.

2. On Mode/Startup (System will typically operate 7 day a week/ 24 hours a day):

a. On command to start the system, the backdraft air dampers shall be energized.
b. The exhaust fans shall start after proof of backdraft air damper position is confirmed via damper end switches.
c. The exhaust fans shall then ramp up to setpoint.

3. Exhaust Fan Control:

a. The airflow volume for the supply fan will be monitored for static pressure via a duct mounted pressure sensor (provided by BAS).
b. Following proof of "On" status from the fan current switch, the exhaust fan will operate at the speed determined by the balancer.

1.17 EF-3 EXHAUST FAN CONTROL SEQUENCE

A. General

1. This Exhaust fan serves AHU-1 as the means of providing exhaust air from the space. The system is composed of a centrifugal blower and a variable frequency drive.
2. The system provides 2 modes of operation: Off mode and normal mode. HVAC operators will have full control of the system at the OWS.
3. This exhaust fan will be controlled by the AHU-1 DDC.
4. The fan status will be monitored by the BAS system. If after being commanded to start by the BAS system, the fans fail to indicate a run condition after a 30 second delay, an alarm will be sent to the BAS.
5. The current switches for each fan shall be adjusted to read "on" at 25% of the fan's assigned RPM.
6. Smoke detectors shall be provided and wired by others. The control contractor will wire the shutdown contact to the fan starter. The fire alarm contractor will provide a signal (dry contact) to the AHU system DDC controller for monitoring and alarming.
7. When the unit is de-energized, valves and dampers shall go to their fail safe condition.
8. All setpoints and time delays shall be adjustable at the DDC system OWS (operator work station).
9. Fan VFDs will be provided with HOA switches and bypass functionality. Controls shall be configured so that the AHU is capable of operating in manual mode or bypass mode with all safety circuits and dampers still operational.

B. Fan Control/Start Up and Shutdown

1. Off Mode (during maintenance or safety shutdown only):

   a. Exhaust fan will de-energize.
   b. Backdraft air damper will close.

2. On Mode/Startup (System will typically operate 7 day a week/ 24 hours a day):

   a. On command to start the system, the backdraft air dampers shall be energized.
   b. The exhaust fans shall start after proof of backdraft air damper position is confirmed via damper end switches.
   c. The exhaust fans shall then ramp up to setpoint.

3. Exhaust Fan Control:

   a. The airflow volume for the supply fan will be monitored for static pressure via a duct mounted pressure sensor (provided by BAS).
   b. Following proof of "On" status from the fan current switch, the exhaust fan VFD will modulate fan speed to maintain a constant supply static pressure set-point (as determined by balancer).

C. Safeties

1. Any of the following conditions will disable/shutdown the exhaust fan:

a. Failure of backdraft air damper to maintain "open" status when commanded to open.
b. Failure of exhaust fan to prove "run" status following its delay when commanded to run.
c. Upon a signal from the fire alarm system, the exhaust fan will be de-energized.

1.18 EF-4 EXHAUST FAN CONTROL SEQUENCE

A. General

1. This Exhaust fan serves the first and second floor mechanical spaces as the means of providing exhaust air from the space. The system is composed of a rooftop exhaust fan and a variable frequency drive.
2. The system provides 2 modes of operation: Off mode and normal mode. HVAC operators will have full control of the system at the OWS.
3. This exhaust fan will be controlled by the AHU-4 DDC.
4. The fan status will be monitored by the BAS system. If after being commanded to start by the BAS system, the fans fail to indicate a run condition after a 30 second delay, an alarm will be sent to the BAS.
5. The current switches for each fan shall be adjusted to read "on" at 25% of the fan's assigned RPM.
6. Smoke detectors shall be provided and wired by others. The control contractor will wire the shutdown contact to the fan starter. The fire alarm contractor will provide a signal (dry contact) to the AHU system DDC controller for monitoring and alarming.
7. When the unit is de-energized, valves and dampers shall go to their fail safe condition.
8. All setpoints and time delays shall be adjustable at the DDC system OWS (operator work station).
9. Fan VFDs will be provided with HOA switches and bypass functionality. Controls shall be configured so that the AHU is capable of operating in manual mode or bypass mode with all safety circuits and dampers still operational.

B. Fan Control/Start Up and Shutdown

1. Off Mode (during maintenance or safety shutdown only):

    a. Exhaust fan will de-energize.
    b. Backdraft air damper will close.
    c. Louver damper will close.

2. On Mode/Startup (System will typically operate 7 day a week/ 24 hours a day):

    a. On command to start the system, the backdraft air damper and louver damper shall be energized.
    b. The exhaust fans shall start after proof of damper position is confirmed via damper end switches.
    c. The exhaust fans shall then ramp up to setpoint.

3. Exhaust Fan Control:

a. The airflow volume for the supply fan will be monitored for static pressure via a duct mounted pressure sensor (provided by BAS).
b. Following proof of "On" status from the fan current switch, the exhaust fan VFD will modulate fan speed to maintain a constant supply static pressure set-point (as determined by balancer).

C. Safeties

1. Any of the following conditions will disable/shutdown the exhaust fan:

a. Failure of backdraft air damper to maintain "open" status when commanded to open.
b. Failure of exhaust fan to prove "run" status following its delay when commanded to run.
c. Upon a signal from the fire alarm system, the exhaust fan will be de-energized.

1.19 TERMINAL UNIT OPERATING SEQUENCE

A. Cabinet Unit Heater, Hydronic:

1. Space Temperature:

a. Input:

1) Device: Line-voltage thermostat.
2) Location: Space.

b. Output:

1) Device: Hard wired.
2) Location: Motor controller.
3) Transference: Starter relay.

c. Action: Cycle fan to maintain 70 deg F (adj) space temperature. Heating coil valve to modulate to maintain 100 deg F LAT (adj)

B. Unit Heater, Hydronic:

1. Space Temperature:

a. Input:

1) Device: Line-voltage thermostat.
2) Location: Space.

b. Output:

1) Device: Hard wired.
2) Location: Motor controller.

3) Transference: Starter relay.

c. Action: Cycle fan to maintain 60 deg F (adj) space temperature.

C. Hydronic Reheat Coils:

1. Space Temperature:

a. Input:

1) Device: Air-temperature sensor
2) Location: Space.
3) Transference: DDC controller.

b. Output:

1) Device: Analog output.
2) Location: Control damper and valve actuators.
3) Input Transference: Control damper and valves.

c. Action: Modulate control valve to maintain the following space temperature set points of 68°F in the space. The zone return air temperature sensor shall be used to determine the room conditions.

1.20 WASTE ROOM FAN COIL UNIT SYSTEM OPERATING SEQUENCE

A. FCU-1:

1. Space Temperature:

a. Input:

1) Device: Line-voltage thermostat.
2) Location: Space.

b. Action: When space temperature rises above 75 deg F (adj) or drops below 65 deg (adj), FCU-1 shall activate to maintain space set-point temperature.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230993.11

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231123

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

NATURAL GAS PIPING

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
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The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

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ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
231123	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 231123 - FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipes, tubes, and fittings.
2. Piping specialties.
3. Piping and tubing joining materials.
4. Valves.
5. Pressure regulators.
6. Service meters –By Utility Provider
7. Mechanical sleeve seals.
8. Grout.
9. Concrete bases.

1.3 DEFINITIONS

A. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

B. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

1.4 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig minimum unless otherwise indicated.
2. Service Regulators: 65 psig minimum unless otherwise indicated.
3. Minimum Operating Pressure of Service Meter: 10 psig.

B. Natural-Gas System Pressure within Boiler room: 5 psig but less than 10 psig.

1.5 SUBMITTALS

A. Product Data: For each type of the following:

1. Piping specialties.

2. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
3. Pressure regulators. Indicate pressure ratings and capacities.
4. Dielectric fittings.
5. Mechanical sleeve seals.
6. Escutcheons.

B. Welding certificates.

C. Field quality-control reports.

D. Operation and Maintenance Data: For motorized gas valves and pressure regulators, to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

C. Protect stored PE pipes and valves from direct sunlight.

1.8 PROJECT CONDITIONS

A. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of natural-gas service.
2. Do not proceed with interruption of natural-gas service without Construction Manager's written permission.

1.9 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

1. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
2. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

    a. Material Group: 1.1.
    b. End Connections: Threaded or butt welding to match pipe.
    c. Lapped Face: Not permitted underground.
    d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
    e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.

3. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.

    a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.

2.2 PIPING SPECIALTIES

A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

2.3 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 MANUAL GAS SHUTOFF VALVES

A. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.

1. CWP Rating: 125 psig.
2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
4. Service Mark: Initials "WOG" shall be permanently marked on valve body.

B. Cast Iron Lubricated Plug Valve (Inside Building):

1. Flanged cast iron body with lubricated tapered plug, 175 psig WOG.

2.5 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for natural gas.
2. End Connections: Flanged for regulators NPS 2-1/2 and larger.

B. Line Gas Pressure Regulator: Comply with ANSI Z21.80

1. Provide 1098-EGR Pilot Operated regulator with Size 40 actuator and 61L pilot (2 to 10 psig pressure range) by Fisher or approved equal.
2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. End Connection: 125 FF
4. Springs: Zinc-plated steel; interchangeable.
5. Diaphragm Plate: Zinc-plated steel.
6. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
7. Orifice: Aluminum; interchangeable.
8. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
11. Maximum Inlet Pressure: 15 psig.

2.6 FLOW METERS – By Utility Provider

2.7 DIELECTRIC FITTINGS

A. Dielectric Flanges:

1. Minimum Operating-Pressure Rating: 150 psig.
2. Combination fitting of copper alloy and ferrous materials.

3. Insulating materials suitable for natural gas.
4. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

B. Dielectric-Flange Kits:

1. Minimum Operating-Pressure Rating: 150 psig.
2. Companion-flange assembly for field assembly.
3. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or PE bolt sleeves, phenolic washers, and steel backing washers.
4. Insulating materials suitable for natural gas.
5. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

2.8 SLEEVES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

2.9 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Close equipment shutoff valves before turning off natural gas to premises or piping section.

B. Inspect natural-gas piping according to NFPA 54 to determine that natural-gas utilization devices are turned off in piping section affected.

C. Comply with NFPA 54 requirements for prevention of accidental ignition.

3.3 OUTDOOR PIPING INSTALLATION

A. Comply with NFPA 54 for installation and purging of natural-gas piping.

B. Steel Piping with Protective Coating:

1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.

C. Install fittings for changes in direction and branch connections.

D. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.

E. Install pressure gauges as indicated on Drawings. Pressure gauges are specified in Division 23 Section "Meters and Gauges for HVAC Piping."

3.4 INDOOR PIPING INSTALLATION

A. Comply with NFPA 54 for installation and purging of natural-gas piping.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.

D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Locate valves for easy access.

H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and branch connections.

K. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."

L. Verify final equipment locations for roughing-in.

M. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

N. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.

1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

O. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

P. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

Q. Connect branch piping from top or side of horizontal piping.

R. Do not use natural-gas piping as grounding electrode.

S. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

T. Install pressure gauges as indicated on Drawings. Pressure gauges are specified in Division 23 Section "Meters and Gauges for HVAC Piping."

3.5 SERVICE-METER ASSEMBLY INSTALLATION – By Utility Provider

3.6 FLOWMETER INSTALLATION – By Utility Provider

3.7 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.

B. Install underground valves with valve boxes.

C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

3.8 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Welded Joints:

1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
2. Bevel plain ends of steel pipe.
3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

3.9 HANGER AND SUPPORT INSTALLATION

A. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

B. Comply with requirements for pipe hangers and supports specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

3.10 CONNECTIONS

A. Connect to utility's gas service according to utility's procedures and requirements.

B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

C. Install piping adjacent to appliances to allow service and maintenance of appliances.

D. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.11 LABELING AND IDENTIFYING

A. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for piping and valve identification.

3.12 PAINTING

A. Comply with requirements in Division 09 painting Sections for painting interior and exterior natural-gas piping.

B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.

1. Alkyd System: MPI EXT 5.1D.

a. Prime Coat: Alkyd anticorrosive metal primer.
b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
c. Topcoat: Exterior alkyd enamel semigloss.
d. Color: Yellow.

C. Paint exposed, interior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.

1. Latex Over Alkyd Primer System: MPI INT 5.1Q.

a. Prime Coat: Alkyd anticorrosive metal primer.
b. Intermediate Coat: Interior latex matching topcoat.
c. Topcoat: Interior latex flat.
d. Color: Yellow.

2. Alkyd System: MPI INT 5.1E.

a. Prime Coat: Alkyd anticorrosive metal primer.
b. Intermediate Coat: Interior alkyd matching topcoat.
c. Topcoat: Interior alkyd flat.
d. Color: Gray.

D. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.13 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Use 3000-psig, 28-day, compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.14 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Test, inspect, and purge natural gas according to NFPA 54 and authorities having jurisdiction.

C. Natural-gas piping will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.15 OUTDOOR PIPING SCHEDULE

A. Underground natural-gas piping shall be one of the following:

1. PE pipe and fittings joined by heat fusion, or mechanical couplings; service-line risers with tracer wire terminated in an accessible location.
2. Steel pipe with wrought-steel fittings and welded joints, or mechanical couplings. Coat pipe and fittings with protective coating for steel piping.

B. Aboveground natural-gas piping shall be the following:

1. Steel pipe with wrought-steel fittings and welded joints.

3.16 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES MORE THAN 0.5 PSIG AND LESS THAN 5 PSIG

A. Aboveground, branch piping NPS 1 and smaller shall be one of the following:

1. Corrugated stainless-steel tubing with mechanical fittings having socket or threaded ends to match adjacent piping.
2. Steel pipe with malleable-iron fittings and threaded joints.

B. Aboveground, distribution piping shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with steel welding fittings and welded joints.

3.17 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Distribution piping valves for pipe sizes NPS 2-1/2 and larger shall be one of the following, as indicated on Drawings:

1. Two-piece, full port, bronze ball valves with bronze trim.
2. Cast-iron, lubricated plug valve.

END OF SECTION 231123

CONFIDENTIAL DOCUMENT

232113

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

HYDRONIC PIPING

ImmuCell
Portland, ME

Reviews / Approvals

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The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

232113

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
232113	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 232113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes pipe and fitting materials, joining methods, special-duty valves, glycol, and specialties for the following:

1. Hot glycol heating piping.
2. Chilled glycol piping.
3. Heat recovery loop piping.
4. Condensate-drain piping.

1.3 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:

1. Hot-Water Glycol Heating Piping: 150 psig at 200 deg F.
2. Chilled Glycol Piping for HVAC and Process: 150 psig at 100 deg. F.
3. Heat recovery Loop Piping: 150 psig at 200 deg. F.
4. Condensate-Drain Piping: 150 deg. F.

1.4 SUBMITTALS

A. Product Data: For each type of the following:

1. Pressure-seal fittings.
2. Valves: Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves. Air control devices.
3. Hydronic specialties.
4. Bypass feeders.
5. Automatic glycol feeders.
6. Chilled water buffer tanks.
7. Glycol.

B. Welding certificates.

C. Qualification Data: For Installer.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

F. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

B. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

D. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.

B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.

C. DWV Copper Tubing: ASTM B 306, Type DWV.

D. Wrought-Copper Fittings: ASME B16.22.

2.2 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as indicated in Part 3 "Piping Applications" Article.

B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in Part 3 "Piping Applications" Article.

C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in Part 3 "Piping Applications" Article.

D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 "Piping Applications" Article.

E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in Part 3 "Piping Applications" Article.

F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

1. Material Group: 1.1.
2. End Connections: Butt welding.
3. Facings: Raised face.

H. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.3 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

E. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

F. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.4 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper-alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Capitol Manufacturing Company.
    b. Central Plastics Company.
    c. Hart Industries International, Inc.
    d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
    e. Zurn Plumbing Products Group; AquaSpec Commercial Products Division.

2. Factory-fabricated union assembly, for 250-psig minimum working pressure at 180 deg F.

D. Dielectric Flanges:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Capitol Manufacturing Company.
    b. Central Plastics Company.
    c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Factory-fabricated companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

E. Dielectric-Flange Kits:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Advance Products & Systems, Inc.
    b. Calpico, Inc.
    c. Central Plastics Company.
    d. Pipeline Seal and Insulator, Inc.

2. Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
3. Separate companion flanges and steel bolts and nuts shall have 150-psigminimum working pressure where required to suit system pressures.

2.5 VALVES

A. Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 23 Section "Valves."

B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 23 Section "Instrumentation and Control for HVAC."

C. Bronze, Calibrated-Orifice, Balancing Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Armstrong Pumps, Inc.
    b. Bell & Gossett Domestic Pump; a division of ITT Industries.
    c. Flow Design Inc.
    d. Taco.

2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
4. Plug: Resin.
5. Seat: PTFE.
6. End Connections: Threaded or socket.
7. Pressure Gauge Connections: Integral seals for portable differential pressure meter.
8. Handle Style: Lever, with memory stop to retain set position.
9. CWP Rating: Minimum 125 psig.
10. Maximum Operating Temperature: 250 deg F.

D. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Armstrong Pumps, Inc.
    b. Bell & Gossett Domestic Pump; a division of ITT Industries.
    c. Flow Design Inc.
    d. Taco.

2. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.

4. Stem Seals: EPDM O-rings.
5. Disc: Glass and carbon-filled PTFE.
6. Seat: PTFE.
7. End Connections: Flanged or grooved.
8. Pressure Gauge Connections: Integral seals for portable differential pressure meter.
9. Handle Style: Lever, with memory stop to retain set position.
10. CWP Rating: Minimum 125 psig.
11. Maximum Operating Temperature: 250 deg F.

E. Diaphragm-Operated, Pressure-Reducing Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Amtrol, Inc.
    b. Conbraco Industries, Inc.
    c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Low inlet-pressure check valve.
8. Inlet Strainer: bronze, removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.
10. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

F. Spring Loaded Pressure Relief Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Tyco.

2. AMSE Section VIII
3. Body: ASME SA216 Gr. WCB.
4. Flange Class: 150.
5. Temperature Range: -20 – 650 deg. F.
6. Cap and Lifting Lever: As indicated on Drawings.

    a. Threaded if none indicated.

7. Seat: BUNA-N O-ring.
8. Disc Insert: 316 SS.
9. Nozzle: 316 SS
10. Capacities: As indicated on Drawings.

2.6 AIR CONTROL DEVICES

A. Basis-of-Design Product: Subject to compliance with requirements, provide as indicated on the drawings, or a comparable product by one of the following:

1. Armstrong Pumps, Inc.
2. Bell & Gossett Domestic Pump; a division of ITT Industries.
3. Taco.
4. Thrush

B. Manual Air Vents:

1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Operator: Screwdriver or thumbscrew.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: NPS 1/8.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 225 deg F.

C. Automatic Air Vents:

1. Body: Bronze or cast iron.
2. Internal Parts: Nonferrous.
3. Operator: Noncorrosive metal float.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: NPS 1/4.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 240 deg F.

D. Bladder-Type Expansion Tanks:

1. Tank: Welded steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature. Factory test with taps fabricated and supports installed and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
2. Bladder: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
3. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.

E. Coalescing-Type Air Separators:

1. Tank: Welded steel; ASME constructed and labeled for 125-psig minimum working pressure and 375 deg F maximum operating temperature.
2. Air Collector Tube: Perforated stainless steel, constructed to direct released air into expansion tank.
3. Inlet and Outlet Connections: Threaded for NPS 2 and smaller; flanged connections for NPS 2-1/2 and larger.
4. Blowdown Connection: Threaded.
5. Size: Match system flow capacity.

2.7 AUTOMATIC GLYCOL FEEDER

A. Basis-of-Design Product: Subject to compliance with requirements, provide as indicated on the drawings, or a comparable product:

B. Description: Packaged automatic glycol feeder with tank, pump, interconnecting piping and valves, and controls.

1. Tank: ¼-inch thick, 50-gallon polyethylene tank with carbon steel stand, and hinged cover.
2. NEMA 4X control panel.
    a. Low level float switch.
    b. Pressure switch and gauge.
3. PVC pressure relief valve.
4. Pump: Single, 1/3-hp rated for 1.6 gpm @ 100 psi.
5. Pressure Range: 10 50 psi.
6. 10 amp relay.
7. 8-foot power cord.

2.8 PROPYLENE GLYCOL

A. Propylene Glycol: Food grade with corrosion inhibitors and environmental-stabilizer additives for mixing with water in systems indicated to contain antifreeze or glycol solutions.

1. Basis of Design: Dow Chemical, model DowFrost or approved equal
2. Concentration:
    a. Chilled and heating Glycol Loops: 30%.

2.9 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

B. Expansion fittings are specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."

2.10 CHILLED WATER BUFFER TANKS

A. Chilled Water Buffer Tanks:

1. Basis-of-Design Product: Taco Model BTH0700F08-125N.

B. Description:

1. ASME rated for 125 psi @ 400 deg. F.
2. Internal baffle.
3. ¾-inch air vent.
4. Support legs for vertical installation.
5. 2-inch drain tapping.
6. Capacity: As indicated on Drawings.
7. Connection Sizes: As indicated on Drawings.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Hot glycol heating piping, aboveground, NPS 2 and smaller, shall be any of the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
2. Schedule 40 steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
3. Schedule 5 steel pipe; steel, pressure-seal couplings and fittings; and pressure-seal joints.

B. Hot-glycol heating piping, aboveground, NPS 2-1/2 and larger, shall be any of the following:

1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.

C. Chilled Glycol Loop piping, aboveground, NPS 2 and smaller, shall be any of the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
2. Schedule 40 steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; and threaded joints.

D. Chilled Glycol Loop piping, aboveground, NPS 2-1/2 and larger, shall be the following:

1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.

E. Condensate-Drain Piping: Type DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

F. Air-Vent Piping:

1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.

2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.

G. Safety-Valve-Inlet and -Outlet Piping for Hot-Glycol Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.

3.2 VALVE APPLICATIONS

A. Install shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.

B. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.

C. Install check valves at each pump discharge and elsewhere as required to control flow direction.

3.3 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

O. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

P. Install valves according to Division 23 Section "Valves."

Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

S. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.

T. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."

U. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.4 HANGERS AND SUPPORTS

A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 7 feet; minimum rod size, 1/4 inch.

3. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
6. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
7. NPS 4: Maximum span, 14 feet; minimum rod size, 1/2 inch.
8. NPS 6: Maximum span, 17 feet; minimum rod size, 1/2 inch.
9. NPS 8: Maximum span, 19 feet; minimum rod size, 5/8 inch.
10. NPS 10: Maximum span, 20 feet; minimum rod size, 3/4 inch.

D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
4. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
6. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.

E. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.5 PIPE JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

F. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.6 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Manual vents at heat-transfer coils and elsewhere as required for air venting.

C. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.

D. Install tangential air separator in pump suction. Install blowdown piping with gate or full-port ball valve; extend full size to nearest floor drain.

E. Install bypass chemical feeders in each hydronic system where indicated, in upright position with top of funnel not more than 48 inches above the floor. Install feeder in minimum NPS 3/4 bypass line, from main with full-size, full-port, ball valve in the main between bypass connections. Install NPS 3/4 pipe from chemical feeder drain, to nearest equipment drain and include a full-size, full-port, ball valve.

F. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system Project requirements.

3.7 TERMINAL EQUIPMENT CONNECTIONS

A. Provide connections as indicated on Drawings.

B. Install ports for pressure gauges and thermometers at coil inlet and outlet connections according to Division 23 Section "Meters and Gauges for HVAC Piping."

3.8 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.

2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

C. Perform the following before operating the system:

1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION 232113

CONFIDENTIAL DOCUMENT

232123

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

HYDRONIC PUMPS

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

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232123

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
232123	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 232123 - HYDRONIC PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Separately coupled, vertically mounted, in-line centrifugal pumps.

1.3 DEFINITIONS

A. Buna-N: Nitrile rubber.

B. EPT: Ethylene propylene terpolymer.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of pump. Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.

B. Shop Drawings: For each pump.

1. Show pump layout and connections.
2. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
3. Include diagrams for power, signal, and control wiring.

C. Heating and chilled water pumps shall be sized for 30% propylene glycol.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Mechanical Seals: One mechanical seal(s) for each pump.

PART 2 - PRODUCTS

2.1 CLOSE-COUPLED, END-SUCTION CENTRIFUGAL PUMPS

A. Taco

B. Armstrong

C. ITT Corporation

D. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, end-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally.

E. Pump Construction:

1. Casing: Radially split, cast iron, with replaceable bronze wear rings, drain plug at bottom and air vent at top of volute, threaded gage tappings at inlet and outlet, and flanged connections.
2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.
3. Pump Shaft: Stainless steel.
4. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N bellows and gasket. Include water slinger on shaft between motor and seal.
5. Pump Bearings: Permanently lubricated ball bearings.

F. Motor: Single speed and rigidly mounted to pump casing with integral pump support.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

a. Enclosure: Open, drip-proof
b. Enclosure Materials: Cast iron.
c. Motor Bearings: Permanently lubricated ball bearings.
d. Unusual Service Conditions:

1) Ambient Temperature: 80 deg F.
2) Altitude: 150 feet above sea level.
3) High humidity.

e. Efficiency: Premium efficient Inverter Duty.
f. NEMA Design: NEMAMG1.
g. Service Factor: 1.15

G. Capacities and Characteristics: See pump schedules on drawings..

2.2 SEPARATELY COUPLED, VERTICALLY MOUNTED, IN-LINE CENTRIFUGAL PUMPS

A. Armstrong

B. Taco

C. ITT Corporation

D. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted vertically.

E. Pump Construction:

1. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet, replaceable bronze wear rings, and threaded companion-flange connections.
2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For pumps not frequency-drive controlled, trim impeller to match specified performance.
3. Pump Shaft: Stainless steel.
4. Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N bellows and gasket. Include water slinger on shaft between motor and seal.
5. Pump Bearings: Permanently lubricated ball bearings.

F. Shaft Coupling: Axially split spacer coupling.

G. Motor: Single speed and rigidly mounted to pump casing with lifting eyebolt and supporting lugs in motor enclosure.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

H. Capacities and Characteristics: See pump schedules on drawings.

2.3 PUMP SPECIALTY FITTINGS

A. Suction Diffuser:

1. Angle pattern.
2. 175-psig pressure rating, cast-iron body and end cap, pump-inlet fitting.
3. Bronze startup and bronze or stainless-steel permanent strainers.
4. Bronze or stainless-steel straightening vanes.
5. Drain plug.
6. Factory-fabricated support.

B. Triple-Duty Valve:

1. Angle or straight pattern.
2. 175-psig pressure rating, cast-iron body, pump-discharge fitting.
3. Drain plug and bronze-fitted shutoff, balancing, and check valve features.
4. Brass gage ports with integral check valve and orifice for flow measurement.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.

C. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PUMP INSTALLATION

A. Comply with HI 1.4.

B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.

C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

D. Automatic Condensate Pump Units: Install units for collecting condensate and extend to open drain.

E. Equipment Mounting:

1. Install base-mounted pumps on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
2. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

3.3 ALIGNMENT

A. Engage a factory-authorized service representative to perform alignment service.

B. Comply with requirements in Hydronics Institute standards for alignment of pump and motor shaft. Add shims to the motor feet and bolt motor to base frame. Do not use grout between motor feet and base frame.

C. Comply with pump and coupling manufacturers' written instructions.

D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.4 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to pump, allow space for service and maintenance.

C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.

D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

E. Install check, shutoff, and throttling valves or triple-duty valve on discharge side of pumps.

F. Install suction diffuser and shutoff valve on suction side of pumps.

G. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.

H. Install pressure gages on pump suction and discharge or at integral pressure-gage tapping, or install single gage with multiple-input selector valve.

I. Install check valve and gate or ball valve on each condensate pump unit discharge.

J. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

K. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. Perform the following startup checks for each pump before starting:

    a. Verify bearing lubrication.
    b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
    c. Verify that pump is rotating in the correct direction.

5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
6. Start motor.
7. Open discharge valve slowly.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps.

END OF SECTION 232123

CONFIDENTIAL DOCUMENT

232213

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

STEAM AND CONDENSATE HEATING PIPING

ImmuCell

Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

232213

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
232213	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 232213 - STEAM AND CONDENSATE HEATING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following for LP and HP steam and condensate piping:

1. Pipe and fittings.
2. Strainers.
3. Flash tanks.
4. Safety valves.
5. Pressure-reducing valves.
6. Steam traps.
7. Thermostatic air vents and vacuum breakers.
8. Steam meters.

1.3 DEFINITIONS

A. HP Systems: High-pressure piping operating at more than 15 psig as required by ASME B31.1.

B. LP Systems: Low-pressure piping operating at 15 psig or less as required by ASME B31.9.

1.4 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressures and temperatures:

1. HP Steam Piping: 100 psig
2. LP Steam Piping: 15 psig
3. Condensate Piping: 100 psig at 250 deg F.
4. Boiler Makeup-Water Piping: 80 psig at 150 deg F.
5. Blowdown-Drain Piping: Equal to pressure of the piping system to which it is attached.
6. Air-Vent and Vacuum-Breaker Piping: Equal to pressure of the piping system to which it is attached.
7. Safety-Valve-Inlet and -Outlet Piping: Equal to pressure of the piping system to which it is attached.

1.5 SUBMITTALS

A. Product Data: For each type of the following:

1. RTRP and RTRF with adhesive.
2. Pressure-reducing and safety valve.
3. Steam trap.
4. Air vent and vacuum breaker.
5. Flash tank.
6. Meter.

B. Shop Drawings: Detail, 1/4 inch equals 1 foot scale, flash tank assemblies and fabrication of pipe anchors, hangers, pipe, multiple pipes, alignment guides, and expansion joints and loops and their attachment to the building structure. Detail locations of anchors, alignment guides, and expansion joints and loops.

C. Qualification Data: For Installer.

D. Welding certificates.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For valves, safety valves, pressure-reducing valves, steam traps, air vents, vacuum breakers, and meters to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:

1. Fiberglass Pipe and Fitting Installers: Installers of RTRF and RTRP shall be certified by the manufacturer of pipes and fittings as having been trained and qualified to join fiberglass piping with manufacturer-recommended adhesive.

B. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code - Steel."

C. Pipe Welding: Qualify processes and operators according to the following:

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

D. ASME Compliance: Comply with ASME B31.9, "Building Services Piping" for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp flash tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART 2 - PRODUCTS

2.1 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, plain ends, Type, Grade, and Schedule as indicated in Part 3 piping applications articles.

B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125, 150, and 300 as indicated in Part 3 piping applications articles.

C. Malleable-Iron Threaded Fittings: ASME B16.3; Classes 150 and 300 as indicated in Part 3 piping applications articles.

D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 piping applications articles.

E. Cast-Iron Threaded Flanges and Flanged Fittings: ASME B16.1, Classes 125 and 250 as indicated in Part 3 piping applications articles; raised ground face, and bolt holes spot faced.

F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

G. Wrought-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

1. Material Group: 1.1.
2. End Connections: Butt welding.
3. Facings: Raised face.

H. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, black steel of same Type, Grade, and Schedule as pipe in which installed.

I. Stainless-Steel Bellows, Flexible Connectors:

1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforced, protective jacket.
2. End Connections: Threaded or flanged to match equipment connected.
3. Performance: Capable of 3/4-inch misalignment.
4. CWP Rating: 150-psig.
5. Maximum Operating Temperature: 250 deg F.

2.2 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

E. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

F. Welding Materials: Comply with Section II, Part C, of ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.

2.3 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Capitol Manufacturing Company.
    b. Central Plastics Company.
    c. Hart Industries, International Inc.
    d. Watts Water Technologies, Inc.
    e. Zurn Plumbing Products Group.

2. Factory-fabricated union assembly, for 250-psig minimum working pressure at 180 deg F.

D. Dielectric Flanges:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Capitol Manufacturing Company.
    b. Central Plastics Company.
    c. Watts Water Technologies, Inc..

2. Factory-fabricated companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

E. Dielectric-Flange Kits:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Central Plastics Company.
   d. Pipeline Seal and Insulator, Inc.

2. Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
3. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure as required to suit system pressures.

2.4 VALVES

A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 23 Section " Valves."

B. Stop-Check Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Crane Co.
   b. Jenkins Valves; a Crane Company.
   c. Lunkenheimer Valves.
   d. A.Y. McDonald Mfg. Co.

2. Body and Bonnet: Malleable iron.
3. End Connections: Flanged.
4. Disc: Cylindrical with removable liner and machined seat.
5. Stem: Brass alloy.
6. Operator: Outside screw and yoke with cast-iron handwheel.
7. Packing: Polytetrafluoroethylene-impregnated packing with two-piece packing gland assembly.
8. Pressure Class: 250.

2.5 STRAINERS

A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B cast iron, with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for strainers NPS 2 and smaller; flanged ends for strainers NPS 2-1/2 and larger.

3. Strainer Screen: Stainless-steel, 20 mesh strainer, and perforated stainless-steel basket with 50 percent free area.
4. With blowoff valve and plug.
5. CWP Rating: 250-psig working steam pressure.

2.6 FLASH TANKS

A. Shop or factory fabricated of welded steel according to ASME Boiler and Pressure Vessel Code, for 150-psig rating; and bearing ASME label. Fabricate with tappings for low-pressure steam and condensate outlets, high-pressure condensate inlet, air vent, safety valve, and legs.

2.7 SAFETY VALVES

A. Bronze or Brass Safety Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Armstrong International, Inc.
    b. Kunkle Valve; a Tyco International Ltd. Company.
    c. Spirax Sarco, Inc.
    d. Watts Water Technologies, Inc.

2. Disc Material: Forged copper alloy.
3. End Connections: Threaded inlet and outlet.
4. Spring: Fully enclosed steel spring with adjustable pressure range and positive shutoff, factory set and sealed.
5. Pressure Class: 250.
6. Drip-Pan Elbow: Cast iron and having threaded inlet and outlet with threads complying with ASME B1.20.1.
7. Size and Capacity: As required for equipment according to ASME Boiler and Pressure Vessel Code.

B. Cast-Iron Safety Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Armstrong International, Inc.
    b. Kunkle Valve; a Tyco International Ltd. Company.
    c. Spirax Sarco, Inc.
    d. Watts Water Technologies, Inc.

2. Disc Material: Forged copper alloy with bronze nozzle.
3. End Connections: Raised-face flanged inlet and threaded or flanged outlet connections.
4. Spring: Fully enclosed cadmium-plated steel spring with adjustable pressure range and positive shutoff, factory set and sealed.

5. Pressure Class: 250.
6. Drip-Pan Elbow: Cast iron and having threaded inlet, outlet, and drain, with threads complying with ASME B1.20.1.
7. Exhaust Head: Cast iron and having threaded inlet and drain, with threads complying with ASME B1.20.1.
8. Size and Capacity: As required for equipment according to ASME Boiler and Pressure Vessel Code.

2.8 PRESSURE-REDUCING VALVES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Armstrong International, Inc.
2. Hoffman Specialty; Division of ITT Industries.
3. Leslie Controls, Inc.
4. Spence Engineering Company, Inc.
5. Spirax Sarco, Inc.

B. Size, Capacity, and Pressure Rating: Factory set for inlet and outlet pressures indicated.

C. Description: Pilot-actuated, diaphragm type, with adjustable pressure range and positive shutoff.

D. Body: Cast iron.

E. End Connections: Threaded connections for valves NPS 2 and smaller and flanged connections for valves NPS 2-1/2 and larger.

F. Trim: Hardened stainless steel.

G. Head and Seat: Replaceable, main head stem guide fitted with flushing and pressure-arresting device cover over pilot diaphragm.

H. Gaskets: Non-asbestos materials.

I. Capacities and Characteristics: As Indicated on drawings.

2.9 STEAM TRAPS

A. Thermodynamic Traps:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Armstrong International, Inc.
b. Barnes & Jones, Inc.
c. Dunham-Bush, Inc.

d. Hoffman Specialty; Division of ITT Industries.
e. Spirax Sarco, Inc.

2. Body: Stainless steel with screw-in cap.
3. End Connections: Threaded.
4. Disc and Seat: Stainless steel.
5. Maximum Operating Pressure: 600 psig.

B. Float and Thermostatic Traps:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Armstrong International, Inc.
b. Barnes & Jones, Inc.
c. Dunham-Bush, Inc.
d. Hoffman Specialty; Division of ITT Industries.
e. Spirax Sarco, Inc.
f. Sterling.

2. Body and Bolted Cap: ASTM A 126, cast iron.
3. End Connections: Threaded.
4. Float Mechanism: Replaceable, stainless steel.
5. Head and Seat: Hardened stainless steel.
6. Trap Type: Balanced pressure.
7. Thermostatic Bellows: Stainless steel or monel.
8. Thermostatic air vent capable of withstanding 45 deg F of superheat and resisting water hammer without sustaining damage.
9. Vacuum Breaker: Thermostatic with phosphor bronze bellows, and stainless steel cage, valve, and seat.
10. Maximum Operating Pressure: 125 psig.

2.10 THERMOSTATIC AIR VENTS AND VACUUM BREAKERS

A. Thermostatic Air Vents:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Armstrong International, Inc.
b. Barnes & Jones, Inc.
c. Dunham-Bush, Inc.
d. Hoffman Specialty; Division of ITT Industries.
e. Spirax Sarco, Inc.
f. Sterling.

2. Body: Cast iron, bronze or stainless steel.
3. End Connections: Threaded.

4. Float, Valve, and Seat: Stainless steel.
5. Thermostatic Element: Phosphor bronze bellows in a stainless-steel cage.
6. Pressure Rating: 125 psig.
7. Maximum Temperature Rating: 350 deg F.

B. Vacuum Breakers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Armstrong International, Inc.
   b. Dunham-Bush, Inc.
   c. Hoffman Specialty; Division of ITT Industries.
   d. Johnson Corporation (The).
   e. Spirax Sarco, Inc.

2. Body: Cast iron, bronze, or stainless steel.
3. End Connections: Threaded.
4. Sealing Ball, Retainer, Spring, and Screen: Stainless steel.
5. O-ring Seal: EPR.
6. Pressure Rating: 125 psig.
7. Maximum Temperature Rating: 350 deg F.

2.11 STEAM METERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Onicon F-2700 or a comparable product by one of the following:

1. EMCO Flow Systems; Division of Advanced Energy Company.
2. ISTEC Corp.
3. Preso Meters; a division of Racine Federated Inc.
4. Spirax Sarco, Inc.

B. Meters shall have a microprocessor to display totalizer flow, flow rate, temperature, pressure, time, and date; alarms for high and low flow rate and temperature.

1. Computer shall have 4 to 20-mA or 2 to 10 volt output for temperature, pressure, and contact closure for flow increments.
2. Independent timers to store four peak flow rates and total flow.
3. Interface compatible with central workstation described in Division 23 Section "Instrumentation and Control for HVAC."
4. Microprocessor Enclosure: NEMA 250, Type 4.

C. Sensor: Vortex type with stainless-steel wetted parts and flange connections; and with a piezoelectric sensor removable and serviceable without shutting down the process. At least 10:1 turndown with plus or minus 1 percent accuracy over full-flow range.

PART 3 - EXECUTION

3.1 LP STEAM PIPING APPLICATIONS

A. LP Steam Piping, NPS 2 and Smaller: Schedule 40, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.

B. LP Steam Piping, NPS 2-1/2 through NPS 12: Schedule 40, Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.

C. Condensate piping above grade, NPS 2 and smaller, shall be the following:

1. Schedule 80, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.

D. Condensate piping above grade, NPS 2-1/2 and larger, shall be the following:

1. Schedule 80, Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.

3.2 HP STEAM PIPING APPLICATIONS

A. HP Steam Piping, NPS 2 and Smaller: Schedule 40, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.

B. HP Steam Piping, NPS 2-1/2 through NPS 12: Schedule 40, Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.

C. Condensate piping above grade, NPS 2 and smaller, shall be the following:

1. Schedule 80, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.

D. Condensate piping above grade, NPS 2-1/2 and larger, shall be the following:

1. Schedule 80, Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.

3.3 ANCILLARY PIPING APPLICATIONS

A. Makeup-water piping installed above grade shall be the following:

1. Drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

B. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.

C. Air-Vent Piping:

1. Inlet: Same as service where installed.
2. Outlet: Type K annealed-temper copper tubing with soldered or flared joints.

D. Vacuum-Breaker Piping: Outlet, same as service where installed.

E. Safety-Valve-Inlet and -Outlet Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed.

3.4 VALVE APPLICATIONS

A. Install shutoff duty valves at branch connections to steam supply mains, at steam supply connections to equipment, and at the outlet of steam traps.

B. Install safety valves on pressure-reducing stations and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install safety-valve discharge piping, without valves, to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

3.5 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Use indicated piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Install piping to allow application of insulation.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

K. Install drains, consisting of a tee fitting, NPS 3/4 full port-ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

L. Install steam supply piping at a minimum uniform grade of 0.2 percent downward in direction of steam flow.

M. Install condensate return piping at a minimum uniform grade of 0.4 percent downward in direction of condensate flow.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side down.

O. Install branch connections to mains using tee fittings in main pipe, with the branch connected to top of main pipe.

P. Install valves according to Division 23 Section "General-Duty Valves for HVAC Piping."

Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

S. Install strainers on supply side of control valves, pressure-reducing valves, traps, and elsewhere as indicated. Install NPS 3/4 nipple and full port ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2 .

T. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."

U. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."

V. Install drip legs at low points and natural drainage points such as ends of mains, bottoms of risers, and ahead of pressure regulators, and control valves.

1. On straight runs with no natural drainage points, install drip legs at intervals not exceeding 150 feet.
2. Size drip legs same size as main. In steam mains NPS 6 and larger, drip leg size can be reduced, but to no less than NPS 4.

W. Flash Tank:

1. Pitch condensate piping down toward flash tank.
2. If more than one condensate pipe discharges into flash tank, install a check valve in each line.
3. Install thermostatic air vent at tank top.
4. Install safety valve at tank top.
5. Install full-port ball valve, and swing check valve on condensate outlet.

6. Install float and thermostatic trap at low-pressure condensate outlet, sized for three times the calculated heat load.
7. Install pressure gage on low-pressure steam outlet according to Division 23 Section "Meters and Gages for HVAC Piping."

3.6 STEAM-TRAP INSTALLATION

A. Install steam traps in accessible locations as close as possible to connected equipment.

B. Install full-port ball valve, strainer, and union upstream from trap; install union, check valve, and full-port ball valve downstream from trap unless otherwise indicated.

3.7 PRESSURE-REDUCING VALVE INSTALLATION

A. Install pressure-reducing valves in accessible location for maintenance and inspection.

B. Install bypass piping around pressure-reducing valves, with globe valve equal in size to area of pressure-reducing valve seat ring, unless otherwise indicated.

C. Install gate valves on both sides of pressure-reducing valves.

D. Install unions or flanges on both sides of pressure-reducing valves having threaded- or flanged-end connections respectively.

E. Install pressure gages on low-pressure side of pressure-reducing valves after the bypass connection according to Division 23 Section "Meters and Gages for HVAC Piping."

F. Install strainers upstream for pressure-reducing valve.

G. Install safety valve downstream from pressure-reducing valve station.

3.8 STEAM OR CONDENSATE METER INSTALLATION

A. Install meters with lengths of straight pipe upstream and downstream according to steam meter manufacturer's instructions.

B. Provide data acquisition wiring. Refer to Division 23 Section "Instrumentation and Control for HVAC."

3.9 SAFETY VALVE INSTALLATION

A. Install safety valves according to ASME B31.9, "Building Services Piping."

B. Pipe safety-valve discharge without valves to atmosphere outside the building.

C. Install drip-pan elbow fitting adjacent to safety valve and pipe drain connection to nearest floor drain.

D. Install exhaust head with drain to waste, on vents equal to or larger than NPS 2-1/2 .

3.10 HANGERS AND SUPPORTS

A. Install hangers and supports according to Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with requirements below for maximum spacing.

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.

C. Install hangers with the following maximum spacing and minimum rod sizes:

1. NPS 3/4 : Maximum span, 9 feet ; minimum rod size, 1/4 inch .
2. NPS 1 : Maximum span, 9 feet ; minimum rod size, 1/4 inch .
3. NPS 1-1/2 : Maximum span, 12 feet ; minimum rod size, 3/8 inch .
4. NPS 2 : Maximum span, 13 feet ; minimum rod size, 3/8 inch .
5. NPS 2-1/2 : Maximum span, 14 feet ; minimum rod size, 3/8 inch .
6. NPS 3 : Maximum span, 15 feet ; minimum rod size, 3/8 inch .
7. NPS 4 : Maximum span, 17 feet ; minimum rod size, 1/2 inch .
8. NPS 6 : Maximum span, 21 feet ; minimum rod size, 1/2 inch .

D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

1. NPS 1/2 : Maximum span, 4 feet ; minimum rod size, 1/4 inch .
2. NPS 3/4 : Maximum span, 5 feet ; minimum rod size, 1/4 inch .
3. NPS 1 : Maximum span, 6 feet ; minimum rod size, 1/4 inch .
4. NPS 1-1/2 : Maximum span, 8 feet ; minimum rod size, 3/8 inch .

E. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.11 PIPE JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube ends. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

F. Welded Joints: Construct joints according to AWS D10.12 , using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.12 TERMINAL EQUIPMENT CONNECTIONS

A. Size for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install traps and control valves in accessible locations close to connected equipment.

C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.

D. Install vacuum breakers downstream from control valve, close to coil inlet connection.

E. Install a drip leg at coil outlet.

3.13 FIELD QUALITY CONTROL

A. Prepare steam and condensate piping according to ASME B31.9, "Building Services Piping," and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush system with clean water. Clean strainers.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.

B. Perform the following tests on steam and condensate piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength.
3. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.

C. Prepare written report of testing.

END OF SECTION 23 2213

CONFIDENTIAL DOCUMENT

232223

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

STEAM CONDENSATE PUMPS

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
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The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

232223

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
232223	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 232223 - STEAM CONDENSATE PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes electric-driven steam condensate pumps.

1.3 SUBMITTALS

A. Product Data: Include certified performance curves and rated capacities, operating characteristics, furnished specialties, and accessories for each type of product indicated. Indicate pump's operating point on curves. Include receiver capacity and material.

B. Shop Drawings: Show pump layout and connections. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain steam condensate pumps through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of steam condensate pumps and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. ASME Compliance: Fabricate and label steam condensate pumps to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.

B. Store steam condensate pumps in dry location.

C. Retain protective covers for flanges and protective coatings during storage.

D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.

E. Comply with pump manufacturer's written rigging instructions.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 ELECTRIC-DRIVEN STEAM CONDENSATE PUMPS

A. Description: Factory-fabricated, packaged, electric-driven pumps; with receiver, pump(s), controls, and accessories suitable for operation with steam condensate.

B. Configuration: Duplex floor-mounting pump with receiver and float switch(es); rated to pump 200 deg F steam condensate.

1. Available Manufacturers:

a. Federal Pump Corp (Basis of Design)
b. Alyan Pump Company; Div. of Hannmann Machinery Systems, Inc.
c. Aurora Pump; Division of Pentair Pump Group.
d. Domestic Pump; Div. of ITT Industries.
e. MEPCO (Marshall Engineered Products Co.

f. Nicholson Steam Trap; a division of Spence Engineering Company, Inc.
g. Pentair Pump Group.
h. Roth Pump Company.
i. Skidmore Div.; Vent-Rite Valve Corp.
j. Spence Engineering Company, Inc.; Division of Circor International, Inc.
k. Spirax Sarco, Inc.
l. Sterling, Inc.

2. Receiver: Floor-mounting, close-grained cast iron; with externally adjustable float switch(es), and flange(s) for pump mounting.
3. Pump(s): Centrifugal, close coupled, vertical design, permanently aligned, and bronze fitted; with replaceable bronze case ring and mechanical seal; mounted on receiver flange.
4. Factory Wiring: Between pump(s) and float switch(es), for single external electrical connection. Fused control power transformer if voltage exceeds 230 V.
5. Electricalpump alternator to operate pumps in lead-lag sequence and allow both pumps to operate if the normal start level for a single pump is exceeded.
6. Capacities and Characteristics: Refer to drawings.

2.3 MOTORS

A. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Examine rough installation of steam condensate piping.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install pumps according to HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation."

B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.

C. Support pumps and piping separately so piping is not supported by pumps.

D. Install pumps on concrete bases. Anchor pumps to bases using inserts or anchor bolts.

E. Install thermometers and pressure gages.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Install check valve, gate valve, and globe valve at pump discharge connections for each electric-driven pump.

D. Pipe drain to nearest floor drain for overflow and drain piping connections.

E. Install full-size vent piping to outdoors, terminating in 180-degree elbow at point above highest steam system connection or as indicated.

F. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

G. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 STARTUP SERVICE

A. Verify that steam condensate pumps are installed and connected according to the Contract Documents.

B. Complete installation and startup checks according to manufacturer's written instructions.

C. Clean strainers.

D. Set steam condensate pump controls.

E. Set pump controls for automatic start, stop, and alarm operation.

F. Perform the following preventive maintenance operations and checks before starting:

1. Set float switches to operate at proper levels.
2. Set throttling valves on pump discharge for specified flow.
3. Check motors for proper rotation.
4. Test pump controls and demonstrate compliance with requirements.
5. Replace damaged or malfunctioning pump controls and equipment.
6. Verify that pump controls are correct for required application.

G. Start steam condensate pumps according to manufacturer's written startup instructions.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain steam condensate pumps.

END OF SECTION 232223

CONFIDENTIAL DOCUMENT

232500

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

HVAC WATER TREATMENT

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

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CONFIDENTIAL DOCUMENT

232500

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
232500	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 232500 - HVAC WATER TREATMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following HVAC water-treatment systems:

1. Bypass chemical-feed equipment and controls.
2. Automatic Chemical-feed equipment and controls.
3. Chemical treatment test equipment.
4. HVAC water-treatment chemicals.
5. Makeup water softeners.

1.3 DEFINITIONS

A. EEPROM: Electrically erasable, programmable read-only memory.

B. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

C. TDS: Total dissolved solids.

1.4 PERFORMANCE REQUIREMENTS

A. Water quality for HVAC systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of HVAC equipment without creating a hazard to operating personnel or the environment.

B. Base HVAC water treatment on quality of water available at Project site, HVAC system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.

C. Closed hydronic systems, including hot-glycol heating chilled glycol cooling and heat recovery glycol, shall have the following water qualities:

1. pH: Maintain a value within 9.0 to 10.5.
2. "P" Alkalinity: Maintain a value within 100 to 500 ppm.
3. Boron: Maintain a value within 100 to 200 ppm.
4. Chemical Oxygen Demand: Maintain a maximum value of 100 ppm.

5. Soluble Copper: Maintain a maximum value of 0.20 ppm.
6. TDS: Maintain a maximum value of 10 ppm.
7. Ammonia: Maintain a maximum value of 20 ppm.
8. Free Caustic Alkalinity: Maintain a maximum value of 20 ppm.
9. Microbiological Limits:

    a. Total Aerobic Plate Count: Maintain a maximum value of 1000 organisms/ml.
    b. Total Anaerobic Plate Count: Maintain a maximum value of 100 organisms/ml.
    c. Nitrate Reducers: Maintain a maximum value of 100 organisms/ml.
    d. Sulfate Reducers: Maintain a maximum value of 0 organisms/ml.
    e. Iron Bacteria: Maintain a maximum value of 0 organisms/ml.

D. Steam Boiler and Steam Condensate:

1. Steam Condensate:

    a. pH: Maintain a value within 7.8 to 8.4.
    b. Total Alkalinity: Maintain a value within 5 to 50 ppm.
    c. Chemical Oxygen Demand: Maintain a maximum value of 15 ppm.
    d. Soluble Copper: Maintain a maximum value of 0.20 ppm.
    e. TDS: Maintain a maximum value of 10 ppm.
    f. Ammonia: Maintain a maximum value of 20 ppm.
    g. Total Hardness: Maintain a maximum value of 2 ppm.

2. Steam boiler operating at more than 15 psig shall have the following water qualities:

    a. "OH" Alkalinity: 200 to 400 ppm.
    b. TDS: Maintain a value within 600 to 1200 ppm to maximum 30 times RO water TDS.

E. Passivation for Galvanized Steel: For the first 60 days of operation.

1. pH: Maintain a value within 7 to 8.
2. Calcium Carbonate Hardness: Maintain a value within 100 to 300 ppm.
3. Calcium Carbonate Alkalinity: Maintain a value within 100 to 300 ppm.

1.5 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for the following products:

1. Bypass feeders.
2. Water meters.
3. Inhibitor injection timers.
4. pH controllers.
5. Chemical solution tanks.
6. Injection pumps.
7. Chemical test equipment.
8. Chemical material safety data sheets.
9. Water softeners.

B. Shop Drawings: Pretreatment and chemical treatment equipment showing tanks, maintenance space required, and piping connections to HVAC systems. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: Power and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For sensors, injection pumps, water softeners, and controllers to include in emergency, operation, and maintenance manuals.

E. Other Informational Submittals:

1. Water-Treatment Program: Written sequence of operation on an annual basis for the application equipment required to achieve water quality defined in the "Performance Requirements" Article above.
2. Water Analysis: Illustrate water quality available at Project site.
3. Passivation Confirmation Report: Verify passivation of galvanized-steel surfaces, and confirm this observation in a letter to Owner.

1.6 QUALITY ASSURANCE

A. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.7 MAINTENANCE SERVICE

A. Scope of Maintenance Service: Provide chemicals and service program to maintain water conditions required above to inhibit corrosion, scale formation, and biological growth for cooling, chilled-water piping heating, steam and condensate piping and equipment. Services and chemicals shall be provided for a period of one year from date of Substantial Completion, and shall include the following:

1. Initial water analysis and HVAC water-treatment recommendations.
2. Startup assistance for Contractor to flush the systems, clean with detergents, and initially fill systems with required chemical treatment prior to operation.
3. Periodic field service and consultation.
4. Customer report charts and log sheets.
5. Laboratory technical analysis.
6. Analyses and reports of all chemical items concerning safety and compliance with government regulations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ampion Corp.
2. Anderson Chemical Co, Inc.
3. Aqua-Chem, Inc.; Cleaver-Brooks Div.
4. Barclay Chemical Co.; Water Management, Inc.
5. Boland Trane Services
6. GE Betz.
7. GE Osmonics.
8. H-O-H Chemicals, Inc.
9. Metro Group. Inc. (The); Metropolitan Refining Div.
10. ONDEO Nalco Company.
11. Watcon, Inc.

2.2 MANUAL CHEMICAL-FEED EQUIPMENT

A. Bypass Feeders: Steel, with corrosion-resistant exterior coating, minimum 3-1/2-inch fill opening in the top, and NPS 3/4 bottom inlet and top side outlet. Quarter turn or threaded fill cap with gasket seal and diaphragm to lock the top on the feeder when exposed to system pressure in the vessel.

1. Capacity: 2 gal..
2. Minimum Working Pressure: 125 psig.

2.3 AUTOMATIC CHEMICAL-FEED EQUIPMENT

A. Water Meter:

1. AWWA C701, turbine-type, totalization meter.
2. Body: Bronze.
3. Minimum Working-Pressure Rating: 100 psig.
4. Maximum Pressure Loss at Design Flow: 3 psig.
5. Registration: Gallons or cubic feet.
6. End Connections: Threaded.
7. Control: Low-voltage signal capable of transmitting 1000 feet.

B. Inhibitor Injection Timers:

1. Microprocessor-based controller with LCD display in NEMA 250, Type 12 enclosure with gasketed and lockable door. Interface for start/stop and status indication at central workstation as described in Division 23 Section "Instrumentation and Control for HVAC."

2. Programmable timers with infinite adjustment over full range, and mounted in cabinet with hand-off-auto switches and status lights.
3. Test switch.
4. Hand-off-auto switch for chemical pump.
5. Illuminated legend to indicate feed when pump is activated.
6. Programmable lockout timer with indicator light. Lockout timer to deactivate the pump and activate alarm circuits.
7. LCD makeup totalizer to measure amount of makeup and bleed-off water from two water meter inputs.

C. pH Controller:

1. Microprocessor-based controller, 1 percent accuracy in a range from zero to 14 units. Incorporate solid-state integrated circuits and digital LCD display in NEMA 250, Type 12 enclosure with gasketed and lockable door. Interface for start/stop and status indication at central workstation as described in Division 23 Section "Instrumentation and Control for HVAC."
2. Digital display and touch pad for input.
3. Sensor probe adaptable to sample stream manifold.
4. High, low, and normal pH indication.
5. High or low pH alarm light, trip points field adjustable; with silence switch.
6. Hand-off-auto switch for acid pump.
7. Internal adjustable hysteresis or deadband.

D. TDS Control:
1. TDS will be controlled by a continuous surface blow down. The boiler bottom blow down will be a manual operating procedure as recommended by the manufacturer.

E. Chemical Solution Tanks:

1. Chemical-resistant reservoirs fabricated from high-density opaque polyethylene with minimum 110 percent containment vessel.
2. Molded cover with recess for mounting pump.
3. Capacity: 50 gal..

F. Chemical Solution Injection Pumps:

1. Self-priming, positive-displacement; rated for intended chemical with minimum 25 percent safety factor for design pressure and temperature.
2. Adjustable flow rate.
3. Metal and thermoplastic construction.
4. Built-in relief valve.
5. Fully enclosed, continuous-duty, single-phase motor. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

G. Chemical Solution Tubing: ASTM A 269, Type 304, stainless steel for steam boiler injection assemblies.

H. Injection Assembly:

1. Quill: Minimum NPS 1/2 with insertion length sufficient to discharge into at least 25 percent of pipe diameter.
2. Ball Valve: Two-piece, stainless steel as described in "Stainless-Steel Pipes and Fittings" Article below; and selected to fit quill.
3. Packing Gland: Mechanical seal on quill of sufficient length to allow quill removal during system operation.
4. Assembly Pressure/Temperature Rating: Minimum 600 psig at 200 deg F.

2.4 STAINLESS-STEEL PIPES AND FITTINGS

A. Stainless-Steel Tubing: Comply with ASTM A 269, Type 304.

B. Stainless-Steel Fittings: Complying with ASTM A 815/A 815M, Type 304, Grade WP-S.

C. Two-Piece, Full-Port, Stainless-Steel Ball Valves: ASTM A 351, Type 316 stainless-steel body; ASTM A 276, Type 316 stainless-steel stem and vented ball, carbon-filled TFE seats, threaded body design with adjustable stem packing, threaded ends, and 250-psig SWP and 600-psig CWP ratings.

2.5 CHEMICAL TREATMENT TEST EQUIPMENT

A. Test Kit: Manufacturer-recommended equipment and chemicals in a wall-mounting cabinet for testing pH, TDS, inhibitor, chloride, alkalinity, and hardness; sulfite and testable polymer tests for high-pressure boilers.

B. Sample Cooler: To be provided, mounted, and pre piped on each boiler and DA.

1. Tube: Sample.

a. Size: NPS 1/4 tubing.
b. Material: ASTM A 666, Type 316 stainless steel.
c. Pressure Rating: Minimum 2000 psig.
d. Temperature Rating: Minimum 850 deg F.

2. Shell: Cooling water.

a. Material: ASTM A 666, Type 304 stainless steel.
b. Pressure Rating: Minimum 250 psig.
c. Temperature Rating: Minimum 450 deg F.

3. Capacities and Characteristics:

a. Tube: Sample.

1) Flow Rate: 0.25 gpm.
2) Entering Temperature: 400 deg F.
3) Leaving Temperature: 88 deg F.
4) Pressure Loss: 6.5 psig.

b. Shell: Cooling water.

1) Flow Rate: 3 gpm.
2) Entering Temperature: 70 deg F.
3) Pressure Loss: 1.0 psig.

C. Corrosion Test-Coupon Assembly: Constructed of corrosive-resistant material, complete with piping, valves, and mild steel and copper coupons. Locate copper coupon downstream from mild steel coupon in the test-coupon assembly.

1. Two-station rack for closed-loop systems.

2.6 CHEMICALS

A. Chemicals shall be as recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment, and that can attain water quality specified in Part 1 "Performance Requirements" Article.

B. Water Softener Chemicals:

1. Mineral: High-capacity, sulfonated-polystyrene ion-exchange resin that is stable over entire pH range with good resistance to bead fracture from attrition or shock. Resin exchange capacity minimum 30,000 grains/cu. ft. of calcium carbonate of resin when regenerated with 15 lb of salt.
2. Salt for Brine Tanks: High-purity sodium chloride, free of dirt and foreign material. Rock and granulated forms are not acceptable.

2.7 HVAC MAKEUP WATER SOFTENER

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on the plumbing drawings or a comparable product by one of the following:

1. Alamo Water Treatment; Ecodyne Water Treatment, Inc.
2. Columbia Water Conditioning Systems, Inc.
3. CSI; a division of Chandler Systems, Inc.
4. Culligan International.
5. CUNO Incorporated.
6. Diamond Water Conditioning.
7. Diamond Water Systems, Inc.
8. Environmental Dynamics Corporation.
9. Hungerford & Terry, Inc.
10. Kinetico Incorporated.
11. Marlo Incorporated.
12. Parker Boiler Company.
13. Plymouth Products, Inc.
14. Rainsoft Div.; Aquion Partners L. P.
15. Water King.

B. Description: Twin mineral tanks and one brine tank, factory mounted on skid.

C. Fabricate supports and attachments to tanks with reinforcement strong enough to resist tank movement during seismic event when tank supports are anchored to building structure as recommended in writing by manufacturer.

D. Mineral Tanks:

1. Fabricate and label steel filter tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
2. Fabricate and label FRP filter tanks to comply with ASME Boiler and Pressure Vessel Code: Section X, if indicated.
3. Pressure Rating: 125 psig minimum.
4. Wetted Components: Suitable for water temperatures from 40 to at least 100 deg F.
5. Freeboard: 50 percent, minimum, for backwash expansion above the normal resin bed level.
6. Support Legs or Skirt: Constructed of structural steel, welded or bonded to tank before testing and labeling.
7. Finish: Hot-dip galvanized on exterior and interior of tank after fabrication.
8. Upper Distribution System: Single-point type, fabricated from galvanized-steel pipe and fittings.
9. Lower Distribution System: Hub and radial-arm or header-lateral type; fabricated from PVC pipe and fittings with individual, fine-slotted, nonclogging PE strainers; arranged for even-flow distribution through resin bed.

E. Controls: Automatic; factory mounted on mineral tanks and factory wired.

1. Adjustable duration of regeneration steps.
2. Push-button start and complete manual operation override.
3. Pointer on pilot-control valve shall indicate cycle of operation.
4. Means of manual operation of pilot-control valve if power fails.
5. Main Operating Valves: Industrial, automatic, multiport, diaphragm type with the following features:

    a. Slow opening and closing, nonslam operation.
    b. Diaphragm guiding on full perimeter from fully open to fully closed.
    c. Isolated dissimilar metals within valve.
    d. Self-adjusting, internal, automatic brine injector that draws brine and rinses at constant rate independent of pressure.
    e. Float-operated brine valve to automatically measure the correct amount of brine to the softener and refill with fresh water.
    f. Sampling cocks for soft water.

6. Flow Control: Automatic control of backwash and flush rates over variations in operating pressures that do not require field adjustments. Equip mineral tanks with automatic-reset-head water meter that electrically activates cycle controller to initiate regeneration at preset total in gallons, and automatically resets after regeneration to preset total in gallons for next service run. Include alternator to regenerate one mineral tank with the other in service.

F. Brine Tank: Combination measuring and wet-salt storing system.

1. Tank and Cover Material: Fiberglass a minimum of 3/16 inch thick; or molded PE a minimum of 3/8 inch thick.
2. Brine Valve: Float operated and plastic fitted for automatic control of brine withdrawn and freshwater refill.
3. Size: Large enough for at least four regenerations at full salting.

G. Factory-Installed Accessories:

1. Piping, valves, tubing, and drains.
2. Sampling cocks.
3. Main-operating-valve position indicators.
4. Water meters.

H. Water Test Kit: Include water test kit in wall-mounting enclosure for water softener.

I. Capacities and Characteristics: As indicated on drawings

PART 3 - EXECUTION

3.1 WATER ANALYSIS

A. Perform an analysis of supply water to determine quality of water available at Project site.

3.2 INSTALLATION

A. Install chemical application equipment on concrete bases, level and plumb. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor chemical tanks and floor-mounting accessories to substrate.

B. Install water testing equipment on wall near water chemical application equipment.

C. Install interconnecting control wiring for chemical treatment controls and sensors.

D. Mount sensors and injectors in piping circuits.

E. Bypass Feeders: Install in closed hydronic systems, including hot-glycol heating and chilled glycol, and equipped with the following:

1. Install bypass feeder in a bypass circuit around circulating pumps.
2. Install water meter in makeup water supply.
3. Install test-coupon assembly in bypass circuit around circulating pumps..
4. Install a gate or full-port ball isolation valves on inlet, outlet, and drain below feeder inlet.
5. Install a swing check on inlet after the isolation valve.

F. Install automatic chemical-feed equipment for steam boiler and steam condensate systems and include the following:

1. Install makeup water softener.
2. Install water meter in makeup water supply.
3. Install inhibitor injection pumps and solution tanks with injection timer sensing contacts in water meter.

    a. Pumps shall operate for timed interval when contacts close at water meter in makeup water supply connection. Injection pump shall discharge into boiler feedwater tank or feedwater supply connection at boiler.

4. Install test equipment and furnish test-kit to Owner.

3.3 WATER SOFTENER INSTALLATION

A. Install water softener equipment on concrete bases, level and plumb. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor mineral and brine tanks and floor-mounting accessories to substrate.

B. Install brine lines and fittings furnished by equipment manufacturer but not factory installed.

C. Prepare mineral-tank distribution system and underbed for minerals and place specified mineral into mineral tanks.

D. Install water-testing sets on wall adjacent to water softeners.

3.4 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Make piping connections between HVAC water-treatment equipment and dissimilar-metal piping with dielectric fittings. Dielectric fittings are specified in Division 23 Section "Common Work Results for HVAC."

D. Install shutoff valves on HVAC water-treatment equipment inlet and outlet. Metal general-duty valves are specified in Division 23 Section "General-Duty Valves for HVAC Piping."

E. Refer to Division 22 Section "Domestic Water Piping Specialties" for backflow preventers required in makeup water connections to potable-water systems.

F. Confirm applicable electrical requirements in Division 26 Sections for connecting electrical equipment.

G. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

H. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Inspect field-assembled components and equipment installation, including piping and electrical connections.
2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.
3. Place HVAC water-treatment system into operation and calibrate controls during the preliminary phase of HVAC systems' startup procedures.
4. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
5. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
6. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
7. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.
8. Repair leaks and defects with new materials and retest piping until no leaks exist.

D. Remove and replace malfunctioning units and retest as specified above.

E. Sample boiler water at one-week intervals after boiler startup for a period of five weeks, and prepare test report advising Owner of changes necessary to adhere to Part 1 "Performance Requirements" Article for each required characteristic. Sample boiler water at four-week intervals following the testing noted above to show that automatic chemical-feed systems are maintaining water quality within performance requirements specified in this Section.

F. At four-week intervals following Substantial Completion, perform separate water analyses on hydronic systems to show that automatic chemical-feed systems are maintaining water quality within performance requirements specified in this Section. Submit written reports of water analysis advising Owner of changes necessary to adhere to Part 1 "Performance Requirements" Article.

G. Comply with ASTM D 3370 and with the following standards:

1. Silica: ASTM D 859.

2. Steam System: ASTM D 1066.
3. Acidity and Alkalinity: ASTM D 1067.
4. Iron: ASTM D 1068.
5. Water Hardness: ASTM D 1126.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC water-treatment systems and equipment. Refer to Division 01 Section "Demonstration and Training."

B. Training: Provide a "how-to-use" self-contained breathing apparatus video that details exact operating procedures of equipment.

END OF SECTION 232500

CONFIDENTIAL DOCUMENT

233113

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

METAL DUCTS

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

233113

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
233113	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Sheet metal materials.
4. Sealants and gaskets.
5. Hangers and supports.

B. Related Sections:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

1.4 SUBMITTALS

A. Product Data: For each type of the following products:

1. Sealants and gaskets.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.

3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment.

C. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:

    a. Lighting fixtures.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Access panels.
    f. Perimeter moldings.

D. Welding certificates.

E. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Lindab Inc.
b. McGill AirFlow LLC.
c. SEMCO Incorporated.
d. Sheet Metal Connectors, Inc.
e. Spiral Manufacturing Co., Inc.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 in Diameter: Flanged.

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger than 90 in diameter with butt-welded longitudinal seams.

D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.

D. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

E. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

C. Solvent-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Base: Synthetic rubber resin.
3. Solvent: Toluene and heptane.
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.
6. Water resistant.
7. Mold and mildew resistant.
8. Maximum Static-Pressure Class: 10-inch wg; positive or negative.
9. Service: Indoor or outdoor.
10. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.5 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines”

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 10 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
2. Test the following systems:

    a. Ducts with a Pressure Class Higher Than 3-Inch wg: Test representative duct sections totaling no less than 25 percent of total installed duct area for each designated pressure class.

3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
4. Test for leaks before applying external insulation.
5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
6. Give seven days' advance notice for testing.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."

    a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.8 DUCT CLEANING

A. Clean new duct system(s) before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.

3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
5. Provide drainage and cleanup for wash-down procedures.
6. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.9 START UP

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.10 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

B. Supply Ducts:

1. Ducts Connected to Constant-Volume Air-Handling Units:

a. Pressure Class: Positive 4-inch.
b. Minimum SMACNA Seal Class: A

C. Return Ducts:

1. Ducts Connected to Air-Handling Units:

a. Pressure Class: Positive or negative 4-inch wg.
b. Minimum SMACNA Seal Class: A

c. All return ductwork within a CNC, ISO 8 or ISO 7 space shall be 304 stainless steel with a No.4 finish.

D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting Air:

a. Pressure Class: Negative 3-inch wg
b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
c. All exhaust ductwork within a CNC, ISO 8, or ISO 7 space shall be 304 stainless steel with a No.4 finish.

E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:

1. Ducts Connected to Air-Handling Units:

a. Pressure Class: Positive or negative 4-inch wg.
b. Minimum SMACNA Seal Class: A.

F. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."

a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
b. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."

2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."

a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

1) Radius-to Diameter Ratio: 1.5.

b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
c. Round Elbows, 14 Inches and Larger in Diameter: Welded.

END OF SECTION 233113

CONFIDENTIAL DOCUMENT

233300

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

AIR DUCT ACCESSORIES

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
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The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

233300

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
233300	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Manual volume dampers.
3. Control dampers.
4. Fire dampers.
5. Flange connectors.
6. Turning vanes.
7. Remote damper operators.
8. Duct-mounted access doors.
9. Flexible connectors.
10. Flexible ducts.
11. Duct accessory hardware.

B. Related Requirements:

1. Division 28 Section “Fire Detection and Alarm” for duct-mounted fire and smoke detectors.

1.3 ACTION SUBMITTALS

A. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

a. Special fittings.
b. Manual volume damper installations.
c. Control-damper installations.
d. Fire-damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
e. Duct security bars.
f. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60
2. Exposed-Surface Finish: Mill phosphatized.

B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and polished finish for exposed ducts.

C. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

D. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.

E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 BACKDRAFT DAMPERS

A. Manufactures: Subject to compliance with requirements, available manufactures offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Greenheck Fan Corporation
2. Nailor Industries Inc.
3. Ruskin Company

B. Description: Gravity balanced.

C. Maximum Air Velocity: 1000 FPM

D. Maximum System Pressure: 4 inch wg.

E. Frame: Hat-shaped, 0.05-inch thick, galvanized sheet steel, with welded corners or mechanically attached and mounting flange.

F. Blades: Multiple single-piece blades, center pivoted, maximum 6-inch width, 0.025-inch thick, roll-formed aluminum with sealed edges.

G. Blade Action: Parallel.

H. Blade Seals: Neoprene, mechanically locked.

I. Blade Axles:

1. Material: Stainless steel.
2. Diameter: 0.20 inch.

J. Tie Bars and Brackets: Aluminum

K. Return Spring: Adjustable tension.

L. Bearings: Steel Ball.

M. Accessories:

1. Adjustment device to permit setting for varying differential static pressure.
2. Counterweights and spring-assist kits for vertical airflow installations.
3. Electric actuators.
4. Chain pulls.

5. Screen Mounting: Front mounted in sleeve.

    a. Sleeve Thickness: 20 gage minimum.

6. Screen Mounting: Rear mounted.
7. Screen Material: Aluminum
8. Screen Type: Insect
9. 90-degree stops.

2.4 MANUAL VOLUME DAMPERS

A. Manufactures: Subject to compliance with requirements, available manufactures offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Greenheck Fan Corporation
2. Nailor Industries Inc.
3. Ruskin Company

B. Standard, Steel, Manual Volume Dampers:

1. Standard leakage rating
2. Suitable for horizontal or vertical applications.
3. Frames:

    a. Frame: Hat-shaped, 0.094-inch thick, galvanized sheet steel
    b. Mitered and welded corners.
    c. Flanges for attaching to walls and flangeless frames for installing in ducts.

4. Blades:

    a. Multiple or single blade.
    b. Parallel- or opposed-blade design.
    c. Stiffen damper blades for stability.
    d. Stainless-steel, 0.064 inch thick.

5. Blade Axles: Stainless Steel.
6. Bearings:

    a. Stainless steel sleeve
    b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

7. Tie Bars and Brackets: Galvanized steel.

2.5 FIRE DAMPERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Air Balance Inc.; a division of Mestek, Inc.
2. Greenheck Fan Corporation.
3. McGill AirFlow LLC.
4. METALAIRE, Inc.
5. Nailor Industries Inc.
6. Ruskin Company.
7. Vent Products Company, Inc.
8. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Type: Dynamicrated and labeled according to UL 555 by an NRTL.

C. Fire Rating: 1-1/2 hours.

D. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Minimum Thickness: 0.052 or 0.138 inch thick, as indicated, and of length to suit application.
2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

E. Mounting Orientation: Vertical or horizontal as indicated.

F. Blades: Roll-formed, interlocking, 0.034-inch-thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch-thick, galvanized-steel blade connectors.

G. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

H. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

2.6 TURNING VANES

A. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

B. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."

C. Vane Construction: Single wall.

D. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.7 DUCT-MOUNTED ACCESS DOORS

A. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."

1. Door:

   a. Double wall, rectangular.
   b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
   c. Vision panel.
   d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
   e. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:

   a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
   b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
   c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
   d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

2.8 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Ventfabrics, Inc.
4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd.
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F .

2.9 FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Flexmaster U.S.A., Inc.
2. McGill AirFlow LLC.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Insulated, Flexible Duct: UL 181, Class 1, aluminum laminate and polyester film mechanically locked and supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.

1. Pressure Rating: 6-inch wg positive and 6.0-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 10 to plus 160 deg F.
4. Insulation R-value: Comply with ASHRAE/IESNA 90.1-2004, minimum R-5.

C. Flexible Duct Connectors:

1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.

2.10 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.
2. Install aluminum volume dampers in aluminum ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Install fire dampers according to UL listing.

H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils.
2. Upstream from duct filters.
3. At outdoor-air intakes and mixed-air plenums.
4. At drain pans and seals.
5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
7. At each change in direction and at maximum 50-foot spacing.
8. Upstream and downstream from turning vanes.
9. Control devices requiring inspection.
10. Elsewhere as indicated.

I. Install access doors with swing against duct static pressure.

J. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches.
2. Two-Hand Access: 12 by 6 inches.
3. Head and Hand Access: 18 by 10 inches.
4. Head and Shoulders Access: 21 by 14 inches.
5. Body Access: 25 by 14 inches.
6. Body plus Ladder Access: 25 by 17 inches.

K. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

L. Install flexible connectors to connect ducts to equipment.

M. Connect flexible ducts to metal ducts with adhesive plus sheet metal screws.

N. Install duct test holes where required for testing and balancing purposes.

O. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4 inch movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

CONFIDENTIAL DOCUMENT

233416

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

CENTRIFUGAL HVAC FANS

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
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ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

233416

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
233416	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 233416 - CENTRIFUGAL HVAC FANS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Backward-inclined centrifugal fans.

1.3 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan performance ratings on 300 ft sea level.

B. Operating Limits: Classify according to AMCA 99.

1.4 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:

1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound-power ratings.
3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Material thickness and finishes, including color charts.
5. Dampers, including housings, linkages, and operators.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.
2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.

C. Coordination Drawings: Show fan room layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For centrifugal fans to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.

C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA 1.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations, with protective crating and covering.

B. Disassemble and reassemble units, as required for moving to the final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

1.7 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Belts: Two (2) sets for each belt-driven unit.

PART 2 - PRODUCTS

2.1 BACKWARD-INCLINED CENTRIFUGAL FANS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on the drawings or a comparable product by one of the following:

1. ABB Fan Group North America.
2. Acme Engineering & Mfg. Corp.
3. Aerovent; a Twin City Fan Company.
4. Carrier Corporation.
5. Loren Cook Company.
6. New York Blower Company (The).
7. Trane.

D. Description: Factory-fabricated, -assembled, -tested, and -finished, belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect swtich, drive assembly, and support structure.

E. Housings: Formed panels to make curved-scroll housings with shaped cutoff; with doors or panels to allow access to internal parts and components.

1. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
2. Horizontally split, bolted-flange housing.
3. Spun inlet cone with flange.
4. Outlet flange.

F. Backward-Inclined Wheels: Single-width-single-inlet and double-width-double-inlet construction with curved inlet flange, backplate, backward-inclined blades and fastened to shaft with set screws.

G. Shafts: Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.

1. Turned, ground, and polished hot-rolled steel with keyway. Ship with a protective coating of lubricating oil.
2. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

H. Prelubricated and Sealed Shaft Bearings: Self-aligning, pillow-block-type ball bearings.

1. Ball-Bearing Rating Life: ABMA 9, Ll0 at 120,000 hours.
2. Roller-Bearing Rating Life: ABMA 11, Ll0 at 120,000 hours

I. Grease-Lubricated Shaft Bearings: Self-aligning, pillow-block-type, tapered roller bearings with double-locking collars and two-piece, cast-iron housing.

1. Ball-Bearing Rating Life: ABMA 9, Ll0 at 120,000 hours.
2. Roller-Bearing Rating Life: ABMA 11, Ll0 at 120,000 hours.

J. Grease-Lubricated Shaft Bearings: Self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing.

1. Ball-Bearing Rating Life: ABMA 9, Ll0 at 120,000 hours.
2. Roller-Bearing Rating Life: ABMA 11, Ll0 at 120,000 hours.

K. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.

1. Service Factor Based on Fan Motor Size: 1.5.
2. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
3. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
4. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
5. Belt Guards: Fabricate to comply with OSHA and SMACNA requirements of diamond-mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.
6. Motor Mount: Adjustable for belt tensioning.

L. Accessories:

1. Cleanout Door: Quick opening latch type gasketed door allowing access to fan scroll, of same material as housing.
2. Companion Flanges: Rolled flanges for duct connections of same material as housing.
3. Discharge Dampers: Assembly with parallel blades constructed of two plates formed around and to shaft, channel frame, and sealed ball bearings; with blades linked outside of airstream to single control lever of same material as housing.
4. Inlet Screens: Grid screen of same material as housing.
5. Shaft Cooler: Metal disk between bearings and fan wheel, designed to dissipate heat from shaft.
6. Spark-Resistant Construction: As indicated on Drawings.
7. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.
8. Weather Cover: Enameled-steel sheet with ventilation slots, bolted to housing.

M. Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

1. Enclosure Type: Totally enclosed, fan cooled.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install centrifugal fans level and plumb.

B. Support floor-mounting units using spring isolators having a static deflection of 1 inch. Vibration- and seismic-control devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

1. Secure vibration and seismic controls to concrete bases using anchor bolts cast in concrete base.

C. Install floor-mounting units on concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."

D. Install floor-mounting units on concrete bases designed to withstand, without damage to equipment, the seismic force required by authorities having jurisdiction. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."

E. Install units with clearances for service and maintenance.

F. Label fans according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."

B. Install ducts adjacent to fans to allow service and maintenance.

C. Install line-sized piping from scroll drain connection, with trap with seal equal to 1.5 times specified static pressure, to nearest floor drain.

D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
10. Remove and replace malfunctioning units and retest as specified above.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans.

END OF SECTION 233416

CONFIDENTIAL DOCUMENT

233423

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

HVAC POWER VENTILATORS

ImmuCell
Portland, ME

Reviews / Approvals

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ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

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CONFIDENTIAL DOCUMENT

233423

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Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
233423	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 233423 - HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Centrifugal roof ventilators.

1.2 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

C. Field quality-control test reports.

D. Operation and maintenance data.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

C. UL Standard: Power ventilators shall comply with UL 705.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL ROOF VENTILATORS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on the drawings or a comparable product by one of the following:

1. Acme Engineering & Mfg. Corp.
2. Aerovent; a Twin City Fan Company.
3. Carnes Company HVAC.
4. Greenheck.

D. Description: Direct- or belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.

E. Housing: Removable, spun-aluminum, dome top and outlet baffle square, one-piece, aluminum base with venturi inlet cone.

1. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.

F. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

G. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:

1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
4. Fan and motor isolated from exhaust airstream.

H. Accessories:

1. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted insidefan housing, factory wired through an internal aluminum conduit.
2. Bird Screens: Removable, 1/2 inch mesh, aluminum or brass wire.
3. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
4. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.

I. Roof Curbs: Galvanized steel; mitered and welded corners; 1 1/2 inch thick, rigid, fiberglass insulation adhered to inside walls; and 1 1/2 inch wood nailer. Size as required to suit roof opening and fan base.

1. Configuration: Built-in raised cant and mounting flange.
2. Overall Height: 16 inches
3. Sound Curb: Curb with sound-absorbing insulation matrix.
4. Pitch Mounting: Manufacture curb for roof slope.
5. Metal Liner: Galvanized steel.
6. Mounting Pedestal: Galvanized steel with removable access panel.
7. Vented Curb: Unlined with louvered vents in vertical sides.

2.2 MOTORS

A. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

B. Enclosure Type: Totally enclosed, fan cooled.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install power ventilators level and plumb.

B. Support units using spring isolators having a static deflection of 1 inch. Vibration- and seismic-control devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

1. Secure vibration and seismic controls to concrete bases using anchor bolts cast in concrete base.

C. Secure roof-mounting fans to roof curbs with cadmium-plated hardware. Refer to Division 07 Section "Roof Accessories" for installation of roof curbs.

D. Install units with clearances for service and maintenance.

E. Label units according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

F. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."

G. Install ducts adjacent to power ventilators to allow service and maintenance.

H. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

I. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.

5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
10. Shut unit down and reconnect automatic temperature-control operators.
11. Remove and replace malfunctioning units and retest as specified above.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION 233423

CONFIDENTIAL DOCUMENT

23371313

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

AIR DIFFUSERS

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
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ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

23371313

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
23371313	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 233713.13 - AIR DIFFUSERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Perforated diffusers.

B. Related Requirements:

1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers.
2. Section 233713.23 "Air Registers and Grilles" for adjustable-bar register and grilles, fixed-face registers and grilles, and linear bar grilles.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5. Duct access panels.

B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 PERFORATED DIFFUSERS

A. Basis-of-Design Product: Subject to compliance with requirements provide the products indicated on the drawings or a comparable product by one of the following:

1. Ruskin
2. Price Industries
3. Carnes Company
4. Titus
5. Nailor
6. Krueger

B. Devices shall be specifically designed for variable-air-volume flows.

C. Material: Steel backpan and pattern controllers, with steel face.

D. Finish: Baked enamel white

E. Face Size: 24 x 24 inches

F. Duct Inlet: Round

G. Face Style: Flush.

H. Mounting: Surface Mount, Flat Frame

I. Pattern Controller: None

J. Dampers: Opposed blade

K. Accessories:

1. Operating rod extension.

2.2 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers are installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install diffusers level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Owner for a determination of final location.

C. Install diffusers with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713.13

CONFIDENTIAL DOCUMENT

23371323

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

AIR REGISTERS AND GRILLES

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

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CONFIDENTIAL DOCUMENT

23371323

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
23371323	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 233713.23 - AIR REGISTERS AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Adjustable blade face registers and grilles.

B. Related Requirements:

1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to registers and grilles.
2. Section 233713.13 "Air Diffusers" for various types of air diffusers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Register and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5. Duct access panels.

B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 REGISTERS

A. Basis-of-Design Product: Subject to compliance with requirements provide the products indicated on the drawings or a comparable product by one of the following:

1. Ruskin
2. Price Industries
3. Carnes Company
4. Titus
5. Nailor

B. Material: Steel

C. Finish: Baked enamel white.

D. Face Blade Arrangement: Vertical, 3/4" apart.

E. Core Construction: Integral.

1. Mounting: Countersunk screw.
2. Damper Type: Adjustable opposed blade

2.2 GRILLES

A. Basis-of-Design Product: Subject to compliance with requirements provide the products indicated on the drawings or a comparable product by one of the following:

1. Ruskin
2. Price Industries
3. Carnes Company
4. Titus
5. Nailor

B. Material: Steel

C. Finish: Baked enamel white.

D. Face Blade Arrangement: Vertical, 3/4" apart.

E. Core Construction: Integral.

1. Mounting: Countersunk screw.
2. Damper Type: Adjustable opposed blade

2.3 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate registers and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where registers and grilles are installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install registers and grilles level and plumb.

B. Outlets and Inlets Locations: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Owner for a determination of final location.

C. Install registers and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust registers and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713.23

CONFIDENTIAL DOCUMENT

235100

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

BREECHINGS, CHIMNEYS, AND STACKS

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
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CONFIDENTIAL DOCUMENT

235100

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
235100	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 235100 - BREECHINGS, CHIMNEYS, AND STACKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Listed building heating appliance chimneys.

1.3 SUBMITTALS

A. Product Data: For the following:

1. Building-heating-appliance chimneys.

B. Shop Drawings: For vents, breechings, chimneys, and stacks. Include plans, elevations, sections, details, and attachments to other work. Vent design shall be by boiler manufacturer.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, methods of field assembly, components, hangers and seismic restraints, and location and size of each field connection.
2. For installed products indicated to comply with design loads, include calculations required for selecting seismic restraints and structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Welding certificates.

D. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain listed system components through one source from a single manufacturer.

B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code--Steel," for hangers and supports and AWS D9.1/D9.1M, "Sheet Metal Welding Code," for shop and field welding of joints and seams in vents, breechings, and stacks.

C. Certified Sizing Calculations: Manufacturer shall certify venting system sizing calculations.

1.5 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of venting system that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, structural failures caused by expansion and contraction.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LISTED BUILDING-HEATING-APPLIANCE CHIMNEYS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide Cleaver Brooks CBILA or a comparable product by one of the following:

1. American Metal Products; MASCO Corporation.
2. FAMCO.
3. Hart & Cooley, Inc.
4. Heat-Fab, Inc.
5. Industrial Chimney Company.
6. LSP Products Group, Inc.
7. Metal-Fab, Inc.
8. Schebler Co. (The).
9. Selkirk Inc.; Selkirk Metalbestos and Air Mate.
10. Simpson Dura-Vent Co., Inc.; Subsidiary of Simpson Manufacturing Co.
11. Tru-Flex Metal Hose Corp.
12. Van-Packer Company, Inc.

D. Description: Double-wall metal vents tested according to UL 103 and rated for 1000 deg F continuously, or 1700 deg F for 10 minutes; with neutral or negative flue pressure complying with NFPA 211.

E. Construction: Inner shell and outer jacket separated by at least a 1-inch annular space filled with high-temperature, ceramic-fiber insulation.

F. Inner Shell: ASTM A 666, Type 304 or Type 316 stainless steel.

G. Outer Jacket: Aluminizedor Stainless steel.

H. Accessories: Tees, elbows, increasers, draft-hood connectors, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly.

1. Termination: Stack cap designed to exclude minimum 90 percent of rainfall.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATION

A. Listed Building-Heating-Appliance Chimneys: Dual-fuel boilers, oven vents, water heaters, and exhaust for engines. Fireplaces and other solid-fuel-burning appliances.

3.3 INSTALLATION OF LISTED VENTS AND CHIMNEYS

A. Locate to comply with minimum clearances from combustibles and minimum termination heights according to product listing or NFPA 211, whichever is most stringent.

B. Seal between sections of positive-pressure vents and grease exhaust ducts according to manufacturer's written installation instructions, using sealants recommended by manufacturer.

C. Support vents at intervals recommended by manufacturer to support weight of vents and all accessories, without exceeding appliance loading.

D. Slope breechings down in direction of appliance, with condensate drain connection at lowest point piped to nearest drain.

E. Lap joints in direction of flow.

F. Connect base section to foundation using anchor lugs of size and number recommended by manufacturer.

G. Join sections with acid-resistant joint cement to provide continuous joint and smooth interior finish.

H. Erect stacks plumb to finished tolerance of no more than 1 inch out of plumb from top to bottom.

3.4 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

B. Clean breechings internally, during and after installation, to remove dust and debris. Clean external surfaces to remove welding slag and mill film. Grind welds smooth and apply touchup finish to match factory or shop finish.

C. Provide temporary closures at ends of breechings, chimneys, and stacks that are not completed or connected to equipment.

END OF SECTION 235100

CONFIDENTIAL DOCUMENT

235239

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

FIRE-TUBE BOILERS

ImmuCell
Portland, ME

Reviews / Approvals

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ImmuCell Project Manager ImmuCell	Elizabeth Williams		
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CONFIDENTIAL DOCUMENT

235239

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
235239	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 235239 - FIRE-TUBE BOILERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes packaged, factory-fabricated and -assembled boilers, trim, and accessories for generating steam with the following configurations and burners:

1. Horizontal, fire-tube boiler.
2. Gas burner.

1.3 SUBMITTALS

A. Product Data: Include performance data, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: For boilers, boiler trim, and accessories. Include plans, elevations, sections, details, and attachments to other work.

1. Design calculations and vibration isolation base details, signed and sealed by a qualified professional engineer.

a. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
b. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails and equipment mounting frames.

2. Wiring Diagrams: Power, signal, and control wiring.

C. Manufacturer Seismic Qualification Certification: Submit certification that boiler, accessories, and components will withstand seismic forces defined in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Source quality-control test reports.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For boilers, components, and accessories to include in emergency, operation, and maintenance manuals.

G. Warranty: Special warranty specified in this Section.

H. Other Informational Submittals:

1. ASME Stamp Certification and Report: Submit "A," "S," or "PP" stamp certificate of authorization, as required by authorities having jurisdiction, and document hydrostatic testing of piping external to boiler.
2. Startup service reports.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. ASME Compliance: Fabricate and label boilers to comply with ASME Boiler and Pressure Vessel Code.

C. ASHRAE/IESNA 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."

D. UL Compliance: Test Boilers for compliance with UL 795, "Commercial-Industrial Gas Heating Equipment." Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.

1.5 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace front- and rear-door refractories and heat exchangers of boilers that fail in materials or workmanship within specified warranty period.

1. Horizontal, Fire-Tube and Fire-Box Boilers: Refractory in front and rear doors, 10 years from date of startup by factory-authorized personnel.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. AESYS Technologies, LLC.
2. Burnham Hydronics.
3. Cleaver-Brooks; div. of Aqua-Chem, Inc.
4. Hurst Boiler & Welding Company, Inc.
5. Iron Fireman Combustion Products.
6. Lattner Boiler Manufacturing.

2.2 MANUFACTURED UNITS

A. The boiler shall be a four pass horizontal firetube updraft boiler with five (5) square feet of heating surface per rated boiler horsepower. It shall be mounted on a heavy steel frame with integral forced draft burner and burner controls.

1. The boiler shall be completely preassembled and fire tested at the factory.
   The unit shall be ready for immediate mounting on floor or simple foundation and ready for attachment of water, steam, fuel, electrical, vent and blowdown connections.
2. The boiler shall be built to comply with the following codes ASME CSD-1.

B. Boiler Shell (Steam)

1. The boiler shell must be constructed in accordance with ASME Boiler Code and must receive authorized boiler inspection prior to shipment. A copy of the inspection report shall be furnished to the purchaser.
2. Two lifting eyes shall be located on top of the boiler.
3. Front doors on the boiler shall be hinged and rear doors on the boiler shall be davited. Doors are to be sealed with fiberglass tadpole gaskets and fastened tightly using heavy capscrews that thread into replaceable brass nuts.
4. Rear refractory and insulation shall be contained in the formed door, which must swing open for inspection of brick work.
5. The boiler tubes shall not include turbulators, swirlers or other add-on appurtenances.

6. Front and rear tube sheets and all flues must be fully accessible for inspection and cleaning when the doors are swung open. The boiler shall be furnished with adequate handholes to facilitate boiler inspection and cleaning.
7. The exhaust gas vent shall be located near the front of the boiler on the top center line and shall be capable of supporting 1000 lbs and shall contain a stack thermometer.
8. The boiler shell shall contain a chemical feed connection.

C. Observation ports for the inspection of flame conditions shall be provided at each end of the boiler.

D. The boiler insulation shall consist of a 2 inch blanket under a sectional preformed sheet metal lagging. This insulation must be readily removable and capable of being reinstalled, if required.

E. The entire boiler base frame and other components shall be factory painted before shipment using a hard finish enamel coating.

2.3 BURNER

A. Mode of Operation

1. Burner operation shall be full modulation principle. The burner shall always return to low fire position for ignition.

B. Blower

1. Air for combustion shall be supplied by a forced draft blower mounted in the front boiler door, above the burner, to eliminate vibration and reduce noise level.
2. The impeller shall be cast aluminum, radial blade, carefully balanced, and directly connected to the blower motor shaft.

C. Combustion Air Control

1. Combustion air damper and cam operated fuel metering valves shall be operated by a single damper control motor that regulates the fire according to load demand. Potentiometer type position controls shall be provided to regulate operation of the damper control motor.

D. Fuel Specification and Piping

1. Fuel Series 700 - Gas Fired

a. Burner Type - The burner shall be integral with the front head of the boiler and of high radiant multi-port type for gas. The burner shall be approved for operation on natural gas fuel.
b. Gas Pilot - The gas pilot shall be a premix type with automatic electric ignition. An electronic detector shall monitor the pilot so that the primary gas valve cannot open until pilot flame has been established. The pilot train shall include two manual shut-off valves, solenoid valve, pressure regulator and pressure gauge.

c. Gas Burner Piping - Gas burner piping on all units shall include pressure regulator, primary gas shutoff valve, motor operated with proof of closure switch and plugged leakage test connection. The main gas valve(s) shall be wired to close automatically in the event of power failure, flame failure, low water or any safety shutdown condition. A lubricating plug cock or butterfly shutoff valve shall be provided as a means for a tightness check of the primary shut off valve. An additional plug cock on butterfly valve shall be furnished at entrance to gas train. High and low gas pressure switches shall be provided.
d. Burner Turndown - Turndown range of burner shall be 4:1 when firing natural gas.

2.4 TRIM

A. Water Column: A water column shall be located on the right hand side of the boiler complete with gauge glass set and water column blowdown valves.

1. Feedwater Pump Control: The boiler feedwater pump control shall be included as an integral part of the water column to automatically actuate a motor driven feed water pump maintaining the boiler water level within normal limits.
2. Low Water Cutoff: The low water cutoff shall be included as an integral part of the boiler feedwater control wired into the burner control circuit to prevent burner operation if the boiler water level falls below a safe level.

B. Auxiliary Low Water Cutoff: Auxiliary low water cutoff manual reset shall be included, piped to the vessel, and wired to the burner control circuit. A manual reset device shall be used on this control.

C. Steam Pressure Gauge: The steam pressure gauge shall be located at the front of the boiler and include cock and test connection.

D. Safety Valves: Safety valves of a type and size to comply with ASME Code requirements shall be shipped loose.

E. Steam Pressure Controls: The steam pressure controls to regulate burner operation shall be mounted near the water column. Controls shall be a high limit (manual reset), operating limit (auto reset), and firing rate control.

2.5 CONTROLS

A. Refer to Division 23 Section "Instrumentation and Control for HVAC."

B. Controller

1. Controller shall be computerized solid state having sequence and flame-on lights and alpha- numeric “first out” fault indications of flame safeguard trip functions. It shall include dynamic self-check logic. The controller shall have a fixed operating sequence incapable of being manually altered. The sequence shall include start, pre-purge, pilot and main fuel ignition run and post-purge cycles.

2. Controller shall be the non-recycle type for maximum safety that shall shutdown the burner and indicate as a minimum the following trip functions: pilot and main flame failure, high and low fire proving switch faults, locking interlocks open, false flame signal and fuel valve open (when proof of closure switch is furnished).
3. The controller shall have a run/test switch. It shall allow interruptions to sequence just after pre-purge, during pilot ignition trial and run cycles for adjustments to firing rate motor, damper linkages and pilot flame for minimum turndown tests.

C. Control Panel

1. Control Panel - The control panel shall be mounted on the front door of the boiler in a location convenient to the operator. The hinged metal cabinet will have NEMA 1A rating that includes a neoprene dust seal and a Yale cabinet key type lock.
2. The panel shall contain the boiler controller, blower motor starter, indicating lights and selector switches.
3. The panel shall have a removable sub-base for mounting the flame safeguard controller, blower motor starter, and terminal blocks. For combination gas-oil and heavy oil fired boilers the panel will contain the fuel selector and/or oil heater selector switch.
4. The panel shall contain the following lights and switches:

a. Lights

1) White - load demanded.
2) White - fuel valve open.
3) Red - low water.
4) Red - flame failure.

b. Control Switches

1) Burner On-Off.
2) Manual-Automatic.
3) Manual Firing Rate Control.

D. Oil, heat and moisture resistant wire shall be used and identified with circuit numbers corresponding to the electrical wiring diagram.

E. All electrical equipment and wiring shall be in conformance with Underwriters Laboratories requirements.

F. Boiler to be supplied with a control circuit transformer and fuse protection for the control circuit.

2.6 BOILER BLOW DOWN SEPARATOR

A. Boiler to be supplied with a blow down separator. Basis of design shall be Penn Separator Corp. model A34 with 1-1/4” inlet, 4” drain, 4” vent, plate thickness 5/16” ASME Code 250 psig @ 450 deg F with flanged connections. Separator to have stainless steel striking plate at point of inlet impingement.

1. Furnish and install a Penn separator with Angle legs for floor mounting.

2. Furnish with automatic control of drain water temperature penn separator after cooler model 18DF 3" with 1" C.W.I., a temperature Regulator Valve, strainer, and 2" dial bimetallic thermometer.

2.7 ELECTRICAL POWER

A. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 26 Sections.

B. Single-Point Field Power Connection: Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to boiler.

1. House in NEMA 250, Type 1 enclosure.
2. Wiring shall be numbered and color-coded to match wiring diagram.
3. Install wiring outside of an enclosure in a metal raceway.
4. Field power interface shall be to fused disconnect switch.
5. Provide each motor with overcurrent protection.

2.8 CAPACITIES AND CHARACTERISTICS: As Indicated on Drawings

2.9 SOURCE QUALITY CONTROL

A. Test and inspect factory-assembled boilers, before shipping, according to ASME Boiler and Pressure Vessel Code.

B. Burner and Hydrostatic Test: Factory adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency; perform hydrostatic test.

C. Allow Owner access to source quality-control testing of boilers. Notify Engineer 14 days in advance of testing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before boiler installation, examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting boiler performance, maintenance, and operations.

1. Final boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

B. Examine mechanical spaces for suitable conditions where boilers will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 BOILER INSTALLATION

A. Install boilers level on concrete base. Concrete base is specified in Division 23 Section "Common Work Results for HVAC," and concrete materials and installation requirements are specified in Division 03.

B. Vibration Isolation: Elastomeric mountswith a minimum static deflection of 0.25 inch. Vibration isolation devices and installation requirements are specified in Division 23 Section "Vibration Controls for HVAC Piping and Equipment."

C. Install gas-fired boilers according to NFPA 54.

D. Assemble and install boiler trim.

E. Install electrical devices furnished with boiler but not specified to be factory mounted.

F. Install control wiring to field-mounted electrical devices.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to boiler to allow service and maintenance.

C. Connect gas piping to boiler gas-train inlet with union. Piping shall be at least full size of gas train connection. Provide a reducer if required.

D. Connect oil piping full size to burner inlet with shutoff valve and union.

E. Connect steam piping to supply, and blowdown-boiler tappings with shutoff valve and union or flange at each connection.

F. Install piping from safety relief valves to nearest floor drain.

G. Install piping from safety valves to drip-pan elbow and to nearest floor drain.

H. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.

I. Connect breeching full size to boiler outlet. Comply with requirements in Division 23 Section "Breechings, Chimneys, and Stacks" for venting materials.

J. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

K. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Perform installation and startup checks according to manufacturer's written instructions.
2. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.
3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

    a. Burner Test: Adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency.
    b. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level, and steam pressure.
    c. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Remove and replace malfunctioning units and retest as specified above.

D. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

E. Performance Tests:

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect component assemblies and equipment installations, including connections, and to conduct performance testing.
2. Boilers shall comply with performance requirements indicated, as determined by field performance tests. Adjust, modify, or replace equipment in order to comply.
3. Perform field performance tests to determine the capacity and efficiency of boilers.

    a. For dual-fuel boilers, perform tests for each fuel.
    b. Test for full capacity.
    c. Test for boiler efficiency at low fire, 20, 40, 60, 80, 100, 80, 60, 40 and 20 percent of full capacity. Determine efficiency at each test point.

4. Repeat tests until results comply with requirements indicated.
5. Provide analysis equipment required to determine performance.
6. Provide temporary equipment and system modifications necessary to dissipate the heat produced during tests if building systems are not adequate.
7. Notify Engineer in advance of test dates.
8. Document test results in a report and submit to Engineer.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain boilers.

END OF SECTION 235239

CONFIDENTIAL DOCUMENT

235316

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

DEAERATORS

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
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ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

235316

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
235316	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 235316 - DEAERATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes packaged, factory-assembled deaerators.

1.3 DEFINITIONS

A. Feedwater Pump: Pump that moves feedwater from the deaerator to the boiler.

B. NPSH: Net-positive suction head.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated makeup water, feedwater, and steam flow rates; working pressure; tank capacities; storage capacity in minutes; temperature and NPSH required; pump performance curves with selection points clearly indicated; furnished specialties; and accessories.

B. Shop Drawings: For deaerators, signed and sealed by a qualified professional engineer; include plans, elevations, sections, details, dimensions, weights, loadings, required clearances, and attachments to other work.

1. For installed products indicated to comply with design loads, include structural analysis data.
2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing deaerator bases.
3. Wiring Diagrams: Power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For deaerators to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. ASME Compliance: ASME B31.1, "Power Piping," for systems more than 15 psig. Safety valves and pressure vessels shall bear the appropriate ASME label.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect flanges, pipe openings, nozzles, bearings, and couplings from damage during shipping and storage.

B. Comply with manufacturer's written rigging instructions.

C. Deliver deaerators as factory-assembled units with protective crating and covering.

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. AESYS Technologies, LLC; York Shipley Global Div.
2. Ambassador Heat Transfer Company.
3. Bethlehem Corporation (The).
4. Bryan Steam LLC.
5. Cleaver-Brooks; Div. of Aqua-Chem Inc.
6. Cochrane, Inc.; a Crane Co. Company.
7. Deaerating Designs; a division of Precision Boilers, Inc.
8. Eastern Industrial Products, Inc.; Smith-Koch, Inc., Div.
9. Ecodyne Limited; Graver Water Conditioning Subsidiary.
10. Enpro, Incorporated.
11. Industrial Steam; Custom Steam and Pressure Vessel Systems.
12. International Boiler Works Co. (The).
13. Kansas City Deaerator Company.
14. Lockwood Products, Inc.; Sub. of John L. Underwood Co., Inc.
15. Nationwide Boiler Incorporated.
16. PVI Industries, LLC.

17. Sellers Engineering Co.
18. Skidmore.
19. Sterling Deaerator Co.
20. U.S. Deaerator Co.

2.2 MANUFACTURED UNITS

A. General

1. Spray type, pressurized, horizontal deaerator rated at 5000 pounds per hour. The system shall be of the single tank design and shall guarantee oxygen removal to not more than 0.005 ccs/liter in the effluent throughout all load conditions between 5 and 100 percent. Two- compartment designs are not acceptable. The deaerator shall be designed for operation at 5 psig, but shall be suitable for use from 2 to 15 psig. Atmospheric operating designs are not acceptable.

B. Deaerator and Storage Tank

1. Feedwater and condensate shall be admitted to the deaerator through a single spring-loaded, self-cleaning, adjustable stainless steel spray valve, which shall provide proper internal vent condensing and water distribution at any load between 5 and 100 percent of rated capacity. The water temperature in the primary heating and vent concentrating section is to be raised within 2 or 3 °F of steam temperature and most of the gases released. The water is then to be collected in a conical water collector. From there, it is to flow to an atomizing valve where high velocity steam strikes it, breaks it down into a fine mist, and heats it to a full steam saturation temperature. The mixture is to strike a deflecting baffle, which separates water and steam. Hot, gas-free water is to then drop to the storage compartment to complete the cycle. The steam and non- condensables are to flow upward, through the primary heating spray, into theinternal vent concentrating section, where they contact the cold influent water. Here, the steam is to be condensed to continue the cycle. Released gasses are discharged to atmosphere through the vent outlet. All internal surfaces, which come in contact with un-deaerated water, shall be constructed of Type 316 stainless steel.

2. Automatic vent valve shall be thermostatically controlled to provide a fast means of venting when a sudden buildup of gases occurs, such as seen at start up. The manual vent valve shall have an orifice for continuous minimum venting. Venting rate shall not exceed 0.1 of 1% of the rated deaerator capacity at 5 psig.

3. The deaerated water storage tank shall have 155 gallons of capacity measured to overflow. A manhole shall be provided for access. All nozzles 3" and under shall be 3000 lbs forged steel couplings and over 3" shall be 150 lbs flat face flanges. Heads to be ASME torispherical type constructed of ASTM A516 GR 70 carbon steel with a minimum thickness of 0.25 inches. Shell plate to be fabricated of ASTM A36 carbon steel with a minimum thickness of 0.25 inches. The tank shall be designed in accordance with ASME, Section VIII of the Pressure Vessel Code for 50 psig at 650 °F and stamped accordingly. Certification shall be required. Joint efficiencies to be 70% circumferential per Table UW-12, which does not require stress relieving or nondestructive examination.

4. The tank shall be factory-insulated and lagged with blanket insulation, pins, clips, and a durable steel jacket. Block-type insulation is not acceptable. The blanket insulation is to be fiberglass, 2" thick, 1 lb/cu-ft, and have a rating of R5. Pins are to be located on 18" centers and holding clips attached. The steel jacket or lagging shall have a shell thickness of 18 gauge (0.0478") minimum and head thickness of 18 gauge (0.0478") minimum.

5. The chemical feed quill shall be located beneath the normal tank water level. The quill material shall be constructed of stainless steel. The tube shall provide even distribution and blending of chemical.

6. The basic deaerator shall be equipped with the following trim and accessories. Piping on packaged units shall comply with ASME Power Piping Code B31.1.

C. Make Up Valve and Controller

1. Electronic inlet water motorized regulating valve with steel body and threaded NPT connections. Motor shall be 110V bi-directional, with a permanently lubricated gear train, and be directly coupled to the valve stem. Valve shall not exceed a delta-P of 10 psig. This valve shall have teflon seats and be suitable for temperatures up to 300 °F. This valve shall be electronically controlled by a solid state control with internally mounted capacitance probes. The electronic solid state control shall be able to set desired level point and acceptable deviation. The electronic solid state control shall include a selection for automatic and manual operating mode. The internals shall include two additional probes for high and low water alarm. A solenoid valve and float switch are not acceptable.

2. The make up valve shall include a ANSI Class 125 lb three-valve bypass with inlet Y-type cast iron strainer. Strainer screen to be removable and of stainless steel construction.

D. Steam Pressure Reducing Station

1. The steam pressure reducing valve shall have a cast iron body and ¾” connections. The valve shall be a self-contained unit capable of reducing 100 psig saturated steam to the operating pressure of the deaerator at a flow rate of 1000 lbs/hr. The valve shall be 250 lb class with stainless steel trim and an adjustable pilot.

2. The steam pressure reducing valve shall include a three valve bypass with Y-type cast iron strainer. Strainer screen to be removable and of stainless steel construction.

3. Relief valves sized to relieve full capacity of the pressure reducing valve in the event of its failure. Valves to meet Paragraph UG-125 of ASME Unfired Pressure Vessel Code, Section VIII. Valve body to be of bronze construction. Relieving set pressure to be 50 psig.

4. High level alarm switch. This shall be an externally mounted float type switch. The switch shall make contact on rise and break on fall. The float cage construction shall be cast iron. (Not required with electronic make up controller.

5. Low level alarm switch. This shall be an externally mounted float type switch. The switch shall make contact on fall and break on rise. The float cage construction shall be cast iron. (Not required with electronic make up controller.

6. Overflow drainer sized to relieve full capacity at the operating pressure of the deaerator. The overflow drainer shall be a float type trap. The construction is to be a steel housing with stainless steel float ball.

7. Suction piping for pumps shall consist of a gate valve, cast iron Y-type strainer with replaceable stainless steel screen and flexible connector or hose. This piping assembly shall be 125 lb class construction. The vortex breaker shall be located in the tank nozzle. Manifold suction lines are not acceptable.

E. Boiler Feedwater Pump And Motor Set

1. Intermittent turbine type boiler feedwater pump and motor set. Centrifugal type pumps are not acceptable in this application. Pump to be rated for 11 gpm at 328 feet TDH. Pump to be 15-stage, stainless fitted, low NPSH induced centrifugal pumps equipped with high temperature mechanical seals of 250 °F. Pump impeller to be hydraulically balanced. The pump shall be mounted on a steel baseplate and flexibly coupled with an OSHA type coupling guard to a 2 hp, 3 phase, 60 Hz, 460 Volt, 3500 rpm, TEPE enclosure motor. Motor to be non- overloading at the rated condition without using any portion of the service factor. Pump and motor set to be factory aligned prior to shipment.

2. The stand shall elevate the deaerator tank to provide the net positive suction head required by the pump at the rated condition to prevent cavitation plus a 1-1/2 foot safety factor. The stand shall be constructed of heavy square steel tubing for the legs and 1/4" steel plate covering the floor.

F. Control Panel

1. Control panel shall be in a NEMA 1 enclosure and wired to the National Electric Code. The wire shall be black number coded. The assembly is to contain individual motor starters with 120 Volt holding coil and fuse protection. Individual green oil-tight pump run lights shall be provided. All switches and lights to have nameplate identification. The assembled panel shall be given a factory continuity test prior to shipment.

2. Audible and visual high and low water alarm function shall be provided by a bell or horn with silence switch and individual red oil-tight lights. Control circuit transformer to supply 110-120 Volts, single-phase power supply. The transformer shall be mounted, wired and fused. Auxiliary contacts shall be furnished for chemical feed pump initiation. Contacts shall be normally open.

3. The deaerator shall have a gauge glass assembly that covers the entire tank diameter. The gauge glass shall be quartz, 0.625 inch diameter by 24 inch maximum length. Each length of glass shall be furnished with a bronze gauge cock set and protector rods. The deaerator shall be supplied with a pressure gauge that has a 4-1/2 inch dial with a 0-60 psig range and a thermometer with a 50 to 300 °F range. Packaged units are required to have both gauges bracket- mounted at eye level. The deaerator is to be hand cleaned with a solvent

to SSPC- SP-1 standards prior to painting. Prime coated to not less than 1 mil thick and finish coated with an enamel paint to not less than 1 mil thick prior to shipment. Unit is to be knocked down for shipment. Piping is to be matched marked. Three, bound, Operating and Maintenance manuals to be provided. Warranty period to be twelve months after start-up or eighteen months.

G. Accessories

1. Provide DA with pre piped-sample cooler for boiler feed water testing.

H. Capacities and Characteristics: As indicated on drawings.

2.3 SOURCE QUALITY CONTROL

A. Fabricate and label deaerator tanks according to ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1.

B. Factory install and test piping that connects pumps to tanks according to ASME B31.1, "Power Piping."

C. Factory test performance and certify test results on packaged deaerator units, according to ASME PTC 12.3, before shipping to Project.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before deaerator installation, examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting performance, maintenance, and operations.

1. Final deaerator locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install deaerators level on concrete base. Concrete base is specified in Division 23 Section "Common Work Results for HVAC," and concrete materials and installation requirements are specified in Division 03.

B. Vibration Isolation: Elastomeric mounts with a minimum static deflection of 0.25 inch. Vibration isolation devices and installation requirements are specified in Division 23 Section "Vibration Controls for HVAC Piping and Equipment."

C. Install deaerators to permit access for service and maintenance.

D. Support piping independent of pumps.

E. Install all parts and materials not factory installed.

F. Extend overflow drains to blow down separator or as indicated on drawings.

G. Extend vent piping to outside and terminate with manufacturer-approved cap furnished with deaerator.

H. Install piping adjacent to machine to allow service and maintenance.

3.3 CONNECTIONS

A. Steam and condensate piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect steam and condensate piping to tank tappings with shutoff valves and unions or flanges at each connection.

C. Connect condensate drains, pump-discharge piping, vents, overflow drains, makeup water, steam supply, and cooling water piping.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Inspect field-assembled components and equipment installation, including piping and electrical connections, for compliance with requirements.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Verify bearing lubrication.
4. Verify proper motor rotation.
5. Test Reports: Prepare a written report to record the following:

    a. Test procedures used.
    b. Test results that comply with requirements.
    c. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

D. Remove and replace malfunctioning equipment and retest as specified above.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Complete installation and startup checks according to manufacturer's written instructions and do the following:

1. Set deaerator makeup water-level controls.
2. Verify bearing lubrication.
3. Verify proper motor rotation.
4. Start pumps according to manufacturer's written instructions.

3.6 ADJUSTING AND CLEANING

A. Adjust initial temperature and pressure set points.

B. Set field-adjustable switches and circuit-breaker trip ranges.

C. Clean strainers.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain deaerators.

END OF SECTION 235316

CONFIDENTIAL DOCUMENT

236426

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

ROTARY SCREW WATER CHILLERS

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
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ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

236426

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
236426	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 236426 - ROTARY-SCREW WATER CHILLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Packaged, air-cooled chillers.

1.3 DEFINITIONS

A. BAS: Building automation system.

B. COP: Coefficient of performance. The ratio of the rate of heat removal to the rate of energy input using consistent units for any given set of rating conditions.

C. EER: Energy-efficiency ratio. The ratio of the cooling capacity given in terms of Btu/h to the total power input given in terms of watts at any given set of rating conditions.

D. IPLV: Integrated part-load value. A single-number part-load efficiency figure of merit calculated per the method defined by ARI 550/590 and referenced to ARI standard rating conditions.

E. kW/Ton: The ratio of total power input of the chiller in kilowatts to the net refrigerating capacity in tons at any given set of rating conditions.

F. NPLV: Nonstandard part-load value. A single-number part-load efficiency figure of merit calculated per the method defined by ARI 550/590 and intended for operating conditions other than ARI standard rating conditions.

1.4 PERFORMANCE REQUIREMENTS

A. Site Altitude: Chiller shall be suitable for altitude in which installed without affecting performance indicated. Make adjustments to affected chiller components to account for site altitude.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated. Include refrigerant, rated capacities, operating characteristics, furnished specialties, and accessories.

1. Performance at ARI standard conditions and at conditions indicated for 30% propylene glycol.
2. Performance at ARI standard unloading conditions.
3. Minimum evaporator flow rate.
4. Refrigerant capacity of chiller.
5. Oil capacity of chiller.
6. Fluid capacity of evaporator.
7. Characteristics of safety relief valves.
8. Minimum entering condenser-air temperature.
9. Maximum entering condenser-air temperature.
10. Performance at varying capacities with constant-design entering condenser-air temperature. Repeat performance at varying capacities for different entering condenser-air temperatures from design to minimum in 10 deg F increments.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, load distribution, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

C. Coordination Drawings: Floor plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Structural supports.
2. Piping roughing-in requirements.
3. Wiring roughing-in requirements, including spaces reserved for electrical equipment.
4. Access requirements, including working clearances for mechanical controls and electrical equipment, and tube pull and service clearances.

D. Certificates: For certification required in "Quality Assurance" Article.

E. Source quality-control reports.

F. Startup service reports.

G. Operation and Maintenance Data: For each chiller to include in emergency, operation, and maintenance manuals.

H. Warranty: Sample of special warranty.

1.6 QUALITY ASSURANCE

A. ARI Certification: Certify chiller according to ARI 550andARI 590 certification program(s).

B. ARI Rating: Rate chiller performance according to requirements in ARI 550/590.

C. ASHRAE Compliance:

1. ASHRAE 15 for safety code for mechanical refrigeration.
2. ASHRAE 147 for refrigerant leaks, recovery, and handling and storage requirements.

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004.

E. ASME Compliance: Fabricate and label chiller to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, and include an ASME U-stamp and nameplate certifying compliance.

F. Comply with NFPA 70.

G. Comply with requirements of UL and UL Canada and include label by a qualified testing agency showing compliance.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Ship chillers from the factory fully charged with refrigerant.

B. Ship each chiller with a full charge of refrigerant. Charge each chiller with nitrogen if refrigerant is shipped in containers separate from chiller.

C. Ship each oil-lubricated chiller with a full charge of oil.

1. Ship oil factory installed in chiller.

D. Package chiller for export shipping in totally enclosed crate.

1.8 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.

B. Coordinate sizes, locations, and anchoring attachments of structural-steel support structures.

C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of chillers that fail in materials or workmanship within specified warranty period.

1. Extended warranties include, but are not limited to, the following:

    a. Complete chiller including refrigerant and oil charge.
    b. Complete compressor and drive assembly including refrigerant and oil charge.
    c. Refrigerant and oil charge.
    d. Parts and labor.
    e. Loss of refrigerant charge for any reason.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PACKAGED, AIR-COOLED CHILLERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Carrier Corporation; a United Technologies company.
2. Dunham-Bush.
3. McQuay International.
4. Trane; a division of American Standard.
5. YORK International Corporation.

B. Description: Factory-assembled and run-tested chiller complete with base and frame, condenser casing, compressors, compressor motors and motor controllers, evaporator, condenser coils, condenser fans and motors, electrical power, controls, and accessories.

C. Fabricate base, frame, and attachment to chiller components strong enough to resist chiller movement during a seismic event when chiller base is anchored to field support structure.

D. Cabinet:

1. Base: Galvanized-steel base extending the perimeter of chiller. Secure frame, compressors, and evaporator to base to provide a single-piece unit.
2. Frame: Rigid galvanized-steel frame secured to base and designed to support cabinet, condenser, control panel, and other chiller components not directly supported by base.
3. Casing: Galvanized steel.
4. Finish: Coat base, frame, and casing with a corrosion-resistant coating capable of withstanding a salt-spray test according to ASTM B 117.
5. Sound-reduction package designed to reduce sound level without affecting performance and consisting of the following:

    a. Acoustic enclosure around compressors.
    b. Reduced-speed fans with acoustic treatment.

6. Security Package: Provide removable louvered panels with fasteners for additional protection of compressors, evaporator, and condenser coils without inhibiting service access. Finish to match cabinet.

E. Compressors:

1. Description: Positive displacement, hermetically sealed.
2. Casing: Cast iron, precision machined for minimum clearance about periphery of rotors.
3. Rotors: Manufacturer's standard one- or two-rotor design.
4. Each compressor provided with suction and discharge shutoff valves, crankcase oil heater, and suction strainer.

F. Service: Easily accessible for inspection and service.

G. Capacity Control: On-off compressor cycling and modulating slide-valve assembly or port unloaders combined with hot-gas bypass, if necessary, to achieve performance indicated.

1. Maintain stable operation throughout range of operation. Configure to achieve most energy-efficient operation possible.
2. Operating Range: From 100 to zero percent of design capacity.
3. Condenser-Air Unloading Requirements over Operating Range: Condenser fan sequencing and speed control
4. For units equipped with a variable frequency controller, capacity control shall be both "valveless" and "stepless," requiring no slide valve or capacity-control valve(s) to operate at reduced capacity.

H. Oil Lubrication System: Consisting of pump if required, filtration, heater, cooler, factory-wired power connection, and controls.

1. Provide lubrication to bearings, gears, and other rotating surfaces at all operating, startup, shutdown, and standby conditions including power failure.
2. Thermostatically controlled oil heater properly sized to remove refrigerant from oil.
3. Factory-installed and pressure-tested piping with isolation valves and accessories.
4. Oil compatible with refrigerant and chiller components.
5. Positive visual indication of oil level.

I. Vibration Control:

1. Vibration Balance: Balance chiller compressors and drive assemblies to provide a precision balance that is free of noticeable vibration over the entire operating range.

    a. Overspeed Test: 25 percent above design operating speed.

2. Isolation: Mount individual compressors on elastomeric isolators.

J. Compressor Motors:

1. Hermetically sealed and cooled by refrigerant suction gas.
2. High-torque, induction type with inherent thermal-overload protection on each phase.

K. Compressor Motor Controllers:

1. Variable Frequency Controller:

a. Motor controller shall be factory mounted and wired on the chiller to provide a single-point, field-power termination to the chiller and its auxiliaries.
b. Description: NEMA ICS 2; listed and labeled as a complete unit and arranged to provide variable speed by adjusting output voltage and frequency.
c. Enclosure: Unit mounted, NEMA 250, Type 3R with hinged full-front access door with lock and key.
d. Integral Disconnecting Means NEMA AB 1, instantaneous-trip circuit breaker with lockable handle. Minimum withstand rating shall be as required by electrical power distribution system, but not less than 100,000 A.
e. Technology: Pulse width modulated (PWM) output suitable for constant or variable torque loads.
f. Motor current at start shall not exceed the rated load amperes, providing no electrical inrush.

L. Refrigerant Circuits:

1. Refrigerant: Type as indicated on Drawings.
2. Refrigerant Type: R-134aHFC. Classified as Safety Group A1 according to ASHRAE 34.
3. Refrigerant Compatibility: Chiller parts exposed to refrigerants shall be fully compatible with refrigerants, and pressure components shall be rated for refrigerant pressures.
4. Refrigerant Circuit: Each shall include a thermal- or electronic-expansion valve, refrigerant charging connections, a hot-gas muffler, compressor suction and discharge shutoff valves, a liquid-line shutoff valve, a filter-dryer, a sight glass with moisture indicator, a liquid-line solenoid valve, and an insulated suction line.
5. Pressure Relief Device:

a. Comply with requirements in ASHRAE 15 and in applicable portions of ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
b. ASME-rated, spring-loaded pressure relief valve; single- or multiple-reseating type.

M. Evaporator:

1. Description: Shell-and-tube design.

a. Direct-expansion (DX) type with fluid flowing through the shell, and refrigerant flowing through the tubes within the shell.
b. Flooded type with fluid flowing through tubes and refrigerant flowing around tubes within the shell.

2. Code Compliance: Tested and stamped according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
3. Shell Material: Carbon steel.
4. Shell Heads: Removable carbon-steel heads located at each end of the tube bundle.
5. Fluid Nozzles: Terminated with mechanical-coupling end connections for connection to field piping.
6. Tube Construction: Individually replaceable copper tubes with enhanced fin design, expanded into tube sheets.
7. Heater: Factory-installed and -wired electric heater with integral controls designed to protect the evaporator to minus 20 deg F.

8. Remote Mounting: Designed for remote field mounting where indicated. Provide kit for field installation.

N. Air-Cooled Condenser:

1. Plate-fin coil with integral subcooling on each circuit, rated at 450 psig.

    a. Construct coil casing of galvanized or stainless steel.
    b. Construct coils of copper tubes or aluminum tubing mechanically bonded to aluminum fins.
    c. Coat coils with a baked-epoxy, corrosion-resistant coating after fabrication.
    d. Hail Protection: Provide condenser coils with louvers, baffles, or hoods to protect against hail damage.

2. Fans: Direct-drive propeller type with statically and dynamically balanced fan blades, arranged for vertical air discharge.
3. Fan Motors: Totally enclosed nonventilating (TENV) or totally enclosed air over (TEAO) enclosure, with permanently lubricated bearings. Equip each motor with overload protection integral to either the motor or chiller controls.
4. Fan Guards: Steel safety guards with corrosion-resistant coating.
5. Low Ambient: Unit shall be able to operate in ambient conditions down to -20 F and up to 105 F.

O. Economizer

1. The unit shall be factory equipped with a waterside economizer package. All mechanically cooled chilled water piping shall be insulated with ¾" Armaflex. The pump for the chiller will be by others and shall be off of the chiller. The chilled water inlet and outlet to the evaporator barrel shall be run and flanges left at the side of the pumping and air separation. The chilled water return to the chiller shall have a 3 way diverting valve that shall on a signal from the Controller divert the return water to the four economizer coils that shall produce partial cooling when the ambient temperature is lower than the building return water temperature. The water from the economizer coils shall return back to the system return line downstream of the 3 way valve and before the evaporator barrel so additional cooling by the refrigeration system can be achieved if needed. The differential pressure switch across the evaporator barrel shall be factory wired into the chiller controls as a safety interlock.

2. Controller shall be in full control of all unit functions during both mechanical and free cooling. The Chilled Water Setpoint shall be adjustable via a Communication Interface. All setpoints are adjustable via Hardwire (0-10vdc, 4-20mA), BACnet, Software. A custom control sequence shall be written for approval in accordance with specific jobsite conditions. The following safety cycle interlocks shall be incorporated into the controls:

    a. All standard unit safety circuits are in effect.
    b. Any time flow is not proven, the economizer will not be allowed to operate.
    c. Any fan, and circuit running status indicators have precedent over economizer operation.

P. Electrical Power:

1. Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a multipoint or single-point, field-power connection to chiller.
2. House in a unit-mounted, NEMA 250, Type 3R enclosure with hinged access door[with lock and key or padlock and key.
3. Wiring shall be numbered and color-coded to match wiring diagram.
4. Install factory wiring outside of an enclosure in a raceway.
5. Field-power interface shall be to NEMA AB 1, instantaneous-trip circuit breaker with lockable handle.

    a. Disconnect means shall be interlocked with door operation.
    b. Minimum withstand rating shall be as required by electrical power distribution system, but not less than 100,000A.

6. Provide branch power circuit to each motor and to controls with one of the following disconnecting means:

    a. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.
    b. NEMA AB 1, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit-trip set point.

7. Provide each motor with overcurrent protection.
8. Overload relay sized according to UL 1995 or an integral component of chiller control microprocessor.
9. Phase-Failure and Undervoltage Relays: Solid-state sensing with adjustable settings.
10. Provide power factor correction capacitors to correct power factor to 0.95at full load.
11. Control Transformer: Unit-mounted transformer with primary and secondary fuses and sized with enough capacity to operate electrical load plus spare capacity.

    a. Power unit-mounted controls where indicated.
    b. Power unit-mounted, ground fault interrupt (GFI) duplex receptacle.

12. Control Relays: Auxiliary and adjustable time-delay relays.
13. For chiller electrical power supply, indicate the following:

    a. Current and phase to phase for all three phases.
    b. Voltage, phase to phase, and phase to neutral for all three phases.
    c. Three-phase real power (kilowatts).
    d. Three-phase reactive power (kilovolt amperes reactive).
    e. Power factor.
    f. Running log of total power versus time (kilowatt-hours).
    g. Fault log, with time and date of each.

Q. Controls:

1. Standalone and microprocessor based.

2. Enclosure: Share enclosure with electrical power devices or provide a separate enclosure.
3. Operator Interface: Multiple-character digital or graphic display with dynamic update of information and with keypad or touch-sensitive display located on front of control enclosure. In either imperial or metric units, display the following information:

    a. Date and time.
    b. Operating or alarm status.
    c. Operating hours.
    d. Outdoor-air temperature if required for chilled-water reset.
    e. Temperature and pressure of operating set points.
    f. Entering and leaving temperatures of chilled water.
    g. Refrigerant pressures in evaporator and condenser.
    h. Saturation temperature in evaporator and condenser.
    i. No cooling load condition.
    j. Elapsed time meter (compressor run status).
    k. Pump status.
    l. Antirecycling timer status.
    m. Percent of maximum motor amperage.
    n. Current-limit set point.
    o. Number of compressor starts.

4. Control Functions:

    a. Manual or automatic startup and shutdown time schedule.
    b. Entering and leaving chilled-water temperatures, control set points, and motor load limits. Chilled-water leaving temperature shall be reset based on return-water or outdoor-air temperature.
    c. Current limit and demand limit.
    d. External chiller emergency stop.
    e. Antirecycling timer.
    f. Automatic lead-lag switching.
    g. Variable evaporator flow.
    h. Thermal storage.

5. Manually Reset Safety Controls: The following conditions shall shut down chiller and require manual reset:

    a. Low evaporator pressure or high condenser pressure.
    b. Low chilled-water temperature.
    c. Refrigerant high pressure.
    d. High or low oil pressure.
    e. High oil temperature.
    f. Loss of chilled-water flow.
    g. Control device failure.

6. Trending: Capability to trend analog data of up to five parameters simultaneously over an adjustable period and frequency of polling.
7. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: view only; view and operate; and view, operate, and service.

8. Control Authority: At least four conditions: Off, local manual control at chiller, local automatic control at chiller, and automatic control through a remote source.
9. BAS Interface: Factory-installed hardware and software to enable the BAS to monitor, control, and display chiller status and alarms.

R. Insulation:

1. Material: Closed-cell, flexible elastomeric, thermal insulation complying with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
2. Thickness: 1-1/2 inches.
3. Factory-applied insulation over cold surfaces of chiller components.

    a. Adhesive: As recommended by insulation manufacturer and applied to 100 percent of insulation contact surface. Seal seams and joints.

4. Apply protective coating to exposed surfaces of insulation to protect insulation from weather.

S. Accessories:

1. Factory-furnished, chilled-water flow switches for field installation.
2. Individual compressor suction and discharge pressure gages with shutoff valves for each refrigerant circuit.
3. Factory-furnished neoprene or spring isolators for field installation.
4. Tool Kit: Chiller manufacturer shall assemble a tool kit specially designed for use in serving the chiller(s) furnished. Include special tools required to service chiller components not readily available to Owner service personnel in performing routine maintenance. Place tools in a lockable case with hinged cover. Provide a list of each tool furnished and attach the list to underside of case cover.

T. Capacity and Characteristics: Refer to Drawings

2.2 SOURCE QUALITY CONTROL

A. Perform functional tests of chillers before shipping.

B. Factory run test each air-cooled chiller with water flowing through evaporator.

1. Allow Owner access to place where chillers are being tested. Notify Owner 14 days in advance of testing.
2. Prepare test report indicating test procedures, instrumentation, test conditions, and results. Submit copy of results within one week of test date.

C. Factory performance test air-cooled chillers, before shipping, according to ARI 550/590.

1. Test the following conditions:

    a. Design conditions indicated.
    b. Reduction in capacity from design to minimum load in steps of 10 25 33 with condenser air at design conditions.

c. At five point(s) of varying part-load performance to be selected by Owner at time of test.

2. Allow Owner access to place where chillers are being tested. Notify Engineer 14 days in advance of testing.
3. Prepare test report indicating test procedures, instrumentation, test conditions, and results. Submit copy of results within one week of test date.

D. Factory sound test air-cooled chillers, before shipping, according to ARI 370.

1. Test the following conditions:

a. Design conditions indicated.
b. Chiller operating at calculated worst-case sound condition.
c. At five point(s) of varying part-load performance to be selected by Owner at time of test.

2. Allow Owner access to place where chillers are being tested. Notify Owner 14 days in advance of testing.
3. Prepare test report indicating test procedures, instrumentation, test conditions, and results. Submit copy of results within one week of test date.

E. Factory test and inspect evaporator and condenser according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

F. For chillers located outdoors, rate sound power level according to ARI 370.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine chillers before installation. Reject chillers that are damaged.

B. Examine roughing-in for equipment support, anchor-bolt sizes and locations, piping, and electrical connections to verify actual locations, sizes, and other conditions affecting chiller performance, maintenance, and operations before equipment installation.

1. Final chiller locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CHILLER INSTALLATION

A. Install chillers on support structure indicated.

B. Equipment Mounting: Install chiller on concrete bases using restrained spring isolators. Comply with requirements for concrete bases specified in Division 03 Section "Cast-in-Place Concrete." Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration Controls for HVAC Piping and Equipment."

1. Minimum Deflection: 1/4 inch.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.

C. Maintain manufacturer's recommended clearances for service and maintenance.

D. Charge chiller with refrigerant and fill with oil if not factory installed.

E. Install separate devices furnished by manufacturer and not factory installed.

3.3 CONNECTIONS

A. Comply with requirements for piping specified in Division 23 Section "Hydronic Piping Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to chiller to allow service and maintenance.

C. Evaporator Fluid Connections: Connect to evaporator inlet with shutoff valve, strainer, flexible connector, thermometer, and plugged tee with pressure gage. Connect to evaporator outlet with shutoff valve, balancing valve, flexible connector, flow switch, thermometer, plugged tee with shutoff valve and pressure gage, flow meter, and drain connection with valve. Make connections to chiller with a flange or mechanical coupling.

D. Connect each chiller drain connection with a union and drain pipe, and extend pipe, full size of connection, to floor drain. Provide a shutoff valve at each connection.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Verify that refrigerant charge is sufficient and chiller has been leak tested.
3. Verify that pumps are installed and functional.
4. Verify that thermometers and gages are installed.
5. Operate chiller for run-in period.
6. Check bearing lubrication and oil levels.
7. For chillers installed indoors, verify that refrigerant pressure relief device is vented outdoors.

8. Verify proper motor rotation.
9. Verify static deflection of vibration isolators, including deflection during chiller startup and shutdown.
10. Verify and record performance of fluid flow and low-temperature interlocks for evaporator.
11. Verify and record performance of chiller protection devices.
12. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.

B. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assembly, installation, and connection.

C. Prepare test and inspection startup reports.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain chillers. Video record the training sessions.

END OF SECTION 236426

CONFIDENTIAL DOCUMENT

237413

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

PACKAGED, OUTDOOR, CENTRAL-STATION AIR-HANDLING UNITS

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
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Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

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Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

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237413	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 237413 - PACKAGED, OUTDOOR, CENTRAL-STATION AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes packaged, outdoor, central-station air-handling units (rooftop units) with the following components and accessories:

1. Chilled glycol cooling coils
2. Heating hot glycol
3. Filters
4. Fans
5. Roof curbs
6. Humidifiers

1.3 DEFINITIONS

A. DDC: Direct-digital control.

B. ECM: Electrically commutated motor.

C. AHU: Air Handling Unit. As used in this Section, this abbreviation means packaged, outdoor, central-station air-handling units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.

D. Supply-Air Fan: The fan providing supply air to conditioned space. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

E. VFD: Variable Frequency Drive.

F. BAS: Building Automation System

1.4 PERFORMANCE REQUIREMENTS

A. Wind-Restraint Performance:

1. Basic Wind Speed: 90 mph.
2. Building Classification Category: II.

3. Minimum 10 lb/sq. ft multiplied by the maximum area of the mechanical component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.

1.5 SUBMITTALS

A. Product Data: For each air-handling unit indicated.

1. Unit dimensions and weight.
2. Cabinet material, metal thickness, finishes, insulation, and accessories.
3. Fans:

    a. Certified fan-performance curves with system operating conditions indicated.
    b. Certified fan-sound power ratings.
    c. Fan construction and accessories.
    d. Motor ratings, electrical characteristics, and motor accessories.

4. Certified coil-performance ratings with system operating conditions indicated.

5. Heat Recovery performance information as design conditions. Performance should include bypass full open and full closed conditions.
6. Dampers, including housings, linkages, and operators.
7. Filters with performance characteristics.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For air handling units to include in emergency, operation, and maintenance manuals.

E. Warranty: Special warranty specified in this Section.

1.6 QUALITY ASSURANCE

A. ARI Compliance:

1. Comply with ARI 340/360 for testing and rating energy efficiencies for air handling units.
2. Comply with ARI 270 for testing and rating sound performance for air handling units.

B. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.

C. UL Compliance: Comply with UL 1995.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to replace components of air handling units that fail in materials or workmanship with a period of 18 months from receipt of units or one year from unit start-up, whichever comes first.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: One set of filters for each unit.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on the Drawings or a comparable product by one of the following:

1. Daikin
2. Trane
3. Carrier
4. Haakon

2.2 GENERAL

A. Custom air handling units shall meet or exceed all requirements of this specification.

B. Air handling units shall be of a configuration, pressure rating and performance as shown on the attached drawings. The unit manufacturer shall guarantee the proper operation and performance of scheduled and specified equipment.

C. Manufacturer must clearly define any exceptions made to Plans and Specifications with proposal.

D. Unit shall be designed to avoid air stratification across filters and coils.

E. The units shall be installed on the roof and shall be fabricated in sections factory assembled prior to shipment. For units which must be shipped in sections, the unit manufacturer shall assemble, test, disassemble, ship and provide all materials and labor required to assemble the unit ready for operation.

F. The unit(s) shall include all of the components as shown in the Contract Documents.

G. It is the intent of this specification to provide a unit with all piping complete to the exterior of the unit. Piping 3" in diameter and larger shall terminate with Class 150 flanges, smaller piping shall terminate with screwed male pipe threads.

H. All units shall be of the size and type as indicated on the attached drawings. The dimensions indicated on the drawings are maximum dimensions to fit within the available space. Under sizing of components to fit within the allocated space is not acceptable and it is expected that the manufacturer will advise if the specified space is not adequate. Units shall be completely factory assembled and tested. The unit performance, including cooling, dehumidifying, ventilating, capacity shall meet or exceed that indicated on the drawing and shown in the schedules. Tags and decals to aid in service or indicate caution areas shall be provided. Operation and maintenance manuals shall be furnished with each unit.

I. Units shall be constructed in a watertight and airtight manner. The manufacturer's cabinet construction shall result in a unit leakage rate that shall not exceed ½% of unit capacity at 1.25 times the operating static pressure.

2.3 CASING

A. Fabricate unit with heavy gauge channel posts and panels secured with mechanical fasteners. All panels, access doors, and ship sections shall be sealed with permanently applied bulb-type gasket. Shipped loose gasketing is not allowed.

B. Panels and access doors shall be constructed as a 2-inch nominal thick; thermal broke double wall assembly, injected with foam insulation with an R-value of not less than R-13.

C. The outer panel shall be constructed of G60 painted galvanized 18-gauge steel.

D. The inner liner shall be constructed of G90 galvanized steel.

E. The floor plate shall be furnished with 0.044 inch thick aluminum tread plate.

F. The floor plate shall be constructed as specified for the inner liner.

G. Unit will be furnished with solid inner liners.

H. Panel deflection shall not exceed L/240 (L=length of unit in inches) ratio at 125% of design static pressure, maximum 5 inches of positive or 6 inches of negative static pressure. Deflection shall be measured at the panel midpoint.

I. The casing leakage rate shall not exceed .5 cfm per square foot of cabinet area at 5 inches of positive static pressure or 6 inches of negative static pressure (.0025 m3/s per square meter of cabinet area at 1.24 kPa static pressure).

J. Module to module field assembly shall be accomplished with an overlapping, full perimeter internal splice joint that is sealed with bulb type gasketing on both mating modules to minimize on-site labor and meet indoor air quality standards.

K. Access doors shall be flush mounted to cabinetry, with minimum of two six inch long stainless steel piano-type hinges, latch and full size handle assembly. Access doors shall swing outward for unit sections under negative pressure. Access doors on positive pressure sections, shall have a secondary latch to relieve pressure and prevent injury upon access.

L. Provide cross broke roofcap system to divert water from the top surface of the air handler. The rain shed roofcap shall have 2”standing seams covered with splice cap channels to seal top seam. Splice cap shall break down over sides of standing seam to protect the ends of the seam.

M. The unit shall have a 6-inch curb ready base for structural rigidity and condensate trapping. The curb-ready base shall be designed with sloped drip pans located under all unit sections except duct openings and shall be supported by frame member.

N. Roof curb kit of 18-inch height shall provide support for the air handler on the building roof and provide a weather protected area for terminating and securing the roof membrane. The roof curb kit shall be manufactured by the air handler unit manufacturer.

O. An insulated, double-walled piping vestibule, 36" deep, shall be factory installed of standard cabinet construction on the coil connection side of the unit. Roofcap over vestibule shall be a continuous single piece covering both the coil section and the vestibule. Roofcap seams between coil section and vestibule are not allowed.

P. Construct drain pans from stainless steel with cross break and double sloping pitch to drain connection. Provide drain pans under cooling coil section. Drain connection centerline shall be a minimum of 3’’ above the base rail to aid in proper condensate trapping. Drain connections that protrude from the base rail are not acceptable. There must be a full 2’’ thickness of insulation under drain pan.

Q. An optional 0.044" thick aluminum treadplate shall be secured to the floor panel.

2.4 FANS

A. Acceptable fan assembly shall be a single width, single inlet, class II, direct-drive type plenum fan dynamically balanced as an assembly, as shown in schedule. Maximum fan RPM shall be below first critical fan speed. Fan assemblies shall be dynamically balanced by the manufacturer on all three planes. Provide access to motor and fan assembly through hinged access door.

B. Fan and motor shall be mounted internally on a steel base. Factory mount motor on slide base that can be slid out the side of the unit if removal is required. Provide access to motor, drive, and bearings through hinged access door. Fan and motor assembly shall be mounted on 2" deflection spring vibration type isolators inside cabinetry. Seismic snubbers shall be provided.

2.5 COILS

A. Certification: Acceptable water cooling and coils shall be certified in accordance with AHRI Standard 410 and bear the AHRI label. Coils exceeding the scope of the manufacturer's certification and/or the range of AHRI's standard rating conditions will be considered provided the manufacturer is a current member of the AHRI Forced Circulation Air-Cooling and Air-Heating Coils certification programs and that the coils have been rated in accordance with AHRI Standard 410. Manufacturer must be ISO 9002 certified.

B. Cooling coil shall be provided and sized to meet the design using 30% propylene glycol. Provide access to coil(s) for service and cleaning. Enclose coil headers and return bends fully within unit casing. Unit shall be provided with coil connections that extend a minimum of 5" beyond unit casing for ease of installation. Drain and vent connections shall be provided exterior to unit casing. Coil connections must be factory sealed with grommets on interior and exterior panel liners to minimize air leakage and condensation inside panel assembly. If not factory packaged, Contractor must supply all coil connection grommets and sleeves. Coils shall be removable through side and/or top panels of unit without the need to remove and disassemble the entire section from the unit.

C. Headers shall consist of seamless copper tubing to assure compatibility with primary surface. Headers to have intruded tube holes to provide maximum brazing surface for tube to header joint, strength, and inherent flexibility. Header diameter should vary with fluid flow requirements.

D. Fins shall have a minimum thickness of 0.0075 inch aluminum plate construction. Fins shall have full drawn collars to provide a continuous surface cover over the entire tube for maximum heat transfer. Tubes shall be mechanically expanded into the fins to provide a continuous primary to secondary compression bond over the entire finned length for maximum heat transfer rates. Bare copper tubes shall not be visible between fins.

E. Coil tubes shall be 5/8 inch OD seamless copper, 0.020 inch nominal tube wall thickness, expanded into fins, brazed at joints.

F. Coil connections shall be carbon steel, NPT threaded connection. Connection size to be determined by manufacturer based upon the most efficient coil circuiting. Vent and drain fittings shall be furnished on the connections, exterior to the air handler. Vent connections provided at the highest point to assure proper venting. Drain connections shall be provided at the lowest point to insure complete drainage and prevent freeze-up.

G. Coil casing shall be a formed channel frame of galvanized steel.

H. Heating coil shall be provided and sized to meet the design using 30% propylene glycol. Provide access to coil(s) for service and cleaning. Enclose coil headers and return bends fully within unit casing. Unit shall be provided with coil connections that extend a minimum of 5" beyond unit casing for ease of installation. Drain and vent connections shall be provided exterior to unit casing. Coil connections must be factory sealed with grommets on interior and exterior panel liners to minimize air leakage and condensation inside panel assembly. If not factory packaged, Contractor must supply all coil connection grommets and sleeves. Coils shall be removable through side and/or top panels of unit without the need to remove and disassemble the entire section from the unit.

I. Headers shall consist of seamless copper tubing to assure compatibility with primary surface. Headers to have intruded tube holes to provide maximum brazing surface for tube to header joint, strength, and inherent flexibility. Header diameter should vary with fluid flow requirements.

J. Fins shall have a minimum thickness of 0.0075 inch aluminum plate construction. Fins shall have full drawn collars to provide a continuous surface cover over the entire tube for maximum heat transfer. Tubes shall be mechanically expanded into the fins to provide a continuous primary to secondary compression bond over the entire finned length for maximum heat transfer rates. Bare copper tubes shall not be visible between fins.

K. Coil tubes shall be 5/8 inch OD seamless copper, 0.020 inch nominal tube wall thickness, expanded into fins, brazed at joints.

L. Coil connections shall be carbon steel, threaded connection. Connection size to be determined by manufacturer based upon the most efficient coil circuiting. Vent and drain fittings shall be furnished on the connections, exterior to the air handler. Vent connections provided at the highest point to assure proper venting. Drain connections shall be provided at the lowest point to insure complete drainage and prevent freeze-up.

M. Coil shall be furnished as an uncased galvanized steel track to allow for thermal movement and slide into a pitched track for fluid drainage.

2.6 AIR FILTRATION

A. Furnish combination filter section with 2-inch pleated MERV 8 flat pre-filter with microbial resistant Intersept coating and 12-inch Varicel SH cartridge 65% efficient (MERV 11) final filter. Provide side loading and removal of filters.

B. Furnish combination filter section with 2-inch no flat pre-filter and 12-inch Varicel SH cartridge 95% efficient (MERV 15) final filter. Provide side loading and removal of filters.

C. Filter media shall be UL 900 listed, Class I or Class II.

D. Filter Magnehelic gauge(s) shall be furnished and mounted by others.

2.7 HUMIDIFIERS

A. All humidifier sections shall have a stainless steel drain pan as minimum 12” longer than scheduled absorption distance. Drain pan to extend upstream and downstream of humidifier. Manufacturer to mount humidifier dispersion tube panel only. (See the unit drawing for location). All exterior piping shall be done in the field by others. See the air handling unit schedule for humidifier capacities.

B. Pressurized Short Absorption Manifold (use when boiler steam is available):

1. Steam Distribution : Short absorption manifold type humidifiers as manufactured by Armstrong:

2. Manifold header:

    a. The manifold header shall be constructed of type 304 stainless steel and installed at the bottom of the duct or air handler for a horizontal airflow installation. The header shall be mounted on supplied support brackets, sloped to ensure efficient condensate removal through the steam inlet connection without the use of a separate condensate connection/leg.

3. Dispersion tubes:

    a. The dispersion tubes shall be constructed of type 304 stainless steel. They shall be welded to the header, closely spaced and spanning the width of the duct. The dispersion tubes spacing shall be optimized for every application to provide the best steam coverage, and the required absorption distance. Each tube shall contain a single row of integrally formed holes facing the airflow for shorter absorption distances. The dispersion tubes shall be supplied with a top support bracket adjustable in height for easy field installation. Manifolds supplied with all around frames will not be accepted because of their higher pressure drop.

4. Tube holes:

    a. Each hole shall be formed to extend the tube material internally in a cylindrical shape to get the driest steam from the center of the tube and prevent any condensation entrainment through the holes. Added plastic/resin or stainless steel nozzles are not acceptable. The spacing between holes shall be optimized, spanning the height of the tube and sized to ensure constant pressure inside every tube for even steam distribution.

5. Pressurized Manifold Steam Accessories:

    a. The appropriate steam valve, actuator, steam trap and strainer shall be shipped loose for field installation by contractor.
    b. The steam valve body should be made of bronze and the valve trim should be made of stainless steel for extended life.
    c. The valve actuator should be electrical (24 Vdc). For electric valve actuators, the control signal shall be coordinated with the controls contractor.
    d. The steam trap shall be an inverted bucket type, constructed of stainless steel.
    e. The Y-strainer shall be of 304 stainless steel construction.
    f. Humidifier manufacturer to provide airflow switch and high limit switch for integration with BAS controls by others.

2.8 ADDITIONAL SECTIONS

A. Plenum section shall be provided and properly sized for inlet and/or discharge air flow (between 600 and 1500 feet per minute). The plenum shall provide single or multiple openings as shown on drawings and project schedule.

B. Access section shall be provided for access between components. Floor options shall include .125-inch aluminum treadplate or drainpan as shown on project schedule.

C. Mixing box section shall be provided with end outside air opening and return air opening with or parallel low leak airfoil damper blades. Dampers shall be hollow core galvanized steel airfoil blades, fully gasketed and have continuous vinyl seals between damper blades in a galvanized steel frame. Dampers shall have stainless steel jamb seals along end of dampers. Connecting linkage and ABS plastic end caps shall be provided when return and outside air dampers are each sized for full airflow. Return and outside air dampers of different sizes must be driven separately. Damper Leakage: Leakage rate shall be less than two tenths of one percent leakage at 2 inches static pressure differential. Leakage rate tested in accordance with AMCA Standard 500.

D. Economizer section, if specified on drawings, shall be provided with right side outside air opening, return air opening as shown on drawings and left side exhaust air opening with parallel low leak airfoil damper blades. Dampers shall be hollow core galvanized steel airfoil blades, fully gasketed and have continuous vinyl seals between damper blades in a galvanized steel frame. Dampers shall have stainless steel jamb seals along end of dampers. Linkage and ABS plastic end caps shall be provided when return and outside air dampers sized for full airflow. Return and outside air dampers of different sizes or very large dampers and exhaust dampers must be driven separately. Damper Leakage: Leakage rate shall be less than two tenths of one percent leakage at 2 inches static pressure differential. Leakage rate tested in accordance with AMCA Standard 500.

2.9 ELECTRICAL POWER CONNECTION

A. Units shall conform to bi-national standard ANSI/UL Standard 1995/CSA Standard C22.2 No. 236.

B. Fan motors shall be manufacturer provided and installed, Totally Enclosed, premium efficiency (meets or exceeds EPA requirements), 1750 RPM, single speed, 460V / 60HZ / 3P. Complete electrical characteristics for each fan motor shall be as shown in schedule.

C. Wiring Termination: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclosed terminal lugs in terminal box sized to NFPA 70.

D. Manufacturer shall provide ASHRAE 90.1 Energy Efficiency equation details for individual equipment to assist Building Engineer for calculating system compliance.

E. Provide marine light, in each section as shown on project schedule, mounted and wired to a junction box with an on-off switch and GFI receptacle mounted on the outside of the cabinet.

F. Installing contractor shall provide GFI receptacle within 25 feet of unit to satisfy National Electrical Code requirements.

G. All electrical connection components shall be field provided and mounted as shown on project schedule.

2.10 CONTROLS

A. Control equipment and sequence of operation are specified in Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC."

2.11 ACCESSORIES

A. Duplex, 115-V, ground-fault-interrupter outlet with 15-A overcurrent protection, weatherproof light and switch with junction box. Include transformer if required.

2.12 ROOF CURBS

A. Roof curbs with vibration isolators and wind restraints are specified in Section 230548 "Vibration and Seismic Controls for HVAC."

B. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.

1. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.

    a. Materials: ASTM C 1071, Type I or II.
    b. Thickness: 1 inch

2. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.

    a. Liner Adhesive: Comply with ASTM C 916, Type I.
    b. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
    c. Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.

C. Curb Height: 18 inches.

D. Wind and Seismic Restraints: Metal brackets compatible with the curb and casing, painted to match AHU, used to anchor unit to the curb, and designed for loads at Project site. Comply with requirements in Section 230548 "Vibration and Seismic Controls for HVAC" for wind-load requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of AHUs.

B. Examine roughing-in for AHUs to verify actual locations of piping and duct connections before equipment installation.

C. Examine roofs for suitable conditions where AHUs will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Roof Curb: Install AHUs on curbs and coordinate roof penetrations and flashing with roof construction specified in Section 077200 "Roof Accessories." Secure AHUs to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts.

3.3 CONNECTIONS

A. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Report results in writing.

C. Tests and Inspections:

1. After installing AHUs and after electrical circuitry has been energized, test units for compliance with requirements.
2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Complete installation and startup checks according to manufacturer's written instructions and do the following:

1. Inspect for visible damage to unit casing.
2. Inspect for visible damage to furnace combustion chamber.
3. Inspect for visible damage to compressor, coils, and fans.
4. Inspect internal insulation.
5. Verify that labels are clearly visible.
6. Verify that clearances have been provided for servicing.
7. Verify that controls are connected and operable.
8. Verify that filters are installed.
9. Clean condenser coil and inspect for construction debris.
10. Remove packing from vibration isolators.
11. Inspect operation of barometric relief dampers.
12. Verify lubrication on fan and motor bearings.
13. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
14. Adjust fan belts to proper alignment and tension.
15. Start unit according to manufacturer's written instructions.
16. Inspect and record performance of interlocks and protective devices; verify sequences.
17. Operate unit for an initial period as recommended or required by manufacturer.
18. Perform the following operations for both minimum and maximum firing. Adjust burner for peak efficiency.
19. Calibrate thermostats.
20. Adjust and inspect high-temperature limits.
21. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
22. Start cooling system and measure and record the following when ambient is a minimum of 15 deg F above return-air temperature:

    a. Coil leaving-air, dry- and wet-bulb temperatures.
    b. Coil entering-air, dry- and wet-bulb temperatures.
    c. Outdoor-air, dry-bulb temperature.
    d. Outdoor-air-coil, discharge-air, dry-bulb temperature.

23. Inspect controls for correct sequencing of heating, mixing dampers, and normal and emergency shutdown.
24. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.

    a. Supply-air volume.
    b. Return-air volume.
    c. Relief-air volume.
    d. Outdoor-air intake volume.

25. Simulate maximum cooling demand.
26. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:

    a. Low-temperature safety operation.
    b. Filter high-pressure differential alarm.
    c. Economizer to minimum outdoor-air changeover.
    d. Relief-air fan operation.
    e. Smoke and firestat alarms.

27. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

3.6 CLEANING AND ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site during other-than-normal occupancy hours for this purpose.

B. After completing system installation and testing, adjusting, and balancing AHU and air-distribution systems, clean filter housings and install new filters.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain AHUs. Training shall be recorded by the service representative and relinquished to the Owner upon completion of the training.

END OF SECTION 237413

CONFIDENTIAL DOCUMENT

238216

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

AIR COILS

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

238216

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
238216	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 238216 - AIR COILS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following types of air coils that are not an integral part of air-handling units:

1. Hot Glycol.

B. Related Sections include the following:

1. Division 23 Sections for air coils that are integral to air-handling units.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each air coil. Include rated capacity and pressure drop for each air coil.

B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which coil location and ceiling-mounted access panels are shown and coordinated with each other.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For air coils to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. ASHRAE Compliance:

1. Comply with ASHRAE 33 for methods of testing cooling and heating coils.

PART 2 - PRODUCTS

2.1 GLYCOL COILS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on the Drawings or a comparable product by one of the following:

1. Aerofin Corporation.
2. Carrier Corporation.
3. Coil Company, LLC.
4. Dunham-Bush, Inc.
5. Heatcraft Refrigeration Products LLC; Heat Transfer Division.
6. Super Radiator Coils.
7. Trane.
8. USA Coil & Air.

B. Performance Ratings: Tested and rated according to ARI 410 and ASHRAE 33.

C. Minimum Working-Pressure/Temperature Ratings: 200 psig, 325 deg F.

D. Source Quality Control: Factory tested to 300 psig

E. Tubes: ASTM B 743 copper, minimum 0.020 inch.

F. Fins: Aluminum, minimum 0.006 inch.

G. Headers: Seamless copper tube with brazed joints, prime coated.

H. Frames: Galvanized-steel channel frame, minimum 0.0625 inch thick for flanged mounting.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine ducts, plenums, and casings to receive air coils for compliance with requirements for installation tolerances and other conditions affecting coil performance.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before coil installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install coils level and plumb.

B. Install coils in metal ducts and casings constructed according to SMACNA's "HVAC Duct Construction Standards, Metal and Flexible."

C. Straighten bent fins on air coils.

D. Clean coils using materials and methods recommended in writing by manufacturers, and clean inside of casings and enclosures to remove dust and debris.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to coils to allow service and maintenance.

C. Connect water piping with unions and shutoff valves to allow coils to be disconnected without draining piping. Control valves are specified in Division 23 Section "Instrumentation and Control for HVAC," and other piping specialties are specified in Division 23 Section "Hydronic Piping."

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION 238216

CONFIDENTIAL DOCUMENT

238219

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

FAN COIL UNITS

ImmuCell

Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
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ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

238219

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
238219	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 238219 - FAN COIL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes fan-coil units and accessories.

1.3 DEFINITIONS

A. BAS: Building automation system.

1.4 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Ceiling suspension components.
2. Structural members to which fan-coil units will be attached.
3. Method of attaching hangers to building structure.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For fan-coil units to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Maintenance schedules and repair part lists for motors, coils, integral controls, and filters.

F. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.6 COORDINATION

A. Coordinate layout and installation of fan-coil units and suspension system components with other construction that penetrates or is supported by ceilings, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fan-Coil-Unit Filters: Furnish two (2) spare filters for each filter installed.
2. Fan Belts: Furnish two (2) spare fan belts for each unit installed.

PART 2 - PRODUCTS

2.1 FAN-COIL UNITS

A. Basis-of-Design Product: Provide the basis-of-design indicated on the Drawings or a comparable product by one of the following:

B. Available Manufacturers:

1. Airtherm; a Mestek Company.
2. Carrier Corporation.
3. Engineered Air Ltd.
4. Environmental Technologies, Inc.
5. First Co.
6. International Environmental Corporation.
7. Marlo Coil; Subsidiary of Engineered Support Systems, Inc.
8. Marshall Engineered Products Co., LLC (MEPCO); Dunham-Bush, Inc.
9. McQuay International.
10. Rosemex.
11. Trane.
12. USA Coil & Air.

13. YORK International Corporation.

C. Description: Factory-packaged and -tested units rated according to ARI 440, ASHRAE 33, and UL 1995.

D. Coil Section Insulation: 1-inch thick, foil-covered, closed-cell foam complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916.

1. Fire-Hazard Classification: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

E. Main and Auxiliary Drain Pans: Stainless steel. Fabricate pans and drain connections to comply with ASHRAE 62.1-2004. Drain pans shall be removable.

F. Chassis: Galvanized steel where exposed to moisture. Floor-mounting units shall have leveling screws.

G. Cabinet: Steel with factory prime coating, ready for field painting.

1. Vertical Unit Front Panels: Removable, steel, with integral stamped discharge grille and channel-formed edges, cam fasteners, and insulation on back of panel.
2. Horizontal Unit Bottom Panels: Fastened to unit with cam fasteners and hinge and attached with safety chain; with integral stamped discharge grilles.

H. Filters: Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.

1. Pleated Cotton-Polyester Media: 90 percent arrestance and 7 MERV.

I. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain valve.

J. Fan and Motor Board: Removable.

1. Fan: Forward curved, double width, centrifugal; directly connected to motor. Thermoplastic or painted-steel wheels, and aluminum, painted-steel, or galvanized-steel fan scrolls.
2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
3. Wiring Termination: Connect motor to chassis wiring with plug connection.

K. Factory, Hydronic Piping Package: ASTM B 88, Type L copper tube with wrought-copper fittings and brazed joints. Label piping to indicate service, inlet, and outlet.

1. Two-way modulating control valve for dual-temperature coil.

2. Hose Kits: Minimum 400-psig working pressure, and operating temperatures from 33 to 211 deg F. Tag hose kits to equipment designations.

    a. Length: 36 inches.
    b. Minimum Diameter: Equal to fan-coil-unit connection size.

3. Two-Piece Ball Valves: Bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and 600 psig minimum CWP rating and blowout-proof stem.
4. Automatic Flow-Control Valve: Brass or ferrous-metal body; 300-psig working pressure at 250 deg F, with removable, corrosion-resistant, tamperproof, self-cleaning piston spring; factory set to maintain constant indicated flow with plus or minus 10 percent over differential pressure range of 2 to 80 psig.
5. Y-Pattern Hydronic Strainers: Cast-iron body (ASTM A 126, Class B); 125-psig working pressure; with threaded connections, bolted cover, perforated stainless-steel basket, and bottom drain connection. Include minimum NPS 1/2 hose-end, full-port, ball-type blowdown valve in drain connection.
6. Wrought-Copper Unions: ASME B16.22.

L. Basic Unit Controls:

1. Control voltage transformer.
2. Wall-mounted thermostat with the following features:

    a. Heat-cool-off switch.
    b. Fan on-auto switch.
    c. Automatic changeover.
    d. Adjustable deadband.
    e. Exposed set point.
    f. Exposed indication.
    g. Degree°F indication.

3. Wall mounting humidistat.

    a. Exposed set point.
    b. Exposed indication.

4. Wall mounting temperature sensor.
5. Unoccupied-period-override push button.
6. Data entry and access port.

    a. Input data includes room temperature, and humidity set points and occupied and unoccupied periods.
    b. Output data includes room temperature and humidity, supply-air temperature, entering-water temperature, operating mode, and status.

M. BAS Interface Requirements:

1. Interface relay for scheduled operation.
2. Interface relay to provide indication of fault at the central workstation.
3. Provide BACnet interface for central BAS workstation for the following functions:

a. Adjust set points.
b. Fan-coil-unit start, stop, and operating status.
c. Data inquiry, including supply- and room-air temperature and humidity].
d. Occupied and unoccupied schedules.

N. Electrical Connection: Factory wire motors and controls for a single electrical connection.

O. Capacities and Characteristics: See drawings for unit design points.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive fan-coil units for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for piping and electrical connections to verify actual locations before fan-coil-unit installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install fan-coil units level and plumb.

B. Install fan-coil units to comply with NFPA 90A.

C. Suspend fan-coil units from structure with elastomeric hangers. Vibration isolators are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

D. Verify locations of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices in-line with lighting and electrical controls.

E. Install new filters in each fan-coil unit within two weeks after Substantial Completion.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:

1. Install piping adjacent to machine to allow service and maintenance.
2. Connect piping to fan-coil-unit factory hydronic piping package. Install piping package if shipped loose.
3. Connect condensate drain to indirect waste.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in-field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

3.5 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fan-coil units. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 238219

CONFIDENTIAL DOCUMENT

238239

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

UNIT HEATERS

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

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ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
238239	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 238239 - UNIT HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cabinet unit heaters with centrifugal fans and hot-water coils.
2. Propeller unit heaters with hot-water coils.

1.2 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated for glycol heating system with 30% propylene glycol.

B. LEED Submittal:

1. Product Data for Prerequisite EQ 1: Documentation indicating that units comply with ASHRAE 62.1-2004, Section 5 - "Systems and Equipment."

C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Plans, elevations, sections, and details.
2. Location and size of each field connection.
3. Equipment schedules to include rated capacities, furnished specialties, and accessories.

D. Field quality-control test reports.

E. Operation and maintenance data.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."

PART 2 - PRODUCTS

2.1 CABINET UNIT HEATERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. Airtherm; a Mestek Company.
2. Carrier Corporation.
3. Dunham-Bush, Inc.
4. Engineered Air Ltd.
5. Indeeco.
6. International Environmental Corporation.
7. Markel Products; a division of TPI Corporation.
8. Daikin Applied
9. Ouellet Canada Inc.
10. Rosemex Products.
11. Trane.
12. USA Coil & Air.

D. Description: A factory-assembled and -tested unit complying with ARI 440.

E. Coil Section Insulation: Glass-fiber insulation; surfaces exposed to airstream shall be aluminum-foil facing to prevent erosion of glass fibers.

1. Thickness: 1/2 inch.
2. Thermal Conductivity (k-Value): 0.26 Btu in./hr sq. ft. at 75 deg mean temperature.
3. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
4. Adhesive: Comply with ASTM C 916 and with NFPA 90A or NFPA 90B.
5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

F. Cabinet: Steel with baked-enamel finish with manufacturer's custom paint, in color selected by Owner.

1. Vertical Unit, Exposed Front Panels: Minimum 0.0528-inch thick, galvanized, sheet steel, removable panels with channel-formed edges secured with tamperproof cam fasteners.
2. Base: Minimum 0.0528-inch- thick steel, finished to match cabinet, 4 inches high with leveling bolts.
3. Extended Piping Compartment: 8-inch- wide piping end pocket.
4. False Back: Minimum 0.0428-inch- thick steel, finished to match cabinet.

G. Filters: Minimum arrestance according to ASHRAE 52.1 and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.

1. Pleated: 90 percent arrestance and 7 MERV.

H. Hot-Water Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain.

I. Fan and Motor Board: Removable.

1. Fan: Forward curved, high static, double width, centrifugal; directly connected to motor. Thermoplastic or painted-steel wheels, and aluminum, painted-steel, or galvanized-steel fan scrolls.
2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
3. Wiring Terminations: Connect motor to chassis wiring with plug connection.

J. Factory, Hot-Water Piping Package: ASTM B 88, Type L copper tube with wrought-copper fittings and brazed joints. Label piping to indicate service, inlet and outlet.

1. Hose Kits: Minimum 400-psig working pressure, and operating temperatures from 33 to 211 deg F. Tag hose kits to equipment designations.

   a. Length: 36 inches.
   b. Minimum Diameter: Equal to cabinet unit heater connection size.

2. Two-Piece, Ball Valves: Bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig minimum CWP rating and blowout-proof stem.
3. Calibrated-Orifice Balancing Valves: Bronze body, ball type, 125-psig working pressure, 250 deg F maximum operating temperature; with calibrated orifice or venture, connection for portable differential pressure meter with integral seals, threaded ends, and equipped with a memory stop to retain set position.
4. Y-Pattern, Hot-Water Strainers: Cast-iron body (ASTM A 126, Class B); 125-psig minimum working pressure; with threaded connections, bolted cover, perforated stainless-steel basket, and bottom drain connection. Include minimum NPS 1/2 Wrought-Copper Unions: ASME B16.22.

K. Control devices and operational sequences are specified in Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls."

1. Manual fan speed switch.
2. Adjustable deadband.
3. Concealed set point.
4. Concealed indication.
5. Deg F indication.
6. Unit-mounted temperature sensor.
7. Unoccupied period override push button.
8. Data entry and access port.

a. Input data includes room temperature, and occupied and unoccupied periods.
b. Output data includes room temperature, supply-air temperature, entering-water temperature, operating mode, and status.

L. DDC Terminal Controller:

1. Scheduled Operation: Occupied and unoccupied periods on seven-day clock with a minimum of four programmable periods per day.
2. Unoccupied Period Override: Two hours.
3. Unit Supply-Air Fan Operations:

a. Occupied Periods: Fan runs continuously.
b. Unoccupied Periods: Fan cycles to maintain setback room temperature.

4. Heating Coil Operations:

a. Occupied Periods: Modulate control valve to provide heating if room temperature falls below thermostat set point.
b. Unoccupied Periods: Start fan and modulate control valve if room temperature falls below setback temperature.

5. Controller shall have volatile-memory backup.

M. Electrical Connection: Factory wire motors and controls for a single field connection.

N. Capacities and Characteristics: See schedule on drawings.

2.2 PROPELLER UNIT HEATERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Airtherm; a Mestek Company.
2. Engineered Air Ltd.
3. McQuay International.
4. Rosemex Products.
5. Ruffneck Heaters; a division of Lexa Corporation.
6. Trane.

C. Description: An assembly including casing, coil, fan, and motor in vertical discharge configuration with adjustable discharge louvers.

D. Cabinet: Removable panels for maintenance access to controls.

E. Cabinet Finish: Manufacturer's standard baked enamel applied to factory-assembled and -tested propeller unit heater before shipping.

F. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

G. Discharge Louver: Adjustable fin diffuser for horizontal units and conical diffuser for vertical units.

H. Hot-Water Coil: Test and rate hot-water propeller unit heater coils according to ASHRAE 33. Copper tube, minimum 0.025-inch wall thickness, with mechanically bonded aluminum fins spaced no closer than 0.1 inch and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 325 deg F, with manual air vent. Test for leaks to 350 psig underwater.

I. Fan: Propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi.

J. Fan Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

1. Motor Type: Permanently lubricated.

K. DDC Terminal Controller:

1. Scheduled Operation: Occupied and unoccupied periods on seven-day clock with a minimum of four programmable periods per day.
2. Unoccupied Period Override: Two hours.
3. Unit Supply-Air Fan Operations:

a. Occupied Periods: Fan runs continuously.
b. Unoccupied Periods: Fan cycles to maintain setback room temperature.

4. Heating Coil Operations:

a. Occupied Periods: Modulate control valve to provide heating if room temperature falls below thermostat set point.
b. Unoccupied Periods: Start fan and modulate control valve if room temperature falls below setback temperature.

5. Controller shall have volatile-memory backup.

L. Capacities and Characteristics: See drawing schedules for all sizes.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install unit heaters to comply with NFPA 90A.

B. Suspend cabinet unit heaters from structure with elastomeric hangers and seismic restraints. Vibration isolators and seismic restraints are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

C. Suspend propeller unit heaters from structure with all-thread hanger rods and elastomeric hangers. Hanger rods and attachments to structure are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Vibration hangers are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

D. Install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

E. Unless otherwise indicated, install union and gate or ball valve on supply-water connection and union and calibrated balancing valve on return-water connection of unit heater.

F. Install new filters in each fan-coil unit within two weeks of Substantial Completion.

G. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

H. Install piping adjacent to machine to allow service and maintenance.

I. Connect piping to cabinet unit heater's factory, hot-water piping package. Install the piping package if shipped loose.

J. Comply with safety requirements in UL 1995.

K. Ground equipment according to Division 26 sections.

L. Connect wiring according to Division 26 sections.

3.2 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

B. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 238239

CONFIDENTIAL DOCUMENT

260500

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

COMMON WORK RESULTS FOR ELECTRICAL

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
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The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
260500	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Electrical equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Sleeve seals.
4. Grout.
5. Common electrical installation requirements.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For sleeve seals.

1.5 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables and wireways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed.

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel.

1. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches (400 mm), thickness shall be 0.052 inch.
b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. A. Manufacturers: Subject to compliance with requirements, provide products from manufacturers offering products that may be incorporated into the Work to include but not limited to the following:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
3. Pressure Plates: Carbon Steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, or wireways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry.

1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements as shown on architectural drawings.

J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."

K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 260500

CONFIDENTIAL DOCUMENT

260519

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
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The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

260519

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
260519	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Qualification Data: For testing agency.

C. Field quality-control test reports.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.5 COORDINATION

A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Alcan Products Corporation; Alcan Cable Division.
2. American Insulated Wire Corp.; a Leviton Company.
3. General Cable Corporation.
4. Senator Wire & Cable Company.
5. Southwire Company.

B. Copper Conductors: Comply with NEMA WC 70.

C. Conductor Insulation: Comply with NEMA WC 70 for Types THW and THHN-THWN

D. Multiconductor Cable: Comply with NEMA WC 70 for armored cable, Type AC and metal-clad cable, Type MC with ground wire.

2.2 CONNECTORS AND SPLICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AFC Cable Systems, Inc.
2. Hubbell Power Systems, Inc.
3. O-Z/Gedney; EGS Electrical Group LLC.
4. 3M; Electrical Products Division.
5. Tyco Electronics Corp.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN-THWN, single conductors in raceway.

B. Exposed Feeders: Type THHN-THWN, single conductors in raceway; Armored cable, Type AC; Metal-clad cable, Type MC.

C. Feeders Concealed in Ceilings, Walls, Partitions: Type THHN-THWN, single conductors in raceway.

D. Feeders Concealed in Concrete: Type THHN-THWN, single conductors in raceway.

E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway; Armored cable, Type AC; Metal-clad cable, Type MC.

F. Branch Circuits Concealed in Concrete, below Slabs-on-Grade: Type THHN-THWN, single conductors in raceway .

G. Branch Circuits in Cable Tray: Type TC - XHHW multi conductor cable. Cable shall be installed in conduit up to tray from panel/equipment.

H. Class 1 Control Circuits: Type THHN-THWN, in raceway.

I. Class 2 Control Circuits: Type THHN-THWN, in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."

F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Perform tests and inspections and prepare test reports.

C. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

D. Test Reports: Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

E. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 260519

CONFIDENTIAL DOCUMENT

260526

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

ImmuCell

Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
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The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

260526

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
260526	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

1.1 SUMMARY

A. Methods and materials for grounding electrical systems and equipment.

1.2 QUALITY ASSURANCE

A. Quality Standard for Grounding Materials and Equipment: UL 467.

1.3 PRODUCTS

A. Insulated Conductors: Copper wire and cable.

B. Bare Copper Conductors:

1. Solid conductors.
2. Stranded conductors.
3. Tinned conductors.
4. Stranded bonding conductors.
5. Copper tape braided bonding jumpers.
6. Tinned-copper braided bonding jumpers.

C. Connectors: Bolted and exothermic-welded type.

1.4 GROUNDING APPLICATIONS

A. Conductors: Solid for No. 8 AWG and smaller; stranded for No.6 AWG and larger.

B. Isolated grounding conductors.

C. Grounding bus.

D. Conductor Terminations and Connections: Bolted and welded.

E. Insulated equipment grounding conductors with circuit conductors for the following:

1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.
6. Flexible raceway runs.
7. Armored and metal-clad cable runs.
8. Computer- and rack-mounted electronic equipment circuits.
9. Air-duct equipment circuits.

F. Signal and communication equipment.

G. Service and central equipment locations and wiring closets.

H. Terminal cabinets.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

C. Grounding Bus: Rectangular bars of annealed copper, 1/4 by 2 inches 6 by 50 mm in cross section, unless otherwise indicated; with insulators.

2.2 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.

B. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors, except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.
6. Flexible raceway runs.
7. Armored and metal-clad cable runs.
8. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.

C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

3.3 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.

2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

C. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

D. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:

B. Perform the following tests and inspections and prepare test reports:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.

    a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    b. Perform tests by fall-of-potential method according to IEEE 81.

3. Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

C. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.
2. Power and Lighting Equipment or System with Capacity 500 to 1000 kVA: 5 ohms.
3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
4. Substations and Pad-Mounted Equipment: 5 ohms.

D. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

CONFIDENTIAL DOCUMENT

260529

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

ImmuCell
Portland, ME

Reviews / Approvals

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ImmuCell Project Manager ImmuCell	Elizabeth Williams		
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The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

260529

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
260529	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Steel slotted support systems.
2. Nonmetallic slotted support systems.

B. Shop Drawings Show fabrication and installation details and include calculations for the following:

1. Trapeze hangers. Include Product Data for components.
2. Steel slotted channel systems. Include Product Data for components.
3. Equipment supports.

C. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Comply with NFPA 70.

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Allied Tube & Conduit.
b. Cooper B-Line, Inc.; a division of Cooper Industries.
c. ERICO International Corporation.
d. GS Metals Corp.
e. Thomas & Betts Corporation.
f. Unistrut; Tyco International, Ltd.
g. Wesanco, Inc.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.

4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
5. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Cable Tray Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) Hilti Inc.
        2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
        3) MKT Fastening, LLC.
        4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) Cooper B-Line, Inc.; a division of Cooper Industries.
        2) Empire Tool and Manufacturing Co., Inc.
        3) Hilti Inc.
        4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
        5) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.

4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with single-bolt conduit clamps.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To New Concrete: Bolt to concrete inserts.
2. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
3. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
4. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69
5. To Light Steel: Sheet metal screws.
6. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi (20.7-MPa) 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."

C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touchup: Comply with requirements in Division 09 painting sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

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260533

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

ImmuCell

Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
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ImmuCell Project Manager ImmuCell	Elizabeth Williams		
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The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

260533

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
260533	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.2 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, details, and attachments to other work.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. Rigid Steel Conduit: ANSI C80.1.

B. IMC: ANSI C80.6.

C. EMT: ANSI C80.3.

D. FMC: Zinc-coated steel.

E. LFMC: Flexible steel conduit with PVC jacket.

F. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
2. Fittings for EMT: Steel set-screw or compression type.

2.2 NONMETALLIC CONDUIT AND TUBING

A. ENT: NEMA TC 13.

B. RNC: NEMA TC 2, Type EPC-40-PVC**,** unless otherwise indicated.

C. LFNC: UL 1660.

D. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.

E. Fittings for LFNC: UL 514B.

2.3 METAL WIREWAYS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper B-Line, Inc.
2. Hoffman.
3. Square D; Schneider Electric.

B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1 unless otherwise indicated.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers As indicated.

E. Finish: Manufacturer's standard enamel finish.

2.4 BOXES, ENCLOSURES, AND CABINETS

A. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

B. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover.

C. Nonmetallic Outlet and Device Boxes: NEMA OS 2.

D. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

E. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, galvanized, cast iron with gasketed cover.

F. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

G. Cabinets:

1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:

1. Exposed Conduit: Rigid steel conduit GRC
2. Concealed Conduit, Aboveground: Rigid steel conduit GRC
3. Underground Conduit: RNC, Type EPC-40 80-PVC, direct buried.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R or 4.

B. Comply with the following indoor applications, unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT
2. Exposed, Not Subject to Severe Physical Damage: Rigid steel conduit
3. Exposed and Subject to Severe Physical Damage: Rigid steel conduit Includes raceways in the following locations:

    a. Loading dock.
    b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    c. Mechanical rooms.

4. Concealed in Ceilings and Interior Walls and Partitions: EMT
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: Rigid steel conduit Raceways for Optical Fiber or Communications Cable: EMT Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, in damp or wet locations.

C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.

3.2 INSTALLATION

A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."

E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.

G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

H. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
3. Change from ENT to RNC, Type EPC-40-PVC, rigid steel conduit, or IMC before rising above the floor.

I. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

J. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire.

K. Raceways for Optical Fiber and Communications Cable: Install as follows:

1. 3/4-Inch (19-mm) Trade Size and Smaller: Install raceways in maximum lengths of 50 feet (15 m).
2. 1-Inch (25-mm) Trade Size and Larger: Install raceways in maximum lengths of 75 feet (23 m).
3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

L. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where otherwise required by NFPA 70.

M. Flexible Conduit Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for recessed and semi-recessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

N. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

O. Set metal floor boxes level and flush with finished floor surface.

P. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom for pipe less than 6 inches (150 mm) in nominal diameter.
2. Install backfill.
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as.
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
    b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

6. Warning Planks: Bury warning planks approximately 12 inches (300 mm) above direct-buried conduits, placing them 24 inches (600 mm) o.c. Align planks along the width and along the centerline of conduit.

3.4 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 260533

CONFIDENTIAL DOCUMENT

260548

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

ImmuCell
Portland, ME

Reviews / Approvals

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CONFIDENTIAL DOCUMENT

260548

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
260548	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 260548 – VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Inertia bases.

B. Seismic restraints.

1.2 RELATED SECTIONS

A. Section 033000 - Cast-in-Place Concrete.

1.3 SUBMITTALS

A. Shop Drawings for Seismic Controls:

1. For conduit and each scheduled piece of equipment that requires seismic controls, submit restraint system and supporting calculations sealed by an Engineer registered in New York.
2. For conduit and each scheduled piece of equipment that does not require seismic controls. Submit a statement indicating that seismic restraints are not required and list each item that does not require seismic restraints. This statement is to be sealed by an Engineer registered in New York.

B. Manufacturer's Instructions: Indicate installation instructions with special procedures and setting dimensions.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Amber-Booth: www.amberbooth.com.

B. Loos & Co, Inc.: www.earthquakebrace.com.

C. Mason Industries: www.mason-ind.com.

D. Cooper B-Line: www.b-line.com.

E. Substitutions: See Section 016000 - Product Requirements.

2.2 SEISMIC BRACING OF CONDUIT AND EQUIPMENT

A. Furnish all materials, labor and equipment for the installation of seismic bracing and restraints for resistance to earthquake loads as prescribed by the 2010 New York State Building Code, Architectural, Mechanical and Electrical Component Seismic Design Requirements and ASCE 7-05.

B. Bracing and restraint systems shall be designed and installed in accordance with the 2010 New York State Building Code, Architectural, Mechanical and Electrical Component Seismic Design Requirements and in accordance with the bracing manufacturer's guidelines and recommendations.

2.3 INERTIA BASES

A. Concrete Inertia Bases:

1. Construction: Structural steel channel perimeter frame, with gusseted brackets and anchor bolts, reinforcing; concrete filled.
2. Mass: Minimum of 1.5 times weight of isolated equipment.
3. Connecting Point: Reinforced to connect isolators and snubbers to base.
4. Concrete: Minimum 3000 psi concrete.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Bases:

1. Set concrete inertia bases for 2 inches clearance between housekeeping pad and base.
2. Adjust equipment level.

C. Prior to making connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.

END OF SECTION 260548

CONFIDENTIAL DOCUMENT

260553

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

IDENTIFICATION FOR ELECTRICAL SYSTEMS

ImmuCell
Portland, ME

Reviews / Approvals

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The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

260553

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
260553	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.

1.3 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.4 QUALITY ASSURANCE

A. Comply with ANSI A13.1

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

B. Colors for Raceways Carrying Circuits at 600 V or Less:

1. White letters on a black field.
2. Legend: Indicate voltage type.

C. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

D. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.2 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Colors for Raceways Carrying Circuits at 600 V and Less:

1. White letters on a black field.
2. Legend: Indicate voltage and system.

C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

C. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.4 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.

2.5 FLOOR MARKING TAPE

A. 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

2.6 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Baked-Enamel Warning Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch (6.4-mm) grommets in corners for mounting.
3. Nominal size, 7 by 10 inches (180 by 250 mm).

D. Metal-Backed, Butyrate Warning Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch (1-mm) galvanized-steel backing; and with colors, legend, and size required for application.
2. 1/4-inch (6.4-mm) grommets in corners for mounting.
3. Nominal size, 10 by 14 inches (250 by 360 mm).

E. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

2.7 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. inches (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.

1. Engraved legend with white letters on black face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.

2.8 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).

B. Stenciled Legend: In nonfading, waterproof, white ink or paint. Minimum letter height shall be 1 inch (25 mm).

2.9 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black.

C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 7000 psi (48.2 MPa).
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
5. Color: Black.

2.10 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

F. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

G. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches (400 mm) overall.

H. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with self-adhesive vinyl label. Install labels at 30-foot (10-m) maximum intervals.

B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:

1. Emergency Power.
2. Power.
3. UPS.

C. Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.

a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
b. Colors for 208Y/120V Circuits:

1) Phase A: Black.
2) Phase B: Red.
3) Phase C: Blue.

c. Colors for 480Y/277V Circuits:

1) Phase A: Brown.
2) Phase B: Orange.
3) Phase C: Yellow.

d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

D. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

E. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.

F. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

G. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.

1. Limit use of underground-line warning tape to direct-buried cables.
2. Install underground-line warning tape for both direct-buried cables and cables in raceway.

H. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

I. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Baked-enamel warning signs.

1. Comply with 29 CFR 1910.145.
2. Identify system voltage with black letters on an orange background.
3. Apply to exterior of door, cover, or other access.
4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:

    a. Power transfer switches.
    b. Controls with external control power connections.

J. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

K. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer.

L. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

    a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.
    b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
    c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
    d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to be Labeled:

    a. Enclosures and electrical cabinets.
    b. Access doors and panels for concealed electrical items.
    c. Switchboards.
    d. Panelboards
    e. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
    f. Emergency system boxes and enclosures.
    g. Enclosed switches.
    h. Enclosed circuit breakers.
    i. Enclosed controllers.
    j. Variable-speed controllers.
    k. Push-button stations.
    l. Power transfer equipment.
    m. Contactors.
    n. Remote-controlled switches, dimmer modules, and control devices.
    o. Battery-inverter units.
    p. Battery racks.
    q. Monitoring and control equipment.
    r. UPS equipment.

END OF SECTION 260553

CONFIDENTIAL DOCUMENT

260573

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

260573

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
260573	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 260573 - OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes computer-based, fault-current and overcurrent protective device coordination studies. Protective devices shall be set based on results of the protective device coordination study.

1. Coordination of series-rated devices is permitted where indicated on Drawings.

1.3 SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Product Certificates: For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.

C. Qualification Data: For coordination-study specialist.

D. Other Action Submittals: The following submittals shall be made after the approval process for system protective devices has been completed. Submittals shall be in digital and hard copy form.

1. Coordination-study input data, including completed computer program input data sheets.
2. Study and Equipment Evaluation Reports.
3. Coordination-Study Report.

1.4 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.

B. Coordination-Study Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. Professional engineer, licensed in the state where Project is located, shall be responsible for the study. All elements of the study shall be performed under the direct supervision and control of engineer.

C. Comply with IEEE 242 for short-circuit currents and coordination time intervals.

D. Comply with IEEE 399 for general study procedures.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Available Computer Software Developers: Subject to compliance with requirements, companies offering computer software programs that may be used in the Work include, but are not limited to, the following:

1. ETAP
2. SKM Systems Analysis, Inc.

2.2 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

A. Comply with IEEE 399.

B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

1. Optional Features:

a. Arcing faults.
b. Simultaneous faults.
c. Explicit negative sequence.
d. Mutual coupling in zero sequence.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.

1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.2 POWER SYSTEM DATA

A. Gather and tabulate the following input data to support coordination study:

1. Product Data for overcurrent protective devices specified in other Division 26 Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Impedance of utility service entrance.
3. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:

    a. Circuit-breaker and fuse-current ratings and types.
    b. Relays and associated power and current transformer ratings and ratios.
    c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
    d. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
    e. Busway ampacity and impedance.
    f. Motor horsepower and code letter designation according to NEMA MG 1.

4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:

    a. Special load considerations, including starting inrush currents and frequent starting and stopping.
    b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
    c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
    d. Ratings, types, and settings of utility company's overcurrent protective devices.
    e. Special overcurrent protective device settings or types stipulated by utility company.
    f. Time-current-characteristic curves of devices indicated to be coordinated.
    g. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
    h. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
    i. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.

3.3 FAULT-CURRENT STUDY

A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:

1. Switchgear and switchboard bus.
2. Distribution panelboard.
3. Branch circuit panelboard.

B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.

C. Calculate momentary and interrupting duties on the basis of maximum available fault current.

D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 241 and IEEE 242.

1. Transformers:

a. ANSI C57.12.10.
b. ANSI C57.12.22.
c. ANSI C57.12.40.
d. IEEE C57.12.00.
e. IEEE C57.96.

2. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
3. Low-Voltage Fuses: IEEE C37.46.

E. Study Report:

1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.
2. Show interrupting (5-cycle) and time-delayed currents (6 cycles and above) on medium-voltage breakers as needed to set relays and assess the sensitivity of overcurrent relays.

F. Equipment Evaluation Report:

1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
3. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

3.4 COORDINATION STUDY

A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.

1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
2. Calculate the maximum and minimum interrupting duty (5 cycles to 2 seconds) short-circuit currents.
3. Calculate the maximum and minimum ground-fault currents.

B. Comply with IEEE 242 recommendations for fault currents and time intervals.

C. Transformer Primary Overcurrent Protective Devices:

1. Device shall not operate in response to the following:

   a. Inrush current when first energized.
   b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
   c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.

2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

D. Motors served by voltages more than 600 V shall be protected according to IEEE 620.

E. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

F. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:

1. Tabular Format of Settings Selected for Overcurrent Protective Devices:

   a. Device tag.
   b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
   c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
   d. Fuse-current rating and type.
   e. Ground-fault relay-pickup and time-delay settings.

2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:

    a. Device tag.
    b. Voltage and current ratio for curves.
    c. Three-phase and single-phase damage points for each transformer.
    d. No damage, melting, and clearing curves for fuses.
    e. Cable damage curves.
    f. Transformer inrush points.
    g. Maximum fault-current cutoff point.

G. Completed data sheets for setting of overcurrent protective devices.

END OF SECTION 260573

CONFIDENTIAL DOCUMENT

260923

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

LIGHTING CONTROL DEVICES

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

260923

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
260923	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following lighting control devices:

1. Indoor occupancy sensors.

1.3 DEFINITIONS

A. LED: Light-emitting diode.

B. PIR: Passive infrared.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show installation details for occupancy and light-level sensors.

1. Interconnection diagrams showing field-installed wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 COORDINATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 INDOOR OCCUPANCY SENSORS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hubbell Lighting.
2. Leviton Mfg. Company Inc.
3. Lithonia Lighting; Acuity Lighting Group, Inc.
4. Novitas, Inc.
5. RAB Lighting, Inc.
6. Sensor Switch, Inc.
7. TORK.
8. Watt Stopper (The).

C. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.

1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
4. Mounting:

    a. Sensor: Suitable for mounting in any position on a standard outlet box.
    b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
    c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
6. Bypass Switch: Override the on function in case of sensor failure.
7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; keep lighting off when selected lighting level is present.

D. PIR Type: Ceiling mounting; detect occupancy by sensing a combination of heat and movement in area of coverage. PIR shall be used in High-ceiling areas.

1. Detector Sensitivity: Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in.
2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.

3. Detection Coverage (Corridor): Detect occupancy within 90 feet when mounted on a 10-foot-high ceiling.

E. Dual-Technology Type: Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit. Unless otherwise noted or recommended by the manufacturer, dual technology sensors shall be used in all areas.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 CONTACTOR INSTALLATION

A. Mount electrically held lighting contactors or powerpacks with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.3 WIRING INSTALLATION

A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 1/2 inch.

B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."

1. Identify controlled circuits in lighting contactors.
2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.5 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
2. Operational Test: Verify operation of each lighting control device, and adjust time delays.

B. Lighting control devices that fail tests and inspections are defective work.

3.6 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

END OF SECTION 260923

CONFIDENTIAL DOCUMENT

262200

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

LOW VOLTAGE TRANSFORMERS

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

262200

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
262200	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 262200 - LOW VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:

1. Distribution transformers.

1.2 SUBMITTALS

A. Product Data: For each product indicated.

B. Shop Drawings: Indicate dimensions and weights.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Manufacturer Seismic Qualification Certification: Submit certification that transformers, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

D. Field quality-control test reports.

E. Operation and maintenance data.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Challenger Electrical Equipment Corp.; a division of Eaton Corp.
2. Eaton Electrical Inc.; Cutler-Hammer Products.
3. Siemens Energy & Automation, Inc.

4. Sola/Hevi-Duty.
5. Square D; Schneider Electric.

2.2 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Cores: Grain-oriented, non-aging silicon steel.

C. Coils: Continuous windings without splices except for taps.

1. Internal Coil Connections: Brazed or pressure type.
2. Coil Material: Copper.

2.3 DISTRIBUTION TRANSFORMERS

A. Comply with NEMA ST 20, and list and label as complying with UL 1561.

B. Provide transformers that are constructed to withstand seismic forces specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

C. Cores: One leg per phase.

D. Enclosure: Ventilated, NEMA 250, Type 2.

1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.

E. Enclosure: Ventilated, NEMA 250,

1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.

F. Transformer Enclosure Finish: Comply with NEMA 250.

1. Finish Color: Gray In three paragraphs below, first option for each size is most prevalent standard with many manufacturers; second option is available from most manufacturers. If multiple transformers are required with different tap arrangements, delete paragraphs and show tap information on Drawings.

G. Taps for Transformers Smaller Than 3 kVA: None.

H. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.

I. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.

J. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise above 40 deg C ambient temperature.

K. Energy Efficiency for Transformers Rated 15 kVA and Larger:

1. Complying with NEMA TP 1, Class 1 efficiency levels.
2. Tested according to NEMA TP 2.

L. K-Factor Rating: Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for non-sinusoidal load current-handling capability to the degree defined by designated K-factor.

1. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.
2. Indicate value of K-factor on transformer nameplate.

M. Electrostatic Shielding: Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize inter-winding capacitance.

N. Wall Brackets: Manufacturer's standard brackets.

2.4 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate. Nameplates are specified in Division 26 Section "Identification for Electrical Systems."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.

1. Brace wall-mounting transformers as specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

B. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions, seismic codes applicable to Project, and requirements in Division 26 Section "Hangers and Supports for Electrical Systems."

3.2 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.

a. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
b. Perform 2 follow-up infrared scans of transformers, one at 4 months and the other at 11 months after Substantial Completion.
c. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

3.3 ADJUSTING

A. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

B. Connect buck-boost transformers to provide nameplate voltage of equipment being served, plus or minus 5 percent, at secondary terminals.

C. Output Settings Report: Prepare a written report recording output voltages and tap settings.

END OF SECTION 262200

CONFIDENTIAL DOCUMENT

262416

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

PANELBOARDS

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
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The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

262416

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
262416	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes distribution panelboards and lighting and appliance branch-circuit panelboards.

1.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Include evidence of NRTL listing for series rating of installed devices.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include wiring diagrams for power, signal, and control wiring.
8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.

C. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

D. Field quality-control reports.

E. Panelboard schedules for installation in panelboards.

F. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NEMA PB 1.

C. Comply with NFPA 70.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

B. Enclosures Flush- and surface mounted cabinets.

1. Rated for environmental conditions at installed location.

a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
b. Outdoor Locations: NEMA 250, Type 3R.
c. Wash-Down Areas: NEMA 250, Type 4X stainless steel.
d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
4. Directory Card: Inside panelboard door, mounted in transparent card holder.

C. Incoming Mains Location: Top or bottom.

D. Phase, Neutral, and Ground Buses: Hard-drawn copper, 98 percent conductivity.

E. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Main and Neutral Lugs: Mechanical type.
3. Ground Lugs and Bus Configured Terminators: Mechanical type.

4. Feed-Through Lugs Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

F. Service Equipment Label: NRTL labeled for use as service equipment for panelboards with one or more main service disconnecting and overcurrent protective devices.

G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

H. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 DISTRIBUTION PANELBOARDS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, power and feeder distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

D. Mains: Circuit breaker. Retain one of three paragraphs below. Allowing only bolt-on circuit breakers will exclude Square D (Schneider Electric), which uses plug-in types with a positive-locking feature, as an approved manufacturer.

E. Branch Overcurrent Protective Devices: For Circuit-Breaker Frame Sizes 125 A and Smaller: Plug-in circuit breakers.

F. Branch Overcurrent Protective Devices: For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.

D. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

E. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Square D; a brand of Schneider Electric.

B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:

    a. Instantaneous trip.
    b. Long- and short-time pickup levels.
    c. Long- and short-time time adjustments.
    d. Ground-fault pickup level, time delay, and I^2t response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
7. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

    a. Standard frame sizes, trip ratings, and number of poles.
    b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
    c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
    d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    e. Shunt Trip: 120V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
    f. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in off position.
    g. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

1. Fuses, and Spare-Fuse Cabinet: Comply with requirements specified in Division 26 Section "Fuses."

2.5 ACCESSORY COMPONENTS AND FEATURES

A. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Receive, inspect, handle, store and install panelboards and accessories according to NECA 407.

B. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

C. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.

D. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

E. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

F. Install filler plates in unused spaces.

G. Stub four 1-inch (27-GRC) empty conduits from recessed mounted panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.

H. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

I. Comply with NECA 1.

3.2 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads and incorporating Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION 262416

CONFIDENTIAL DOCUMENT

262420

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

SWITCHBOARDS

ImmuCell
Portland, ME

Reviews / Approvals

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Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

262420

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
262420	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 262420 - SWITCHBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Service and distribution switchboards rated 600 V and less.
2. Transient voltage suppression devices.
3. Disconnecting and overcurrent protective devices.
4. Instrumentation.
5. Control power.
6. Accessory components and features.
7. Identification.

1.3 SUBMITTALS

A. Product Data: For each type of switchboard, overcurrent protective device, transient voltage suppression device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

B. Shop Drawings: For each switchboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
5. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.
6. Detail utility company's metering provisions with indication of approval by utility company.
7. Include evidence of NRTL listing for series rating of installed devices.
8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
9. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

10. Include diagram and details of proposed mimic bus.
11. Include schematic and wiring diagrams for power, signal, and control wiring.

C. Samples: Representative portion of mimic bus with specified material and finish, for color selection.

D. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

E. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Routine maintenance requirements for switchboards and all installed components.
2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
3. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graph paper; include selectable ranges for each type of overcurrent protective device.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.

B. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

C. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

D. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

F. Comply with NEMA PB 2.

G. Comply with NFPA 70.

H. Comply with UL 891.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.

B. Remove loose packing and flammable materials from inside.

1.6 PROJECT CONDITIONS

A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.

B. Environmental Limitations:

1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

    a. Ambient Temperature: Not exceeding 104 deg F (40 deg C).

C. Service Conditions: NEMA PB 2, usual service conditions, as follows:

1. Ambient temperatures within limits specified.

1.7 COORDINATION

A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

1.9 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Potential Transformer Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
2. Control-Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
3. Fuses and Fusible Devices for Fused Circuit Breakers: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
4. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
5. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
6. Indicating Lights: Equal to 10 percent of quantity installed for each size and type, but no fewer than one of each size and type.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by

1. Square D; a brand of Schneider Electric.

B. Front-Connected, Front-Accessible Switchboards:

1. Main Devices: Panel mounted.
2. Branch Devices: Panel mounted.
3. Sections front and rear aligned.

C. Nominal System Voltage: 480Y/277 V, 208Y/120 V.

D. Indoor Enclosures: Steel, NEMA 250, Type 1.

E. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

F. Barriers: Between adjacent switchboard sections.

G. Insulation and isolation for main bus of main section and main and vertical buses of feeder sections.

H. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.

I. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.

J. Buses and Connections: Three phase, four wire unless otherwise indicated.

1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity, with or copper feeder circuit-breaker line connections.
2. Ground Bus: Minimum-size required by UL 891, hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
3. Main Phase Buses and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
4. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
5. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.

K. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

L. Bus-Bar Insulation: Factory-applied, flame-retardant, tape wrapping of individual bus bars or flame-retardant, spray-applied insulation. Minimum insulation temperature rating of 105 deg C.

M. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components including instruments and instrument transformers.

2.2 SURGE PROTECTION DEVICES

A. Manufacturers: Provide products from available manufacturers offering products that may be incorporated into the Work.

1. Square D; a brand of Schneider Electric.

B. SPDs: Comply with UL 1449, Type 1

1. SPDs with the following features and accessories:

a. Integral disconnect switch.
b. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
c. Indicator light display for protection status.
d. Form-C contacts rated at 5 A and 250-V ac<, one normally open and one normally closed, for remote monitoring of protection status.Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
e. Surge counter.

C. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 250kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

D. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V, three-phase, four-wire circuits shall not exceed the following:

1. Line to Neutral: 1200 V for 480Y/277 V.
2. Line to Ground: 1200 V for 480Y/277 V.
3. Line to Line: 2000 V for 480Y/277 V.

E. SCCR: Equal or exceed 200 kA.

F. Nominal Rating: 20 kA.

2.3 OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:

    a. Instantaneous trip.
    b. Long- and short-time pickup levels.
    c. Long- and short-time time adjustments.
    d. Ground-fault pickup level, time delay, and I^2t response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
6. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
7. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

    a. Standard frame sizes, trip ratings, and number of poles.
    b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
    c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
    d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

e. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
f. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
g. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
h. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
i. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.

2.4 INSTRUMENTATION

A. Instrument Transformers: IEEE C57.13, NEMA EI 21.1, and the following:

1. Potential Transformers: IEEE C57.13; 120 V, 60 Hz, single secondary; disconnecting type with integral fuse mountings. Burden and accuracy shall be consistent with connected metering and relay devices.
2. Current Transformers: IEEE C57.13; 5 A, 60 Hz, secondary; bar or window type; single secondary winding and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.
3. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kVA.
4. Current Transformers for Neutral and Ground-Fault Current Sensing: Connect secondary wiring to ground overcurrent relays, via shorting terminals, to provide selective tripping of main and tie circuit breaker. Coordinate with feeder circuit-breaker, ground-fault protection.

B. Multifunction Digital-Metering Monitor: Square D CM4000 or equal UL-listed or recognized microprocessor-based unit suitable for three- or four-wire systems and with the following features:

1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:

a. Phase Currents, Each Phase: Plus or minus 1 percent.
b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
d. Three-Phase Real Power: Plus or minus 2 percent.
e. Three-Phase Reactive Power: Plus or minus 2 percent.
f. Power Factor: Plus or minus 2 percent.
g. Frequency: Plus or minus 0.5 percent.
h. Accumulated Energy, Megawatt Hours: Plus or minus 2 percent; accumulated values unaffected by power outages up to 72 hours.
i. Megawatt Demand: Plus or minus 2 percent; demand interval programmable from five to 60 minutes.
j. Contact devices to operate remote impulse-totalizing demand meter.

2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.

2.5 CONTROL POWER

A. Control Circuits: 120-V ac, supplied through secondary disconnecting devices from control-power transformer.

B. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.

C. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.6 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: For testing functions of solid-state trip devices without removing from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.

C. Portable Circuit-Breaker Lifting Device: Floor-supported, roller-based, elevating carriage arranged for movement of circuit breakers in and out of compartments for present and future circuit breakers.

D. Overhead Circuit-Breaker Lifting Device: Mounted at top front of switchboard, with hoist and lifting yokes matching each drawout circuit breaker.

E. Spare-Fuse Cabinet: Suitably identified, wall-mounted, lockable, compartmented steel box or cabinet. Arrange for wall mounting.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store switchboards according to NEMA PB 2.1.

B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.

C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install switchboards and accessories according to NEMA PB 2.1.

B. Equipment Mounting: Install switchboards on concrete base, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to switchboards.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.

D. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

E. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.

F. Install filler plates in unused spaces of panel-mounted sections.

G. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.

1. Set field-adjustable switches and circuit-breaker trip ranges.

H. Install spare-fuse cabinet.

I. Comply with NECA 1.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

E. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:

    a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove front and rear panels so joints and connections are accessible to portable scanner.
    b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchboard 11 months after date of Substantial Completion.
    c. Instruments and Equipment:

        1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. Switchboard will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

3.6 PROTECTION

A. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories**,** and to use and reprogram microprocessor-based trip, monitoring, and communication units.

END OF SECTION 262420

CONFIDENTIAL DOCUMENT

262726

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

WIRING DEVICES

ImmuCell
Portland, ME

Reviews / Approvals

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Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

262726

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
262726	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Twist-locking receptacles.
3. Wall-box motion sensors.
4. Snap switches
5. Wall-switch occupancy sensors.
6. Communications outlets.
7. Pendant cord-connector devices.
8. Cord and plug sets.
9. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.

B. Related Sections include the following:

1. Division 27 Section "Communications Horizontal Cabling" for workstation outlets.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-frequency interference.

E. TVSS: Transient voltage surge suppressor.

F. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Samples: One for each type of device and wall plate specified, in each color specified.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.6 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1. Cord and Plug Sets: Match equipment requirements.

1.7 EXTRA MATERIALS

A. Furnish extra materials described in subparagraphs below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Service/Power Poles: One for every 10, but no fewer than one

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
3. Leviton Mfg. Company Inc. (Leviton).
4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

    a. Cooper; 5351 (single), 5352 (duplex).
    b. Hubbell; HBL5351 (single), CR5352 (duplex).
    c. Leviton; 5891 (single), 5352 (duplex).
    d. Pass & Seymour; 5381 (single), 5352 (duplex).

2.3 GFCI RECEPTACLES

A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

    a. Cooper; GF20.
    b. Pass & Seymour; 2084.

2.4 HAZARDOUS (CLASSIFIED) LOCATION RECEPTACLES

A. Wiring Devices for Hazardous (Classified) Locations: Comply with NEMA FB 11 and UL 1010.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Cooper Crouse-Hinds.
    b. EGS/Appleton Electric.
    c. Killark; a division of Hubbell Inc.

2.5 TWIST-LOCKING RECEPTACLES

A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

    a. Cooper; L520R.
    b. Hubbell; HBL2310.
    c. Leviton; 2310.
    d. Pass & Seymour; L520-R.

2.6 PENDANT CORD-CONNECTOR DEVICES

A. Description: Matching, locking-type plug and receptacle body connector; NEMA WD 6 configurations L5-20P and L5-20R, heavy-duty grade.

1. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.
2. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.7 SNAP SWITCHES

A. Comply with NEMA WD 1 and UL 20.

B. Switches, 120/277 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

    a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
    b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
    c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
    d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

C. Key-Operated Switches, 120/277 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

    a. Cooper; 2221L.
    b. Hubbell; HBL1221L.
    c. Leviton; 1221-2L.
    d. Pass & Seymour; PS20AC1-L.

3. Description: Single pole, with factory-supplied key in lieu of switch handle.

2.8 VACANCY SENSORS

A. Wall-Switch Sensors:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

   a. Cooper; 6111 for 120 V, 6117 for 277 V.
   b. Hubbell; WS1277.
   c. Leviton; ODS 10-ID.
   d. Pass & Seymour; WS3000.
   e. Watt Stopper (The); WS-200.

3. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft. (84 sq. m).

2.9 COMMUNICATIONS OUTLETS

A. Telephone Outlet:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

   a. Cooper; 3560-6.
   b. Leviton; 40649.

3. Description: Single RJ-45 jack for terminating 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 5e. Comply with UL 1863.

2.10 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: Steel with white baked enamel, suitable for field painting polymer finish 0.05-inch- (1.2-mm-) thick anodized aluminum.
3. Material for Unfinished Spaces: Galvanized steel
4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."
5. Material for clean room spaces: Stainless steel

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant die-cast aluminum.

2.11 MULTIOUTLET ASSEMBLIES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hubbell Incorporated; Wiring Device-Kellems.
2. Wiremold Company (The).

C. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.

D. Raceway Material: Metal, with manufacturer's standard finish

E. Wire: No. 12 AWG.

2.12 SERVICE POLES

A. Description: Factory-assembled and -wired units to extend power and voice and data communication from distribution wiring concealed in ceiling to devices or outlets in pole near floor.

1. Poles: Nominal 2.5-inch- (65-mm-) square cross section, with height adequate to extend from floor to at least 6 inches (150 mm) above ceiling, and with separate channels for power wiring and voice and data communication cabling.
2. Mounting: Ceiling trim flange with concealed bracing arranged for positive connection to ceiling supports; with pole foot and carpet pad attachment.
3. Finishes: Satin-anodized aluminum.
4. Wiring: Sized for minimum of five No. 12 AWG power and ground conductors and a minimum of four, 4-pair, Category 3 or 5 voice and data communication cables.
5. Power Receptacles: Two duplex, 20-A, heavy-duty, NEMA WD 6 configuration 5-20R units.
6. Voice and Data Communication Outlets: Two RJ-45 Category 5e jacks

2.13 FINISHES

A. Color: Wiring device catalog numbers in Section Text do not designate device color.

1. Wiring Devices Connected to Normal Power System: As selected by Owner unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to UPS Power System: Red

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:

1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:

    a. Cut back and pigtail, or replace all damaged conductors.
    b. Straighten conductors that remain and remove corrosion and foreign matter.
    c. Pigtailing existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.

9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

3.2 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION 262726

CONFIDENTIAL DOCUMENT

262813

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

FUSES

ImmuCell
Portland, ME

Reviews / Approvals

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ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

262813

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
262813	0	8/19/2016	Interior Fit-Out - Issued for Construction

262813 - FUSES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Fuses.

1.2 REFERENCE STANDARDS

A. NEMA FU 1 - Low Voltage Cartridge Fuses; National Electrical Manufacturers Association.

B. NFPA 70 - National Electrical Code; National Fire Protection Association.

1.3 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data sheets showing electrical characteristics, including time-current curves.

1.4 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience and with service facilities within 100 miles of Project.

C. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.5 MAINTENANCE MATERIALS

A. Furnish two fuse pullers.

B. Furnish three of each size and type fuse installed.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Bussmann: www.bussmann.com.

B. GE Industrial: www.geindustrial.com.

C. Ferraz Shawmut, Inc: www.ferrazshawmut.com.

D. Substitutions: See Section 016000 - Product Requirements.

2.2 FUSES - GENERAL

A. Dimensions and Performance: NEMA FU 1, Class as specified or indicated.

B. Voltage: Rating suitable for circuit phase-to-phase voltage.

C. Motor Load Feeder Switches: Class RK5 dual element (time delay).

D. General Purpose Branch Circuits: Class RK1 dual element (time delay).

E. Motor Branch Circuits: Class L time delay.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fuses with label oriented such that manufacturer, type, and size are easily read.

B. Install fuses in accordance with manufacturer's instructions.

C. Coordinate with equipment supplied and/or protected.

END OF SECTION 262813

CONFIDENTIAL DOCUMENT

262816

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

ImmuCell
Portland, ME

Reviews / Approvals

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The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

262816

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
262816	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Nonfusible switches.
2. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.4 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

C. Qualification Data: For qualified testing agency.

D. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Field quality-control reports.

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

F. Manufacturer's field service report.

G. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Submit on translucent log-log graph paper.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

1.7 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 NONFUSIBLE SWITCHES

A. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Square D; a brand of Schneider Electric.

B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
4. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
5. Hookstick Handle: Allows use of a hookstick to operate the handle.
6. Lugs: Compression type, suitable for number, size, and conductor material.
7. Accessory Control Power Voltage: Remote mounted and powered; 120-V ac.

2.2 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

C. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Instantaneous trip.
2. Long- and short-time pickup levels.
3. Long- and short-time time adjustments.

D. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.

2.3 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Wash-Down Areas: NEMA 250, Type 4X stainless steel.
4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
6. Hazardous Areas Indicated on Drawings: NEMA 250, Type 9.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

C. Install fuses in fusible devices.

D. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION 262816

CONFIDENTIAL DOCUMENT

262913

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

ENCLOSED CONTROLLERS

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

262913

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
262913	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 262913 - ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. This section does not apply to specialty drives supplied by other trades for devices such as chillers.

1.2 SUMMARY

A. Section includes the following enclosed stand-alone controllers rated 600 V and less:

1. Full-voltage magnetic.

B. Related Section:

1. Division 26 Section "Variable-Frequency Controllers" for general-purpose, ac, adjustable-frequency, pulse-width-modulated controllers for use on variable torque loads in ranges up to 200 hp.

1.3 DEFINITIONS

A. CPT: Control power transformer.

B. MCCB: Molded-case circuit breaker.

C. MCP: Motor circuit protector.

D. N.C.: Normally closed.

E. N.O.: Normally open.

F. OCPD: Overcurrent protective device.

G. SCR: Silicon-controlled rectifier.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Enclosed controllers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event.

1.5 SUBMITTALS

A. Product Data: For each type of enclosed controller. Include manufacturer's technical data on features, performance, electrical characteristics, ratings, and enclosure types and finishes.

B. Shop Drawings: For each enclosed controller. Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.

1. Show tabulations of the following:

a. Each installed unit's type and details.
b. Factory-installed devices.
c. Nameplate legends.
d. Short-circuit current rating of integrated unit.
e. Listed and labeled for integrated short-circuit current (withstand) rating of OCPDs in combination controllers by an NRTL acceptable to authorities having jurisdiction.
f. Features, characteristics, ratings, and factory settings of individual OCPDs in combination controllers.

2. Wiring Diagrams: For power, signal, and control wiring.

C. Qualification Data: For qualified testing agency.

D. Seismic Qualification Certificates: For enclosed controllers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Field quality-control reports.

F. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Routine maintenance requirements for enclosed controllers and installed components.
2. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
3. Manufacturer's written instructions for setting field-adjustable overload relays.
4. Manufacturer's written instructions for testing, adjusting, and reprogramming reduced-voltage solid-state controllers.

G. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

H. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor running overload protection suit actual motors to be protected.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NFPA 70.

D. IEEE Compliance: Fabricate and test enclosed controllers according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

B. If stored in areas subject to weather, cover enclosed controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install temporary electric heating, with at least 250 W per controller.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

1.9 COORDINATION

A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

1.10 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
3. Indicating Lights: Two of each type and color installed.
4. Auxiliary Contacts: Furnish three spare(s) for each size and type of magnetic controller installed.
5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.
6. One spare complete unit for each type used.

PART 2 - PRODUCTS

2.1 FULL-VOLTAGE CONTROLLERS

A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.

B. Motor-Starting Switches: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off or on.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
    b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
    c. Rockwell Automation, Inc.; Allen-Bradley brand.
    d. Siemens Energy & Automation, Inc.
    e. Square D; a brand of Schneider Electric.

2. Configuration: Non-reversing, Reversing or Two speed.
3. Surface mounting.
4. Green pilot light.
5. Additional Nameplates: FORWARD and REVERSE for reversing switches and HIGH and LOW for two-speed switches.

C. Fractional Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
c. Rockwell Automation, Inc.; Allen-Bradley brand.
d. Siemens Energy & Automation, Inc.
e. Square D; a brand of Schneider Electric.

2. Configuration: Non-reversing and Two speed.
3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button**;** bimetallic type.
4. Surface mounting.
5. Green pilot light.
6. Additional Nameplates: HIGH and LOW for two-speed controllers.

D. Combination Magnetic Controller: Factory-assembled combination of magnetic controller, OCPD, and disconnecting means.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
c. Rockwell Automation, Inc.; Allen-Bradley brand.
d. Siemens Energy & Automation, Inc.
e. Square D; a brand of Schneider Electric.

2. Nonfusible Disconnecting Means:

a. NEMA KS 1, heavy-duty, horsepower-rated, nonfusible switch.
b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
c. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.

2.2 ENCLOSURES

A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.

1. Dry and Clean Indoor Locations: Type 1.
2. Outdoor Locations: Type 3R.
3. Kitchen and Wash-Down Areas: Type 4X, stainless steel.
4. Other Wet or Damp Indoor Locations: Type 4X.
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.
6. Hazardous Areas Indicated on Drawings: Type 7 & 9.

2.3 ACCESSORIES

A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.

1. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty, oiltight type.

a. Push Buttons: Shrouded types; maintained or momentary as required.
b. Pilot Lights: Transformer types; colors as indicated.
c. Selector Switches: Rotary type.

2. Elapsed Time Meters: Heavy duty with digital readout in hours**;** nonresettable.
3. Meters: Panel type, 2-1/2-inch (64-mm) minimum size with 90- or 120-degree scale and plus or minus two percent accuracy. Where indicated, provide selector switches with an off position.

B. Reversible N.C./N.O. auxiliary contact(s).

C. Control Relays: Auxiliary and adjustable solid-state time-delay relays.

D. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.

E. Breather and drain assemblies, to maintain interior pressure and release condensation in Type 7 & 9 enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.

F. Space heaters, with N.C. auxiliary contacts, to mitigate condensation in Type 3R, Type 4X and Type 12 enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.

G. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.

H. Cover gaskets for Type 1 enclosures.

I. Terminals for connecting power factor correction capacitors to the load side of overload relays.

J. Spare control wiring terminal blocks, quantity as indicated**;** unwired.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and surfaces to receive enclosed controllers, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine enclosed controllers before installation. Reject enclosed controllers that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."

B. Floor-Mounted Controllers: Install enclosed controllers on 4-inch nominal-thickness concrete base. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.

C. Seismic Bracing: Comply with requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

E. Install fuses in each fusible-switch enclosed controller.

F. Install fuses in control circuits if not factory installed. Comply with requirements in Division 26 Section "Fuses."

G. Install heaters in thermal overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.

H. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.

I. Install power factor correction capacitors. Connect to the load side of overload relays. If connected to the load side of overload relays, adjust overload heater sizes to accommodate the reduced motor full-load currents.

J. Comply with NECA 1.

3.3 IDENTIFICATION

A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved nameplate.
3. Label each enclosure-mounted control and pilot device.

3.4 CONTROL WIRING INSTALLATION

A. Install wiring between enclosed controllers and remote devices and facility's central control system.

B. Bundle, train, and support wiring in enclosures.

C. Connect selector switches and other automatic-control selection devices where applicable.

1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.
2. Connect selector switches with enclosed-controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

E. Tests and Inspections:

1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
2. Test insulation resistance for each enclosed-controller element, component, connecting motor supply, feeder, and control circuits.
3. Test continuity of each circuit.
4. Verify that voltages at controller locations are within plus or minus 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Owner before starting the motor(s).
5. Test each motor for proper phase rotation.

6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
8. Perform the following infrared (thermographic) scan tests and inspections and prepare reports:

    a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each multi-pole enclosed controller. Remove front panels so joints and connections are accessible to portable scanner.
    b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each multi-pole enclosed controller 11 months after date of Substantial Completion.
    c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

9. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. Enclosed controllers will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports including a certified report that identifies enclosed controllers and that describes scanning results. Include notation of deficiencies detected, remedial action taken and observations after remedial action.

3.6 ADJUSTING

A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

B. Adjust overload-relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.

C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable instantaneous trip elements. Initially adjust to six times the motor nameplate full-load ampere ratings and attempt to start motors several times, allowing for motor cooldown between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Owner before increasing settings.

D. Set field-adjustable switches and program microprocessors for required start and stop sequences in reduced-voltage solid-state controllers.

3.7 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until enclosed controllers are ready to be energized and placed into service.

B. Replace controllers whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers.

END OF SECTION 262913

CONFIDENTIAL DOCUMENT

262923

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

VARIABLE FREQUENCY CONTROLLERS

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

262923

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
262923	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 262923 - VARIABLE FREQUENCY CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Variable Frequency Controller: The Electrical and Mechanical Contractors are responsible for coordinating the variable frequency drives for all equipment. All drives for all equipment will be of the same manufacturer.

1.3 REFERENCES

A. NFPA 70 - National Electrical Code

B. NEMA ICS 3.1 - Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems

C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)

D. IEEE 587 - Voltage Surge Protection (6000 Volts Minimum)

1.4 SUBMITTALS

A. Submit under provisions of Section 013000 - Administrative Requirements

B. Shop Drawings: Include front and side views of enclosures with overall dimensions and weights shown; conduit entrance locations and requirements; and nameplate legends

C. Product Data: Provide catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details

D. Test Reports: Indicate field test and inspection procedures and test results

E. Manufacturer’s Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

F. Manufacturer's Field Reports: Submit under provisions of Section 014000 - Quality Requirements

G. Manufacturer's Field Reports: Indicate start-up inspection findings

1.5 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 017800 - Closeout Submittals.

B. Operation Data: Include instructions for starting and operating controllers, and describe operating limits that may result in hazardous or unsafe conditions.

C. Maintenance Data: Include routine preventive maintenance schedule

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years' experience, and with service facilities within 100 miles of Project.

1.7 REGULATORY REQUIREMENTS

A. All adjustable frequency controllers shall comply with the applicable requirements of the latest standards of ANSI, IEEE, NEMA and the National Electric Code.

B. Controllers and factory-mounted options shall be UL listed and CSA certified (from 3 to 75 hp).

C. Furnish products listed and classified by Underwriters Laboratories, Inc. or a testing firm acceptable to authority having jurisdiction as suitable for purpose specified and indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 016000 - Product Requirements.

B. Accept controllers on site in original packing. Inspect for damage.

C. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

D. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to components, enclosure, and finish.

1.9 WARRANTY

A. Provide warranty under provisions of Section 017800 - Closeout Submittals

1.10 FIELD MEASUREMENTS

A. Verify that field measurements are as instructed by manufacturer.

1.11 MAINTENANCE SERVICE

A. Furnish service and maintenance of controller for one year from Date of Substantial Completion.

1.12 EXTRA MATERIALS

A. Furnish under provisions of Section 016000 - Product Requirements

B. Provide two of each air filter

C. Provide three of each fuse size and type

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:

1. ABB Drives
2. GE
3. Danfoss

2.2 DESCRIPTION

A. Provide enclosed variable frequency controllers suitable for operating the indicated loads. Conform to requirements of NEMA ICS 3.1.

2.3 RATINGS

A. Rated Input Voltage: As scheduled

B. Motor Nameplate Voltage: As scheduled

C. Displacement Power Factor: Between 1.0 and 0.95, lagging, over entire range of operating speed and load.

D. Operating Ambient: 32 degrees F to 104 degrees F

E. Minimum Efficiency at Full Load: 97 percent

2.4 DESIGN

A. Employ microprocessor based inverter logic isolated from power circuits.

B. Employ pulse width modulated inverter system.

C. Employ positive and negative DC bus chokes/filters.

D. Design for ability to operate controller with motor disconnected from output.

E. Design to attempt five automatic restarts following fault condition before locking out and requiring manual restart.

F. Design to include P.I.D. regulator.

2.5 PRODUCT OPTIONS AND FEATURES

A. The adjustable frequency controllers shall convert fixed utility voltage and frequency to variable voltage and frequency for AC motor speed control adjustable from 4 to 60 hertz. Maximum controller operating frequency shall be adjustable up to 66 hertz.

B. The AFC shall produce adjustable voltage and frequency via a two-step process. The first section shall utilize a diode bridge rectifier converting AC to fixed voltage DC. The rectifier shall maintain AC line side power factor at .95 or greater at any combination of speed or load. The second section shall utilize a pulse width modulated inverter that converts the DC potential into a variable frequency and voltage AC waveform suitable for speed control operation of any standard AC induction motor. This inverter section shall utilize power Darlington transistors or Gate turn-off (GTO) thyristors as switching devices. Full load efficiencies shall be in excess of 96% at rated output frequency.

C. The adjustable frequency controllers shall be rated as shown on the drawings. The adjustable frequency and voltage output shall provide constant volts-per-hertz excitation to the motor terminals up to 60 hertz. The full load output current of the AFC shall not be less than that listed for the motor of equivalent horsepower as defined by the National Electric Code, NEC Table 430-150.

D. The controller enclosure shall be of type as scheduled, and/or required for its environment, and freestanding with all factory options specified herein mounted within the controller enclosure (or integrally mounted expansion enclosure). All parts and subassemblies shall be completely front accessible and easily removable. For safety purposes, no power terminations (above 115 VAC control power) or power devices shall be mounted on the enclosure door and no power wiring shall pivot about the door hinges. Enclosure paint shall be ANSI 61, light gray.

E. Standard conditions of operation shall include:

1. Incoming three-phase power, +/- 10%, 50 or 60 hertz
2. AC line frequency variation, +/- 2 hertz
3. Service factor of 1.0 with 10% overload capability for 60 seconds
4. Humidity rating of 0 to 95% (non-condensing)
5. Altitude from 0 to 3,000 feet above sea level.

6. Ambient temperature rating from 32 to 104 degrees F
7. Motor slip dependent speed regulation of 3%
8. Frequency stability of +/- 0.5% for 24 hours with voltage regulation of +/- 2% of maximum rated output voltage
9. Adjustable frequency controllers shall include a process control speed reference interface (non-isolated) of 0-10 volts DC or 4-20 mA DC with standard range and span adjustments.
10. AC control power shall be internally derived via a 115 AC control power transformer with VA capacity to power all required options.

F. Controllers shall include the following protective features:

1. Incoming current limiting fuses rated for 200,000 amperes interrupting
2. Phase loss protection
3. Undervoltage protection
4. Overfrequency protection
5. DC overvoltage protection
6. Line-to-line and line-to-ground output short circuit protection
7. Ground fault protection
8. Overtemperature protection

G. For any protective condition listed above, the controller will trip and an internal fault relay contact will close for remote trip indication. An auto-restart feature shall be provided for controller automatic restart (after phase loss, overvoltage and undervoltage trip conditions only).

H. Standard adjustment shall include:

1. Minimum speed from 4 to 40 hertz.
2. Maximum speed from 40 to 66 hertz
3. Independent acceleration and deceleration from 2 to 120 seconds
4. Low frequency boost 0-46 volts
5. Stability from 0-100%

I. A door-mounted diagnostic indicator shall annunciate any fault condition. Up to ten faults shall be held in memory. Each fault will include a trend buffer to indicate drive operating condition at the time of fault.

J. All controllers shall have common interchangeable logic sections throughout the horsepower range to minimize spare parts.

K. The following control functions shall be available with all AFCs and wiring to standard terminals shall allow enabling of:

1. Run control
2. Stop control
3. Fault reset
4. Hand-Off-Automatic
5. Manual/auto reference
6. Speed

7. Load
8. Voltage

L. The following factory integrally mounted options shall be provided with all adjustable frequency controllers:

1. Thermal-magnetic circuit breaker with door-mounted operating mechanism. Interlock provisions shall prevent unauthorized opening or closing of the controller door with the disconnect in the ON position. Mechanism shall have provisions for padlocking.
2. Manual electric bypass controls to allow operation of the motor directly from the AC power line. Bypass controls shall include an adjustable frequency controller output contactor and AC line bypass starter, with overloads, mechanically and electrically interlocked for safety. In additional, a door-mounted Inverter-Off-Bypass selector switch and indicating lights for Inverter On, Bypass On and Standby shall be part of the bypass controls mounted within the AFC enclosure. An integral time delay while transferring from line to AFC shall be included. All life safety controls, such as fan shut down, shall operate in the bypass mode.
3. Door-mounted Hand-Off-Auto selector switch with factory jumpers for EMS interface control of controller run and manual/auto functions.
4. Door-mounted manual digital speed selector.
5. Door-mounted digital speed load and voltage meter calibrated from 0 to 100%.
6. Door-mounted non-resettable elapsed time meter, 0 to 99,999 hours.
7. DC Bus: The DC shall be filtered by a series choke between the input section and one or more capacitors to provide ripple free DC current. An additional series choke shall be located between the bus capacitors and the inverter to provide enhanced output short circuit and ground fault protection. The use of DC bus chokes shall be required to reduce input transformer sizing requirements (by 25 to 50%) of the main power distribution transformer vs VFDs that use only DC bus capacitors. VFDs which use only bus capacitors require that input isolation transformers be supplied.

M. Equip drives as required to communicate with the Building Automation System.

N. Equip drives with 5% line reactor.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify conditions under provisions of Section 017000.

B. Verify that surface is suitable for controller installation.

C. Do not install controller until building environment can be maintained within the service conditions required by the manufacturer.

3.2 INSTALLATION

A. Install controller where indicated, in accordance with manufacturer’s written instructions and NEMA ICS 3.1.

B. Tighten accessible connections and mechanical fasteners after placing controller.

C. Install fuses in fusible switches.

D. Select and install overload heater elements in motor controllers to match installed motor characteristics.

E. Provide engraved plastic nameplates under the provisions of Section 260553 – Identification for Electrical Systems.

F. Provide neatly typed label inside each motor controller door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating

3.3 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Section 014000. Testing by a factory trained service engineer to include ground fault and short circuit tests.

B. Inspect completed installation for physical damage, proper alignment, anchorage, and grounding.

3.4 MANUFACTURER'S FIELD SERVICES

A. Prepare and start systems under provisions of Section 014000 and 017000.

3.5 ADJUSTING

A. Adjust work under provisions of Section 017000.

B. Make final adjustments to installed drive to assure proper operation of system. Obtain performance requirements from installer of driven loads.

3.6 CLEANING

A. Touch up scratched or marred surfaces to match original finish.

3.7 DEMONSTRATION

A. Provide systems demonstration under provisions of Section 017000.

B. Demonstrate operation of controllers in automatic and manual modes.

END OF SECTION 262923

CONFIDENTIAL DOCUMENT

263213

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

ENGINE GENERATORS

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

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Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
263213	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 263213 - ENGINE GENERATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes packaged engine-generator sets for standby power supply with the following features:

1. Gas engine.
2. Unit-mounted cooling system.
3. Unit-mounted control and monitoring.
4. Performance requirements for sensitive loads.
5. Fuel system.
6. Outdoor enclosure.

B. Related Requirements:

1. Section 263600 "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.

1.3 DEFINITIONS

A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
2. Include thermal damage curve for generator.
3. Include time-current characteristic curves for generator protective device.

4. Include fuel consumption in cubic feet per hour at 0.8 power factor at 0.5, 0.75 and 1.0 times generator capacity.
5. Include generator efficiency at 0.8 power factor at 0.5, 0.75 and 1.0 times generator capacity.

6. Include air flow requirements for cooling and combustion air in cfm at 0.8 power factor, with air supply temperature of 95, 80, 70, and 50 deg F. Provide drawings showing requirements and limitations for location of air intake and exhausts.
7. Include generator characteristics, including, but not limited to kw rating, efficiency, reactances, and short-circuit current capability.

B. Shop Drawings:

1. Include plans and elevations for engine-generator set and other components specified. Indicate access requirements affected by height of subbase fuel tank.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Identify fluid drain ports and clearance requirements for proper fluid drain.
4. Design calculations for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
5. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include base weights.
6. Include diagrams for power, signal, and control wiring. Complete schematic, wiring, and interconnection diagrams showing terminal markings for EPS equipment and functional relationship between all electrical components.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and testing agency.

B. Seismic Qualification Certificates: For engine-generator set, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: With engine and generator mounted on rails identify center of gravity and total weight supplied enclosure, external silencer, and each piece of equipment not integral to the engine-generator set, and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Source quality-control reports, including, but not limited to the following:

1. Certified summary of prototype-unit test report.
2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
3. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria for sensitive loads.
4. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
5. Report of sound generation.
6. Report of exhaust emissions showing compliance with applicable regulations.
7. Certified Torsional Vibration Compatibility: Comply with NFPA 110.

D. Field quality-control reports.

E. Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
b. Operating instructions laminated and mounted adjacent to generator location.
c. Training plan.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: One for every 10 of each type and rating but no fewer than one of each.
2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.
3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.
4. Tools: Each tool listed by part number in operations and maintenance manual.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved by manufacturer.

B. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.9 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:

1. Caterpillar; Engine Div.
2. Generac Power Systems, Inc.
3. Kohler Co.; Generator Division.
4. Magnetek, Inc.
5. Onan/Cummins Power Generation; Industrial Business Group.
6. Spectrum Detroit Diesel.

B. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Engine-generator set housing, engine-generator set, batteries, battery racks, silencers, and sound attenuating equipment, accessories, and components shall withstand the effects of earthquake motions determined according to ASCE/SEI 7

1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
2. Shake-table testing shall comply with ICC-ES AC156. Testing shall be performed with all fluids at worst case normal levels

B. ASME Compliance: Comply with ASME B15.1.

C. NFPA Compliance:

1. Comply with NFPA 37.
2. Comply with NFPA 70.

D. UL Compliance: Comply with UL 2200.

E. Engine Exhaust Emissions: Comply with EPA Tier 3 requirements and applicable state and local government requirements.

F. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

G. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:

1. Ambient Temperature: Minus 15 to plus 40 deg C.
2. Relative Humidity: Zero to 95 percent.
3. Altitude: Sea level to 1000 feet (300 m).

2.3 ASSEMBLY DESCRIPTION

A. Factory-assembled and -tested, water-cooled engine, with brushless generator and accessories.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.

C. Induction Method: Naturally aspirated.

D. Governor: Adjustable isochronous, with speed sensing.

E. Emissions: Comply with EPA Tier 4 requirements.

F. Mounting Frame: Structural steel framework to maintain alignment of mounted components without depending on concrete foundation. Provide lifting attachments sized and spaced to prevent deflection of base during lifting and moving.

1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.

G. Capacities and Characteristics:

1. Power Output Ratings: Nominal ratings as indicated at 0.8 power factor excluding power required for the continued and repeated operation of the unit and auxiliaries, with capacity as required to operate as a unit as evidenced by records of prototype testing.
2. Output Connections: Three-phase, four wire.
3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.

H. Generator-Set Performance:

1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.
2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.

6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
7. Sustained Short-Circuit Current: For a three-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.

I. Generator-Set Performance for Sensitive Loads:

1. Oversizing generator compared with the rated power output of the engine is permissible to meet specified performance.

    a. Nameplate Data for Oversized Generator: Show ratings required by the Contract Documents rather than ratings that would normally be applied to generator size installed.

2. Steady-State Voltage Operational Bandwidth: 1 percent of rated output voltage from no load to full load.
3. Transient Voltage Performance: Not more than 10 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 0.5 second.
4. Steady-State Frequency Operational Bandwidth: Plus or minus 0.25 percent of rated frequency from no load to full load.
5. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
6. Transient Frequency Performance: Less than 2-Hz variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within three seconds.
7. Output Waveform: At no load, harmonic content measured line to neutral shall not exceed 2 percent total with no slot ripple. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
8. Sustained Short-Circuit Current: For a three-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to winding insulation or other generator system components.
9. Excitation System: Performance shall be unaffected by voltage distortion caused by nonlinear load.

    a. Provide permanent magnet excitation for power source to voltage regulator.

2.4 ENGINE

A. Fuel: Natural gas.

B. Rated Engine Speed: 1800 rpm.

C. Maximum Piston Speed for Four-Cycle Engines: 2250 fpm (11.4 m/s).

D. Lubrication System: The following items are mounted on engine or skid:

1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

E. Jacket Coolant Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.

F. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.

1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
3. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.

    a. Rating: 50-psig (345-kPa) maximum working pressure with coolant at 180 deg F (82 deg C), and noncollapsible under vacuum.
    b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

G. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.

1. Minimum sound attenuation of 25 dB at 500 Hz.
2. Sound level measured at a distance of 25 feet (8 m) from exhaust discharge after installation is complete shall be 55 dBA or less.

H. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.

I. Starting System: 24-V electric, with negative ground.

1. Components: Sized so they are not damaged during a full engine-cranking cycle with ambient temperature at maximum specified in "Performance Requirements" Article.
2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
3. Cranking Cycle: 60 seconds.

4. Battery: Lead acid, with capacity within ambient temperature range specified in "Performance Requirements" Article to provide specified cranking cycle at least three times without recharging.
5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 10 deg C regardless of external ambient temperature within range specified in "Performance Requirements" Article. Include accessories required to support and fasten batteries in place. Provide ventilation to exhaust battery gases.
7. Battery Stand: Factory-fabricated, two-tier metal with acid-resistant finish designed to hold the quantity of battery cells required and to maintain the arrangement to minimize lengths of battery interconnections.
8. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35 A minimum continuous rating.
9. Battery Charger: Current-limiting, automatic-equalizing and float-charging type designed for lead-acid batteries. Unit shall comply with UL 1236 and include the following features:

    a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
    b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg F (minus 40 deg C) to 140 deg F (plus 60 deg C) to prevent overcharging at high temperatures and undercharging at low temperatures.
    c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
    d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
    e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
    f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.5 GASEOUS FUEL SYSTEM

A. Natural-Gas Piping: Comply with requirements in Section 231123 "Facility Natural-Gas Piping."

B. LP-Gas Piping: Comply with requirements in Section 231126 "Facility Liquefied-Petroleum Gas Piping."

C. Gas Train: Comply with NFPA 37.

D. Engine Fuel System:

1. Natural-Gas, Vapor-Withdrawal System:

    a. Carburetor.
    b. Secondary Gas Regulators: One for each fuel type, with atmospheric vents piped to building exterior.
    c. Fuel-Shutoff Solenoid Valves: NRTL-listed, normally closed, safety shutoff valves; one for each fuel source.
    d. Fuel Filters: One for each fuel type.
    e. Manual Fuel Shutoff Valves: One for each fuel type.
    f. Flexible Fuel Connectors: Minimum one for each fuel connection.
    g. LP-gas flow adjusting valve.
    h. Fuel change gas pressure switch.

2.6 CONTROL AND MONITORING

A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms.

B. Provide minimum run time control set for 30 minutes with override only by operation of a remote emergency-stop switch.

C. Comply with UL 508A.

D. Configuration: Operating and safety indications, protective devices, basic system controls, engine gages, instrument transformers, generator disconnect switch or circuit breaker, and other indicated components shall be grouped in a combination control and power panel. Control and monitoring section of panel shall be isolated from power sections by steel barriers. Panel shall be powered from the engine-generator set battery. Panel features shall include the following:

    1. Wall-Mounting Cabinet Construction: Rigid, self-supporting steel unit complying with NEMA ICS 6. Power bus shall be copper. Bus, bus supports, control wiring, and temperature rise shall comply with UL 891.

E. Indicating Devices : As required by NFPA 110 for Level 1 system, including the following:

    1. AC voltmeter.
    2. AC ammeter.
    3. AC frequency meter.
    4. Ammeter and voltmeter phase-selector switches.
    5. DC voltmeter (alternator battery charging).
    6. Engine-coolant temperature gage.
    7. Engine lubricating-oil pressure gage.
    8. Running-time meter.
    9. Current and Potential Transformers: Instrument accuracy class.

F. Protective Devices and Controls in Local Control Panel: Shutdown devices and common visual alarm indication as required by NFPA 110 for Level [1] [2] system, including the following:

1. Start-stop switch.
2. Overcrank shutdown device.
3. Overspeed shutdown device.
4. Coolant high-temperature shutdown device.
5. Coolant low-level shutdown device.
6. Low lube oil pressure shutdown device.
7. Air shutdown damper shutdown device when used.
8. Overcrank alarm.
9. Overspeed alarm.
10. Coolant high-temperature alarm.
11. Coolant low-temperature alarm.
12. Coolant low-level alarm.
13. Low lube oil pressure alarm.
14. Air shutdown damper alarm when used.
15. Lamp test.
16. Contacts for local and remote common alarm.
17. Coolant high-temperature prealarm.
18. Generator-voltage adjusting rheostat.
19. Run-Off-Auto switch.
20. Control switch not in automatic position alarm.
21. Low-starting air pressure alarm.
22. Low-starting hydraulic pressure alarm.
23. Low cranking voltage alarm.
24. Battery-charger malfunction alarm.
25. Battery low-voltage alarm.
26. Battery high-voltage alarm.
27. Generator overcurrent protective device not closed alarm.

G. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

H. Connection to Datalink: A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication. Provide connections for datalink transmission of indications to remote data terminals via ModBus.

I. Remote Alarm Annunciator: Comply with NFPA 99. An LED labeled with proper alarm conditions shall identify each alarm event, and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.

1. Overcrank alarm.
2. Coolant low-temperature alarm.
3. High engine temperature prealarm.
4. High engine temperature alarm.

5. Low lube oil pressure alarm.
6. Overspeed alarm.
7. Low fuel main tank alarm.
8. Low coolant level alarm.
9. Low cranking voltage alarm.
10. Contacts for local and remote common alarm.
11. Audible-alarm silencing switch.
12. Air shutdown damper when used.
13. Run-Off-Auto switch.
14. Control switch not in automatic position alarm.
15. Fuel tank derangement alarm.
16. Fuel tank high-level shutdown of fuel supply alarm.
17. Lamp test.
18. Low cranking voltage alarm.
19. Generator overcurrent protective device not closed.

J. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

K. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

2.7 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Generator Circuit Breaker: Molded-case, electronic-trip type; 100 percent rated; complying with UL 489.

1. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
2. Trip Settings: Selected to coordinate with generator thermal damage curve.
3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
4. Mounting: Adjacent to or integrated with control and monitoring panel.

B. Generator Protector: Microprocessor-based unit shall continuously monitor current level in each phase of generator output, integrate generator heating effect over time, and predict when thermal damage of alternator will occur. When signaled by generator protector or other generator-set protective devices, a shunt-trip device in the generator disconnect switch shall open the switch to disconnect the generator from load circuits. Protector performs the following functions:

1. Initiates a generator overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other generator-set malfunction alarms. Contacts shall be available for load shed functions.
2. Under single or three-phase fault conditions, regulates generator to 300 percent of rated full-load current for up to 10 seconds.
3. As overcurrent heating effect on the generator approaches the thermal damage point of the unit, protector switches the excitation system off, opens the generator disconnect device, and shuts down the generator set.

4. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot.

2.8 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with NEMA MG 1.

B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: Class H or Class F.

D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required. Provide 12 lead alternator.

E. Range: Provide broad range of output voltage by adjusting the excitation level.

F. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

G. Enclosure: Dripproof.

H. Instrument Transformers: Mounted within generator enclosure.

I. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified and as required by NFPA 110.

1. Adjusting Rheostat on Control and Monitoring Panel: Provide plus or minus 5 percent adjustment of output-voltage operating band.
2. Maintain voltage within 20 percent on one step, full load.
3. Provide anti-hunt provision to stabilize voltage.
4. Maintain frequency within 10 percent and stabilize at rated frequency within 5 seconds.

J. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.

K. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

L. Subtransient Reactance: 12 percent, maximum.

2.9 OUTDOOR GENERATOR-SET ENCLOSURE

A. Description: Vandal-resistant, sound-attenuating, weatherproof steel housing, wind resistant up to 100 mph (160 km/h). Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.

B. Description: Prefabricated or pre-engineered galvanized-steel-clad, integral structural-steel-framed, walk-in enclosure, erected on concrete foundation.

1. Structural Design and Anchorage: Comply with ASCE 7 for wind loads up to 100 mph (160 km/h).
2. Seismic Design: Comply with seismic requirements in Section 260548.16 "Seismic Controls for Electrical Systems."
3. Hinged Doors: With padlocking provisions.
4. Space Heater: Thermostatically controlled and sized to prevent condensation.
5. Lighting: Provide weather resistant LED lighting with 30 footcandles average maintained.
6. Thermal Insulation: Manufacturer's standard materials and thickness selected in coordination with space heater to maintain winter interior temperature within operating limits required by engine-generator-set components.
7. Muffler Location: Within enclosure.

C. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.

1. Louvers: Fixed-engine, cooling-air inlet and discharge. Storm-proof and drainable louvers prevent entry of rain and snow.
2. Automatic Dampers: At engine cooling-air inlet and discharge. Dampers shall be closed to reduce enclosure heat loss in cold weather when unit is not operating.
3. Ventilation: Provide temperature-controlled exhaust fan interlocked to prevent operation when engine is running.

D. Interior Lights with Switch: Factory-wired, vapor-proof fixtures within housing; arranged to illuminate controls and accessible interior. Arrange for external electrical connection.

1. AC lighting system and connection point for operation when remote source is available.
2. DC lighting system for operation when remote source and generator are both unavailable.

E. Convenience Outlets: Factory wired, GFCI. Arrange for external electrical connection.

2.10 MOTORS

A. Description: NEMA MG 1, Design B, medium induction random-wound, squirrel cage motor.

B. Efficiency: Energy efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

E. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

F. Temperature Rise: Match insulation rating.

G. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.

2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

H. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

I. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in electrical Sections.

2.11 VIBRATION ISOLATION DEVICES

A. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch- (6-mm-) thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
2. Outside Spring Diameter: Not less than 80 percent of compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Minimum Deflection: 1 inch

B. Vibration isolation devices shall not be used to accommodate misalignments or to make bends.

2.12 FINISHES

A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.13 SOURCE QUALITY CONTROL

A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.

1. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.

B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:

1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
2. Test generator, exciter, and voltage regulator as a unit.
3. Full load run.
4. Maximum power.
5. Voltage regulation.

6. Transient and steady-state governing.
7. Single-step load pickup.
8. Safety shutdown.
9. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.
10. Report factory test results within 10 days of completion of test.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.

B. Examine roughing-in for piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.

B. Equipment Mounting:

1. Install packaged engine generators on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
2. Coordinate size and location of concrete bases for packaged engine generators and remote radiators mounted on grade. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

C. Install packaged engine-generator to provide access, without removing connections or accessories, for periodic maintenance.

D. Install engine-generator in a walk-in enclosure with restrained spring isolators having a minimum deflection of 1 inch (25 mm) on 4-inch- (100-mm-) high concrete base. Secure enclosure to anchor bolts installed in concrete bases. Concrete base construction is specified in Section 260548.16 "Seismic Controls for Electrical Systems."

E. Install Schedule 40, black steel piping with welded joints and connect to engine muffler. Install thimble at wall. Piping shall be same diameter as muffler outlet.

1. Install flexible connectors and steel piping materials.
2. Insulate muffler/silencer and exhaust system.

F. Install condensate drain piping to muffler drain outlet full size of drain connection with a shutoff valve, stainless-steel flexible connector, and Schedule 40, black steel pipe with welded joints.

G. Copper and galvanized steel shall not be used in the fuel-oil piping system.

H. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping and specialties.

B. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine-generator to allow service and maintenance.

C. Connect engine exhaust pipe to engine with flexible connector.

D. Connect fuel piping to engines with a gate valve and union and flexible connector.

1. Natural-gas piping, valves, and specialties for gas distribution are specified in Section 231123 "Facility Natural-Gas Piping."
2. Install manual shutoff valve in a remote location to isolate natural-gas supply to the generator enclosure.
3. Vent gas pressure regulators outside building a minimum of 60 inches (1500 mm) from building openings.

E. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

F. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Provide a minimum of one 90 degree bend in flexible conduit routed to the generator set from a stationary element.

G. Balance single-phase loads to obtain a maximum of 10 percent unbalance between any two phases.

3.4 IDENTIFICATION

A. Identify system components according to Section 230553 "Identification for HVAC Piping and Equipment" and Section 260553 "Identification for Electrical Systems."

B. Install a sign indicating the generator neutral is bonded to the main service neutral at the main service location.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Tests and Inspections:

1. Perform tests recommended by manufacturer and each visual and mechanical inspection and electrical and mechanical test listed in the first two subparagraphs as specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.

    a. Visual and Mechanical Inspection

        1) Compare equipment nameplate data with drawings and specifications.
        2) Inspect physical and mechanical condition.
        3) Inspect anchorage, alignment, and grounding.
        4) Verify the unit is clean.

    b. Electrical and Mechanical Tests

        1) Perform insulation-resistance tests in accordance with IEEE 43.

            a) Machines larger than 200 horsepower (150 kilowatts). Test duration shall be 10 minutes. Calculate polarization index.
            b) Machines 200 horsepower (150 kilowatts) or less. Test duration shall be one minute. Calculate the dielectric-absorption ratio.

        2) Test protective relay devices.
        3) Verify phase rotation, phasing, and synchronized operation as required by the application.
        4) Functionally test engine shutdown for low oil pressure, overtemperature, overspeed, and other protection features as applicable.
        5) Conduct performance test in accordance with NFPA 110.
        6) Verify correct functioning of the governor and regulator.

2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.
3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.

    a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
    b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
    c. Verify acceptance of charge for each element of the battery after discharge.
    d. Verify that measurements are within manufacturer's specifications.

4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.

5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
6. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg (120 kPa). Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.
7. Exhaust Emissions Test: Comply with applicable government test criteria.
8. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
9. Harmonic-Content Tests: Measure harmonic content of output voltage at 25 percent and 100 percent of rated linear load. Verify that harmonic content is within specified limits.
10. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at four locations 25 feet (7.6 m) from edge of the generator enclosure, and compare measured levels with required values.

C. Coordinate tests with tests for transfer switches and run them concurrently.

D. Test instruments shall have been calibrated within the last 12 months, traceable to NIST Calibration Services, and adequate for making positive observation of test results. Make calibration records available for examination on request.

E. Leak Test: After installation, charge exhaust, coolant, and fuel systems and test for leaks. Repair leaks and retest until no leaks exist.

F. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation for generator and associated equipment.

G. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

H. Remove and replace malfunctioning units and retest as specified above.

I. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

J. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

K. Infrared Scanning: After Substantial Completion, but not more than 60 days after final acceptance, perform an infrared scan of each power wiring termination and each bus connection while running with maximum load. Remove all access panels so terminations and connections are accessible to portable scanner.

1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan 11 months after date of Substantial Completion.
2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

3. Record of Infrared Scanning: Prepare a certified report that identifies terminations and connections checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators.

END OF SECTION 263213

CONFIDENTIAL DOCUMENT

263353

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

UNINTERRUPTIBLE POWER SUPPLY (UPS)

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
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The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

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Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
263353	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 263353 - UNINTERRUPTIBLE POWER SUPPLY (UPS)

PART 1 - GENERAL

1.1 SUMMARY

A. This specification describes a three-phase continuous duty, on-line, double conversion, solid-state uninterruptible power system, hereafter referred to as the UPS. The UPS shall operate in conjunction with the existing building electrical system to provide high-quality. The UPS shall consist of, as required by the project, the UPS module, battery cabinets, and accessory cabinet(s) for transformers, maintenance bypass, parallel tie, and distribution applications, and other features as described in this specification.

1.2 UPS SYSTEM DESCRIPTION

A. UPS System Components: The UPS system shall consist of the following main components:

1. UPS module containing a Rectifier, Inverter, Battery Charger, Static Bypass, and associated Control and Monitor Panel.
2. Battery strings in Line-and-Match Battery Cabinets.
3. Line-and-Match accessory cabinets for transformer, maintenance bypass, parallel tie, and distribution applications.

B. UPS Module Modes of Operation: The UPS Module shall operate as an on-line, fully automatic system in the following modes:

1. Normal: Utilizing commercial AC power, the critical load shall be continuously supplied by the Inverter. The Inverter shall power the load while regulating both voltage and frequency. The Rectifier shall derive power from the commercial AC source and shall supply DC power to the Inverter. Simultaneously, the Battery Charger shall charge the battery.
2. Battery: Upon failure of the commercial AC power, the critical load shall continue to be supplied by the Inverter, which shall obtain power from the batteries without any operator intervention. There shall be no interruption to the critical load upon failure or restoration of the commercial AC source.
3. Recharge: Upon restoration of the AC source, the Charger shall recharge the batteries and simultaneously the Rectifier shall provide power to the Inverter. This shall be an automatic function and shall cause no interruption to the critical load.
4. Bypass: If the UPS module must be taken out of the Normal mode for overload, load fault, or internal failures, the static bypass switch shall automatically transfer the critical load to the commercial AC power. Return from Bypass mode to Normal mode of operation shall be automatic. No-break transfer to and from Bypass mode shall be capable of being initiated manually from the front panel.

5. Energy Saver: The UPS shall continuously monitor the voltage and frequency of the bypass source. When the source parameters are within acceptable limits, the UPS will utilize a minimal/optimal combination of its internal subsystems to ensure acceptable power is always delivered to the critical load, at a system efficiency of 99% or greater, over the range of 10% to 100% load. The Energy Saver System shall be enabled by the user, and shall be adjustable. It shall incorporate a "High Alert Mode" to automatically (without user intervention) provide maximum power conditioning any time bypass source variation levels exceed preset, adjustable limits. When Energy Saver System is utilized, the UPS must attenuate ANSI C62.41-type line transients to within IEC and ITIC limits. The Energy Saver System shall be able to distinguish between upstream (utility) faults and downstream (load) faults, and react appropriately to protect and support the critical load, without interruption.

1.3 REFERENCES

A. UL 1778 (Underwriters Laboratories) – Standard for Uninterruptible Power Supply Equipment. Product safety requirements for the United States.

B. CSA C22.2 No 107.1 (Canadian Standards Association) – Commercial and Industrial Power Supplies. Product safety requirements for Canada.

C. NEMA PE-1 (National Electrical Manufacturers Association) – Uninterruptible Power Systems standard.

D. IEC 62040-1-1 (International Electrotechnical Commission) – Uninterruptible power systems (UPS) – Part 1-1: General and safety requirements for UPS used in operator access areas.

E. IEC 62040-1-2 (International Electrotechnical Commission) – Uninterruptible power systems (UPS) – Part 1-2: General and safety requirements for UPS used in restricted access locations.

F. IEC 62040-3 (International Electrotechnical Commission) – Uninterruptible power systems (UPS) – Part 3: Method of specifying the performance and test requirements.

G. IEEE 587 (ANSI C62.41) Category A & B (International Electrical and Electronics Engineers) – Recommended practices on surge voltages in low voltage power circuits.

H. CISPR 22: FCC Rules and Regulations 47, Part 15, Class A (Federal Communications Commission) – Radio Frequency Devices (prior to Feb 16, 2006).

I. MIL-HDBK-217E (Military Handbook) – Reliability prediction of electronics equipment.

1.4 SUBMITTALS

A. The UPS shall be supplied with sufficient documentation, including the following manuals:

1. Installation and Operation Manual: One copy of the installation and operation manual shall be furnished. It shall possess sufficient detail and clarity to enable the owner's technicians or representatives to install and operate the UPS equipment and accessories. The manual shall include the following major items:

    a. UPS description
    b. UPS site planning and unpacking
    c. UPS installation
    d. Optional accessory installation
    e. UPS theory of operation
    f. Operating procedures
    g. System events
    h. UPS maintenance
    i. Performance and technical specifications
    j. Wiring requirements and recommendations
    k. Physical features and requirements
    l. Cabinet dimensions

1.5 QUALIFICATIONS

A. The UPS manufacturer shall have a minimum of forty years experience in the design, manufacture and testing of solid-state UPS systems. A list of installed UPS systems of the same type as the manufacturer proposes to furnish for this application shall be supplied upon request.

B. The UPS manufacturer shall have ISO 9001 certification for engineering/R&D, manufacturing facilities and service organization.

C. The UPS manufacturer shall maintain a staffed 7x24x365 call center for technical and emergency support.

D. Field Engineering Support: The UPS manufacturer shall directly employ a nationwide field service department staffed by factory-trained field service engineers dedicated to startup, maintenance, and repair of UPS equipment. The organization shall consist of local offices managed from a central location. Field engineers shall be deployed in key population areas to provide on-site emergency response within 24 hours. A map of the United States showing the location of all field service offices must be submitted with the proposal. Third-party maintenance will not be accepted.

E. Spare Parts Support: Parts supplies shall be located in the field to provide 80% of all emergency needs. The factory shall serve as the central stocking facility where a dedicated supply of all parts shall be available within 24 hours.

F. Product Enhancement Program: The UPS manufacturer shall make available feature upgrade service offerings to all users as they are developed. These upgrades shall be available as optional field-installable kits.

G. Maintenance Contracts: A complete range of preventative and corrective maintenance contracts shall be provided and offered with the proposal. Under these contracts, the manufacturer shall maintain the user's equipment to the latest factory revisions.

1.6 ENVIRONMENTAL REQUIREMENTS

A. The UPS shall withstand any combination of the following external environmental conditions without operational degradation.

1. Operating Temperature: 0 degrees C to + 40 degrees C (32 degrees F to 104 degrees F) without de-rating (excluding batteries).
2. Storage Temperature: - 25 degrees C to + 60 degrees C (-13 degrees F to 140 degrees F). Prolonged storage above + 40 degrees C (104 degrees F) will cause rapid battery self-discharge.
3. Relative Humidity (operating and storage): 95% maximum non-condensing.
4. Elevation:

a. Operational: 5000 ft (1500 m) maximum without de-rating.
b. Transportation: Capable of air transport.

1.7 SAFETY

A. The UPS shall be certified by Underwriters Laboratories in accordance with UL 1778.

B. The UPS shall be certified by the Canadian Standards Association in accordance with CSA C22.2 NO.107.1-M91.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Approved Manufacturers: Eaton Corporation or approved equal. Design was based on the Eaton 93PM 30kVA UPS with separate maintenance bypass cabinet.

2.2 UPS MODULE STANDARD FEATURES

A. The UPS module shall consist of the following standard components:

B. Rectifier/Charger: The rectifier/charger shall convert incoming AC power to regulated DC output for supplying the inverter and for charging the battery. The rectifier/charger shall be a high-frequency PWM design, using Insulated Gate Bi-polar Transistors (IGBTs). The modular design of the UPS shall permit safe and fast removal and replacement of the rectifier/charger module. Mean time to repair (MTTR) for the module shall be no more than 30 minutes in order to return UPS to normal mode. The rectifier/charger module shall also provide the following:

1. The rectifier shall be capable of drawing power from the utility with a power factor of 0.99 under nominal conditions.
2. The rectifier shall feature protection circuitry that prevents the IGBTs from sourcing current in excess of their published ratings.
3. An option shall be provided to allow the rectifier to be capable of operating from a delta transformer output or high impedance grounded transformer.

C. Inverter: The inverter shall feature an IGBT pulse-width-modulation (PWM) design with high speed switching. The inverter shall also have the following features:

1. The inverter shall be capable of providing the specified quality output power while operating from any DC source voltage (rectifier or battery) within the specified DC operating range.
2. The modular design of the UPS shall permit safe and fast removal and replacement of the inverter module. Mean time to repair (MTTR) for the module shall be no more than 30 minutes in order to return UPS to normal mode.
3. The inverter shall feature protection circuitry that prevents the IGBTs from sourcing current in excess of their published ratings.

D. Static Bypass: The bypass shall serve as an alternative source of power for the critical load when an abnormal condition prevents operation in normal mode. The bypass shall consist of a fully rated, continuous duty, naturally commutated static switch for high-speed transfers. The bypass shall feature the following transfer and operational characteristics.

1. Transfers to bypass shall be automatically initiated for the following conditions:

    a. Output overload period expired.
    b. Critical bus voltage out of limits.
    c. Internal over temperature period expired.
    d. Total battery discharge.
    e. UPS failure.

2. Uninterrupted automatic re-transfer shall take place whenever the inverter is capable of assuming the critical load.
3. Uninterrupted automatic re-transfers shall be inhibited for the following conditions:

    a. When transfer to bypass is activated manually or remotely.
    b. In the event of multiple transfers/re-transfer operations the control circuitry shall limit “cycling” to three (3) operations in any ten-minute period. The fourth transfer shall lock the critical load on the bypass source.
    c. UPS failure.

4. Uninterrupted manual transfers shall be initiated from the control panel. Uninterrupted manual transfers to bypass and from bypass shall be possible with the inverter logic. During manual transfers to bypass mode, the inverter must verify proper bypass operations before transferring the critical load to the bypass.
5. All transfers to bypass shall be inhibited for the following conditions:

    a. Bypass voltage out of limits (+/- 10% of nominal)
    b. Bypass frequency out of limits (+/- 3 Hz, adjustable, factory set)
    c. Bypass out of synchronization
    d. Bypass phase rotation / installation error

6. Static transfer time: No break, complete in less than 4ms.
7. The bypass shall be manually energized using the control panel or remotely through a building alarm input.

E. Monitoring and control components: The following components shall provide monitor and control capability:

1. Control panel with status indicators.
2. Alarm and metering display.
3. Building alarm monitoring.
4. Communication ports.

F. Battery management system: The UPS shall contain a battery management system which has the following features:

1. The battery management system shall provide battery time remaining while operating in normal mode and battery mode. Battery time available information shall be displayed real-time, even under changing load conditions. Upon commissioning, battery runtime information shall be available.
2. The battery management system shall automatically test the battery strings to ensure that the battery is capable of providing greater that 80% of its rated capacity. Testing the batteries shall not jeopardize the operation of the critical load. Upon detection of the battery strings not capable of providing 80%, the UPS system will alarm that the battery needs attention/replacement. The battery test shall be able to detect the following:

    a. Open battery string
    b. Shorted battery string
    c. Battery capacity (runtime) less than 80% of "new" battery capacity

3. The UPS shall communicate battery test and monitoring data to the UPS manufacturer's remote monitoring site. Battery life remaining, capacity, and number of on-battery events shall be provided in a monthly report.
4. A temperature sensor shall be provided to monitor the ambient temperature internal to the battery cabinet. If the ambient temperature increases, the UPS system charger shall automatically reduce the charging voltage to a level recommended by the battery manufacturer. If the ambient temperature is decreased the UPS shall automatically increase the battery charge voltage to that recommended by the battery manufacturer.

G. Wiring Terminals: The neutral output compression terminal shall be sized for 200% of UPS module rated current to accommodate higher neutral currents associated with non-linear loads. The UPS module shall contain mechanical compression terminals (adequately sized to accommodate 90°C wiring) for securing user wiring to the following locations:

1. Rectifier/charger input connections (3-wire plus ground)
2. Bypass input connections 3-wire plus ground for 3-wire plus ground output configuration or 4-wire plus ground for 4-wire plus ground output configuration.
3. DC link connections for battery cabinets (positive and negative).
4. AC output connections (3 or 4 wires plus ground).

2.3 UPS MODULE OPTIONS AND ACCESSORIES

A. The UPS system shall consist of the following options and accessories as required:

1. External Maintenance Bypass cabinet(s) shall be provided that include(s):

    a. All hardware and interconnecting cable for connection to UPS module.
    b. Manual maintenance bypass switch to isolate UPS module from commercial AC input and critical load. Switch shall provide complete isolation of UPS for servicing and, if necessary, complete removal and replacement of UPS while still providing bypass power to critical load. Switch shall be make-before-break, interlocked between UPS and bypass to prohibit improper operation.

B. SNMP Network Adapter and UPS Power Monitoring Software: SNMP adapters shall provide a communications interface between the UPS module and SNMP-compatible network management systems. This capability shall allow the unit to be monitored remotely over an Ethernet network using a standard web browser.

1. UPS Power Monitoring Software: This system shall continuously monitor critical power elements associated with the UPS, using the communications port on each module and a customer furnished PC. The system shall automatically alarm if any problems arise and notify local or remote personnel of the alarm condition via email, page, or text message.

C. Battery Cabinet: The battery cabinet shall feature valve regulated, high-rate discharge, lead-acid batteries which provide energy to the support the critical load during a momentary loss of input power to the rectifier. The batteries shall be flame retardant in accordance with UL 94V2 requirements. The battery cabinet shall have the following features:

1. The battery cabinet shall be the same depth and height as the UPS module.
2. The battery cabinet shall feature a mechanical enclosure of like appearance to the UPS module and shall feature casters. Each battery cabinet shall require front access only for installation, service and maintenance. The battery cabinet shall provide top and bottom cable entry.
3. Power wiring internal to each battery cabinet shall be factory provided. Each battery cabinet shall feature 10 battery trays which can be individually disconnected from the battery cabinet power wiring with quick disconnect devices. Each battery tray shall be firmly secured to the battery cabinet frame with fasteners. Each battery tray shall be removable from the front of the battery cabinet.
4. Each battery cabinet shall feature a DC rated circuit breaker. The circuit breaker within the battery cabinet shall only provide protection to the battery string within that battery cabinet. For battery configurations involving multiple battery cabinets, a battery string in one battery cabinet may be isolated from the DC link via its circuit breaker without removing other battery strings from the DC link and the UPS module.
5. The circuit breaker in each battery cabinet shall feature an A/B auxiliary switch. The UPS module shall be capable of monitoring and alarming an open battery cabinet circuit breaker condition.
6. The circuit breaker in each battery cabinet shall feature a 48VDC under voltage release device. The UV device shall operate to trip the battery breaker(s) for an emergency power off command or battery disable command.
7. Power and Control wiring between the battery cabinet and the UPS shall be factory provided with compression type connectors between cabinets.
8. The batteries shall be configured with a ¼” spade type connector for attaching sense leads to each jar to facilitate the future addition of a battery monitoring system.

9. Expected battery life: 200 complete full load discharge cycles when operated and maintained within specifications.

2.4 UNINTERRUPTIBLE POWER SUPPLY RATINGS AND OPERATING CHARACTERISTICS

A. UPS Continuous Ratings. The UPS shall be rated: 30kVA back-up time shall be 9.3 minutes at 100% load.

B. UPS Rating (max) is the maximum output possible from the UPS (for a load power factor range of 0.9 lagging to 0.9 leading). The UPS shall not require de-rating when supporting a leading power factor load of 0.9 or greater.

C. Rectifier/charger input:

1. Input/Output – 208Y/120V – 3 Phase, 4 Wire
2. Operating input voltage range: +10%, -15% of average nominal input voltage without battery discharge.
3. For 60Hz systems, operating input frequency range shall be 55 to 65Hz.
4. Input power factor 0.99 lagging.
5. Normal input current limit: The UPS shall have the following programmable input current limit settings while operating in normal mode:

    a. Rectifier/charger input current limit shall be adjustable from 100 to 115% of full-load input current.
    b. Battery input current limit shall be adjustable from 10% to 15% of the UPS full load input current regardless of the actual load on the UPS.

6. On generator input current limit: The UPS shall have the following programmable input current limit settings while operating in normal mode on generator:

    a. Rectifier/charger input current limit shall be adjustable from 100% to 115% of full-load input current.
    b. Battery recharge input current limit shall be adjustable from 10% to 15% of the UPS full load input current regardless of the actual load on the UPS.

7. Input current total harmonic distortion (THD) shall be less than 4.5%.
8. Power walk-in: Ramp-up to full utility load adjustable from 3 seconds to 60 seconds.

D. Bypass input:

1. Synchronizing bypass voltage range shall be +/- 10% of average nominal input voltage.
2. Synchronizing bypass frequency range is centered on the nominal frequency.
3. Bypass and rectifier inputs can be supplied from out of phase sources if required.
4. Input surge withstand capability: The UPS shall be in compliance with IEEE 587 (ANSI C62.41), category A & B (6kV).

E. Rectifier/charger output:

1. Nominal DC voltage shall be 480VDC.

2. Steady state voltage regulation shall be +/- 0.5%.
3. Voltage ripple shall be less that 0.5% (peak-to-peak).
4. Capacity: The rectifier/charger shall support a fully loaded inverter and recharge the battery to 90% of its full capacity within 10 times the discharge when input current limit is set at maximum.
5. Low line operation: The rectifier/charger shall be capable of sharing the DC load with the battery when the input voltage falls below the specified operation input voltage range, the on battery indicator shall enunciate operation in this mode.
6. DC sensing: Redundant DC voltage sensing methods shall be incorporated for providing battery over-voltage protection.
7. Battery charger characteristics: The UPS battery charging system shall have the following characteristics:

    a. The charger shall be capable of being configured for several charge modes including:

        1) A charging mode that increases battery life by allowing the battery to rest, reducing positive plate corrosion
        2) A charging mode floating the battery at a set level, which can be adjusted via software, used for flooded cell applications.

            a) Nominal Float Voltage: 2.25 V per cell.
            b) Equalizing Voltage: 2.38 V maximum per cell (adjustable).
            c) Automatic (time based) or manual (user initiated) equalization available

    b. UPS module will automatically adjust battery shutdown based upon loading and battery capacity.

        1) The UPS module shall automatically adjust the final discharge voltage between 1.67 and 1.75 Volts per cell based on the existing load and the rate and length of discharge.
        2) The absolute minimum operational voltage is 1.67 V per cell (adjustable).

8. The UPS module will automatically disconnect the battery system in case of full battery discharge followed by prolonged utility AC voltage failure. The time window before battery disconnection occurs shall be programmable for both time and voltage.

F. UPS output in normal mode

1. Nominal output voltage 208Y/120V, 3-phase, 4-wire plus ground. Output wiring configuration is based upon input wiring configuration for systems without internal transformers.
2. Steady-state voltage regulation (in inverter) shall be within +/- 1% average from nominal output voltage.
3. Transient voltage response shall be < +/- 5% from nominal voltage for 100% load step, full load re-transfers and full load drop on battery.
4. Transient voltage recovery shall be 25ms to within +/- 1% of steady state.
5. Linear load harmonic distortion capability: Output voltage THD of less than 2% for 100% linear load.

6. Non-linear load harmonic distortion capability: Output voltage THD of less than 5% for 100% non-linear load when tested using the non-linear load described in IEC 62040-3 connected line to neutral.
7. Manual output voltage adjustment shall be +/- 3% from nominal.
8. Line synchronization range shall be +/- 3Hz, adjustable to+/-0.5 Hz.
9. Frequency regulation shall be +/- 0.01Hz free running.
10. Frequency slew rate shall be 1 Hz/second maximum (adjustable).
11. Phase angle control:

    a. Balanced linear load shall be +/- 1 degree from nominal 120 degrees
    b. Unbalanced linear loads shall less than +/- 5 degrees from average phase voltage for 100% load unbalance.

12. Phase voltage control:

    a. Balanced linear loads shall be +/- 1% from average phase voltage.
    b. Unbalanced linear loads shall be less than +/- 5% for 100% load unbalanced.

13. Overload current capability (with nominal line and fully charged battery): The unit shall maintain voltage regulation for 102% to <110% of resistive/inductive load for 10 minutes, 110% to <125% for 30 seconds, and >125% for 10 seconds (up to Inverter current limit).
14. Fault clearing current capability: 150% phase-to-phase for 10 cycles; 300% phase-to-neutral for up to 10 cycles
15. Static transfer time: No break, completed in less than 4ms.
16. Common mode noise attenuation:

    a. -65dB up to 20kHz, -40db up to 100kHz
    b. > 100dB with isolation transformer

17. Acoustical noise: Noise generated by the UPS under normal operation shall not exceed 65dbA at one meter from any operator surface, measured at 25 degrees C (77 degrees F) and full load.
18. EMI Suppression: The UPS shall meet FCC rules and regulation 47, part 15, for Class A devices prior to Feb 16, 2006, CISPR .
19. Electrostatic discharge (ESD): The UPS shall meet IEC 801-2 specifications. The UPS shall withstand a 25 kV pulse without damage and with no disturbance or adverse effect to the critical load.
20. Efficiency: The UPS efficiency shall be up to 94%.

G. UPS Output with Energy Saver System enabled

1. The Energy Saver System acts to optimize the internal components of the UPS power train to maximize system efficiency when the bypass source is within the following (adjustable) limits: Voltage: +/-10%, and Frequency: +/-3Hz.
2. Nominal output voltage 208Y/120V, 3-phase, 4-wire. Output wiring configuration is based upon input wiring configuration for systems without internal transformers.
3. Steady-state voltage regulation shall be within +/- 10% from nominal output voltage.
4. Line synchronization range shall be +/- 3Hz, adjustable to +/- 5Hz.
5. Frequency regulation shall be +/-3Hz when bypass source is within the limits in (1) above, and +/- 0.01Hz free running,

6. Overload current capability (with bypass source within the limits of (1) above) 1000% for 20msec, 600% for 50 ms
7. Static transfer time: No break, completed in less than 2ms, including detection time.
8. Acoustical noise: Noise generated by the UPS under normal operation shall not exceed 65dbA at one meter from any operator surface, measured at 25 degrees C (77 degrees F) and full load.
9. EMI Suppression: The UPS shall meet FCC rules and regulation 47, part 15, for Class A devices prior to Feb 16, 2006.
10. Electrostatic discharge (ESD): The UPS shall meet IEC 801-2 specifications. The UPS shall withstand a 25 kV pulse without damage and with no disturbance or adverse effect to the critical load.
11. Efficiency: The UPS efficiency shall greater than 99%, over the range of 10 to 100% load.

H. UPS in Parallel Configurations:

1. UPS modules shall be capable of being paralleled to increase system power levels or to provide redundant power. A total of eight (8) UPS modules shall be capable of parallel operation, either for capacity or redundant systems. It shall be possible to parallel up to six (6) UPS modules without a central bypass cabinet. The parallel system shall have intelligence to automatically recognize the need for capacity and/or redundancy. Parallel systems shall utilize autonomous UPS power modules that do not rely on any control interconnections for synchronized operation. The individual modules shall operate in a peer-to-peer manner to provide automatic load sharing, synchronization, and selective tripping capabilities. "Master-slave" configurations are not acceptable.
2. The parallel system shall utilize a communications network to provide system information and status, such as operating mode and meter data. This network shall provide individual module information as well as total system information, and individual module information shall be available from any module's front panel display. The loss of this system information network shall not cause the parallel units to transfer to bypass or drop the critical load.

2.5 MECHANICAL DESIGN

A. Enclosures: The UPS shall be housed in free-standing double front enclosures (safety shields behind doors) equipped with casters and leveling feet. The enclosures shall be designed for computer room applications. Front doors shall have locks to prevent unauthorized entry.

B. Ventilation: The UPS shall be designed for forced-air cooling. Air inlets shall be on the front of the unit. Air outlets shall be on the top. Eighteen inches of clearance over the UPS outlets shall be required for proper air circulation. Air filters shall be commonly available sizes.

C. No back or side clearance or access shall be required for the system. The back and side enclosure covers shall be capable of being located directly adjacent to a wall.

D. Cable entry: Standard cable entry for the UPS cabinet shall be through either the enclosure bottom or top. A dedicated wireway shall be provided within the UPS cabinet for routing user input and output wiring.

E. Front access: All serviceable subassemblies shall be modular and capable of being replaced from the front of the UPS (front access only required). Side or rear access for installation, service, repair or maintenance of the UPS system shall not be required.

F. Service area requirements: The system shall require no more than thirty-six (36) inches of front service access room and shall not require side or rear access for service or installation.

2.6 CONTROLS AND INDICATORS

A. Microprocessor controlled circuitry: The UPS controls shall have the following design and operating characteristics:

1. Fully automatic operation of the UPS shall be provided through the use of microprocessor controlled Digital Signal Processing. DSP shall eliminate variances from component tolerance or drift, and provide consistent operational responses.
2. All operating and protection parameters shall be firmware controlled, thus eliminating a need for manual adjustments. The logic shall include system test capability to facilitate maintenance and troubleshooting. Printed circuit board replacement shall be possible without requiring calibration.
3. Start-up and transfers shall be automatic functions.

B. Digital Front Panel Display: The UPS control panel shall be a digital front panel display that features an 8x40 (8 lines, each with 40 characters) backlit LCD display. The LCD shall display UPS status, metering, battery status, alarm/event queue, active alarms and UPS configurations. The front panel display shall show a system mimic diagram with an outlined power path, current operating mode and event logs.

C. Control Panel Indicators: The UPS control panel shall provide the following monitoring functions with indicator LED's:

1. NORMAL: This shall indicate that the commercial AC utility or generator source is supplying power to the rectifier and the inverter is supporting the critical load. A text message shall indicate if the bypass line is not within tolerance.
2. BYPASS: This shall indicate that the UPS has transferred the load to the bypass circuit.
3. BATTERY: This shall indicate that the commercial AC utility or generator source has failed and the battery is supplying power to the inverter, which is supporting the load. A text message shall indicate if the battery charge is low or if the battery is installed but disconnected.
4. ALARM: This shall indicate that the UPS detects an alarm condition, outlined in detail in the operator's manual.

D. Control Panel Controls: The UPS control panel shall provide the following functions from front panel push buttons:

1. EVENTS: Displays the list of Active System Events and a historical log of system events. Historical logs shall include a detailed time stamped list of the latest 128 events.
2. METERS: Displays performance meters for the system or critical load. When selected, the front display shall show individual screens of input parameters, output parameters or bypass parameters including; voltage, current and frequency. In addition, the battery display shall show runtime remaining.

3. CONTROLS: Displays a System Controls screen. Allows selection of operating mode, normal, bypass, charger on/off and Power Module on/off.
4. SETUP: Allows display contrast, date and time information serial communication port configuration and display of firmware revision numbers.
5. RETURN: Confirms selection or returns to previous screen.

E. Interface panel: The UPS shall be equipped with an interface panel, located behind a protective cover, which provides the following signals and communication features in a Class 2 environment:

1. Alarm contact: A dry contact for annunciating a summary alarm shall be provided for customer use. This contact shall be Form "C" capable of supplying both N/O and N/C contacts. Contact ratings shall be 5A max at a voltage not to exceed 28VDC or 277VAC.
2. RS232 (EIA / TIA-232) communications interface: Circuitry shall be provided for one RS232 (EIA / TIA-232) communication port for connection to automated service department diagnostic tools. This port may be used with simple ("dumb") terminals to gain remote access to all unit operation information.
3. Building alarms: Two inputs shall be provided for monitoring the status of external dry contacts. Building alarms shall be set up through the UPS configuration mode function on the RS232 (EIA / TIA-232) port.
4. External EPO contacts: Shall be provided to connect an external remote emergency power off switch to shutdown the UPS and de-energize the critical load.
5. Battery control contacts: Contacts shall be provided to connect the battery UVR and auxiliary signals from a battery breaker or battery disconnect switch.
6. External bypass indicator connection: A connection point shall be provided to acknowledge that an external maintenance bypass has been closed around the UPS, placing the critical load on utility power.
7. The system shall have the capability to add four (4) additional building alarms, 384 logged events, 4 additional languages, Mandarin or Russian as a primary language.

2.7 COMMUNICATIONS

A. Communications Bay: The UPS shall be equipped with field configurable communications bays that will accommodate four (4) communication devices

B. Remote Monitoring:

1. Provide WEB/SNMP communication capability
2. The UPS shall be able to be monitored remotely via communications devices. UPS manufacturer shall provide communications card. Coordinate requirements with facility Monitoring of UPS status may also be performed through isolated dry contact Form C relays.
3. Remote monitoring of the UPS shall also be possible through status indicators elsewhere in the same facility through a device that replicates these indicators.
4. The UPS communication capability should be able to integrate into any industry standard Building Management System (BMS) and/or Network Management System (NMS). The UPS must also be able to be monitored via any standard Internet browser (i.e. Internet Explorer and Netscape).
5. All optional hardware interfaces shall be "Hot-swappable" (UPS maintains power to critical applications while changing interfaces).

C. Shutdown:

1. There shall be a mechanism that provides graceful, orderly, unattended, sequential shutdown of one or multiple computers powered by one UPS. This shutdown shall be performed via in-network or out-of-network means. The order of shutdown shall be user-defined, allowing the maximization of runtime on battery for more critical systems.
2. Shutdown of AS/400 computers shall be possible through open-collector relay contacts or isolated, dry contact, Form-C relays.
3. The UPS shall also be capable of interfacing with an operating system's built-in shutdown routine, e.g. Windows NT. This shall be done through a cable connection to the serial port on the UPS.

D. Notification:

1. There shall be a mechanism to send alerts to key personnel via email or SNMP traps. An alarm notification may also be sent by a network message.
2. Dial-out to a computer for alarm notification may be performed. The user may respond by dialing-in to retrieve alarm history and a summary of current meter status.
3. Management: A remote battery test may be performed via an Ethernet network. The UPS shall be tested through invoking a single command.

2.8 UPS MODULE PROTECTION

A. Rectifier/Charger and Bypass protection shall be provided through individual fusing of each phase.

B. Battery protection shall be provided by thermal-magnetic molded-case circuit breakers in each battery cabinet (if standard battery pack is provided) or external protective device for an external battery.

C. Electronic current limiting circuitry and fuses in the Inverter circuit shall provide output protection.

D. To comply with agency safety requirements, the UPS module shall not rely upon any disconnect devices outside of the UPS module to isolate the battery cabinet from the UPS module.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in compliance with all agency and local standards.

3.2 COMMISSIONING

A. Factory start-up shall be provided on a 5x8 basis (7 x 24 optional). Start-up service shall be provided at no extra charge and shall include one visit to perform all procedures and tests specified within UPS Installation and Operation manual. UPS manufacturer shall provide the following services:

1. Pre-energize visit to inspect installation and provide guidance to installers as required.
2. Post-start-up visit for alarm notification configuration, operator training, generator testing, etc.

B. The following procedures and tests shall be performed by Field Service personnel during the UPS startup:

1. Visual Inspection:

a. Visually inspect all equipment for signs of damage or foreign materials.
b. Observe the type of ventilation, the cleanliness of the room, the use of proper signs, and any other safety related factors.

2. Mechanical Inspection:

a. Check all the power connections for tightness.
b. Check all the control wiring terminations and plugs for tightness or proper seating.

3. Electrical Pre-check:

a. Check the DC bus for a possible short circuit.
b. Check input and Bypass power for proper voltages and phase rotation.
c. Check all lamp test functions.

4. Initial UPS Startup:

a. Verify that all the alarms are in a “go” condition.
b. Energize the UPS module and verify the proper DC, walkup, and AC phase on.
c. Check the DC link holding voltage, AC output voltages, and output waveforms.
d. Check the final DC link voltage and Inverter AC output. Adjust if required.
e. Check for the proper synchronization.
f. Check for the voltage difference between the Inverter output and the Bypass source.
g. On site full-load, step-load, and battery discharge tests using supplier furnished load bank, shall also be offered.

5. Operational Training: Before leaving the site, the field service engineer shall familiarize responsible personnel with the operation of the UPS. The UPS equipment shall be available for demonstration of the modes of operation.

3.3 WARRANTY

A. All components of the UPS system shall be covered by a standard one-year limited factory warranty and service protection package.

B. One-year limited factory warranty shall include replacement coverage for the UPS parts for a period of 18 months from shipment or 12 months from start-up, whichever occurs sooner.

C. One-year service protection package shall include 7x24 on-site repair/replacement labor for UPS parts and batteries; 7x24 technical support coverage; and 7x24 remote monitoring service (with monthly reports for UPS and battery performance). Standard response time shall be 8 hours from receipt of call. Manufacturer shall also offer, as an option, 7x24 on-site service support with guaranteed response times of 4, or 2 hours in certain major metropolitan areas. Additional preventive maintenance visits shall be available as an option for both UPS and battery components.

D. Manufacturer shall also include Start-up services consisting of: 5x8 Start-up service of UPS and batteries, with option for 7x24 Start-up. On-site user training, Site Audit, installation and commissioning of monitoring service, and validation of one-year limited factory warranty will be performed during the start-up.

E. Manufacturer shall also offer an optional service plan to provide 7x24 on-site coverage (preventive and corrective) for UPS and batteries, guaranteed response time, remote monitoring, Web access to service site history, annual Site Audit, UPS and battery preventive maintenance visit, and discounts on upgrade and modification kits. Manufacturer shall also provide an optional battery service plan to provide parts-and-labor coverage for partial and full battery strings, either with preventive maintenance or replacement coverage.

END OF SECTION 260553

CONFIDENTIAL DOCUMENT

263600

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

TRANSFER SWITCHES

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
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The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

263600

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Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
263600	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 263600 - TRANSFER SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes automatic transfer switches rated 600 V and less.

1.2 SUBMITTALS

A. Product Data: Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.

C. Manufacturer Seismic Qualification Certification: Submit certification that transfer switches accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces.

2. Dimensioned Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based.

D. Field quality-control test reports.

E. Operation and maintenance data.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NEMA ICS 1.

C. Comply with NFPA 70.

D. Comply with NFPA 99.

E. Comply with NFPA 110.

F. Comply with UL 1008 unless requirements of these Specifications are stricter.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Contactor Transfer Switches:

a. Caterpillar; Engine Div.
b. Russelectric, Inc.
c. Asco Power Technologies.

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.

B. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.

1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.

C. Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.

D. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

E. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.

F. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.
2. Switch Action: Double throw; mechanically held in both directions.

3. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.

G. Neutral Switching. Where four-pole switches are indicated, provide neutral pole switched simultaneously with phase poles.

H. Bypass / Isolation Switch: This switch shall match automatic transfer switch for electrical ratings.

I. Neutral Terminal: Solid and fully rated, unless otherwise indicated.

J. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508, unless otherwise indicated on drawings.

2.3 AUTOMATIC TRANSFER SWITCHES

A. Comply with Level 1 equipment according to NFPA 110.

B. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.

C. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.

D. Transfer Switches Based on Molded-Case-Switch Components: Comply with NEMA AB 1, UL 489, and UL 869A.

E. In-Phase Monitor: Factory-wired, internal relay controls transfer so it occurs only when the two sources are synchronized in phase.

F. Motor Disconnect and Timing Relay: Controls designate starters so they disconnect motors before transfer and reconnect them selectively at an adjustable time interval after transfer. Time delay for reconnecting individual motor loads is adjustable between 1 and 60 seconds, and settings are as indicated.

G. Programmed Neutral Switch Position: Switch operator has a programmed neutral position arranged to provide a midpoint between the two working switch positions, with an intentional, time-controlled pause at midpoint during transfer.

H. Automatic Transfer-Switch Features:

1. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
2. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.

3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
4. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
5. Test Switch: Simulate normal-source failure.
6. Switch-Position Pilot Lights: Indicate source to which load is connected.
7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.

    a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
    b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."

8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
9. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
11. Engine Shutdown Contacts: Instantaneous; shall initiate shutdown sequence at remote engine-generator controls after retransfer of load to normal source.
12. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
13. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:

    a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
    b. Push-button programming control with digital display of settings.
    c. Integral battery operation of time switch when normal control power is not available.

2.4 SOURCE QUALITY CONTROL

A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Design each fastener and support to carry load indicated by seismic requirements and according to seismic-restraint details. See Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

B. Floor-Mounting Switch: Anchor to floor by bolting.

1. Concrete Bases: 4 inches (100 mm) high, reinforced, with chamfered edges. Extend base no more than 4 inches (100 mm) in all directions beyond the maximum dimensions of switch, unless otherwise indicated or unless required for seismic support. Construct concrete bases according to Division 26 Section "Hangers and Supports for Electrical Systems."

C. Identify components according to Division 26 Section "Identification for Electrical Systems."

D. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.2 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installation, including connections, and to assist in testing.
2. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.

a. Check for electrical continuity of circuits and for short circuits.
b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
c. Verify that manual transfer warnings are properly placed.
d. Perform manual transfer operation.

5. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.

a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
b. Simulate loss of phase-to-ground voltage for each phase of normal source.
c. Verify time-delay settings.
d. Verify pickup and dropout voltages by data readout or inspection of control settings.
e. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.
f. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

6. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.

a. Verify grounding connections and locations and ratings of sensors.

C. Coordinate tests with tests of generator and run them concurrently.

D. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

E. Remove and replace malfunctioning units and retest as specified above.

F. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.

1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
3. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below. Refer to Division 01 Section "Demonstration and Training."

B. Coordinate this training with that for generator equipment.

END OF SECTION 263600

CONFIDENTIAL DOCUMENT

265100

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

INTERIOR LIGHTING

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

265100

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
265100	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 265100 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Interior lighting fixtures, lamps, ballasts and drivers.
2. Exit signs.
3. Lighting fixture supports.

B. Related Sections:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
2. Section 262726 "Wiring Devices" for wall-box vacancy sensors

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color-rendering index.

C. HID: High-intensity discharge.

D. LED: Light emitting diode.

E. LER: Luminaire efficacy rating.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting fixture, including ballast housing if provided.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Physical description of lighting fixture including dimensions.

2. LED driver for LED light fixtures.
3. Energy-efficiency data.
4. Life, output (lumens, CCT, and CRI), and energy-efficiency data for lamps and LED sources.
5. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.

    a. Testing Agency Certified Data: For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by manufacturer.
    b. Manufacturer Certified Data: Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

6. Light fixture cutsheet booklet complete with color light fixture catalog pages, lighting controls, light fixture layouts and lighting controls. 2 copies of the booklet are to be submitted.

B. Submittals Format: All submittals shall be in PDF format for ease in sharing electronically.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.6 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NFPA 70.

D. FMG Compliance: Lighting fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FMG.

1.7 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.8 WARRANTY

A. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

1. Warranty Period: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products indicated on Drawings.

2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Luminaires: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.

E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit maintenance without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during maintenance and when secured in operating position.

F. Diffusers and Globes:

1. Lens shall be 100% virgin acrylic injection molded prismatic diffusers meeting the ASTM specifications for methacrylite molding compounds D.788-69A. Minimum lens thickness shall be 0.125”.
2. Glass: Annealed crystal glass unless otherwise indicated.

G. Factory-Applied Labels: Comply with UL 1598. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

2.3 DRIVERS FOR LED LIGHT FIXTURES

A. Ten-year operational life while operating with a case temperature range of 0 degrees C to 62 degrees C and 90 percent non-condensing relative humidity.

B. Designed and tested to withstand electrostatic discharges up to 15,000 V without impairment per IEC 801-2.

C. Electrolytic capacitors to operate at least 20 degrees C below the capacitor's maximum temperature rating when the driver is under fully-loaded conditions and case temperature is 62 degrees C.

D. Maximum inrush current of 2 amperes for 120V and 277 V drivers.

E. Withstand up to a 4,000 volt surge without impairment of performance as defined by ANSI C62.41 Category A.

F. Manufactured in a facility that employ ESD reduction practices in compliance with ANSI/ESD S20.20.

G. Inaudible in a 27 dBA ambient.

H. No visible change in light output with a variation of +/- 10 percent line voltage input.

I. Total Harmonic Distortion less than 10 percent and meet ANSI C82.11 maximum allowable THD requirements

J. Drivers to track evenly across

1. Multiple fixtures.
2. All light levels.

K. Compatibility of driver and LED light engine must be tested and ensured by driver manufacturer.

L. Driver Labels: Provide driver label stickers on each luminaire driver chamber/housing indicating the following information:

M. 277 V; Power Factor, >.94; Temperature Rating -40 deg F to 122 deg F.

N. All label lettering shall be minimum 1/8" text.

O. Driver disconnects: Provide in-line disconnects on all drivers to meet NEC 2008 Article 410.130(G). Lighting manufacturer shall provide "wire-nut" connections on the load side of the driver disconnects to facilitate driver replacement.

1. Manufacturer: Ideal
2. Model: PowerPlug Luminaire Disconnect 30-102.

P. Power Factor: 90 percent, minimum.

Q. Maximum drive current: 350mA.

R. Load regulation shall be +/-1% from no load to full load.

S. Minimum Efficiency: 85%

T. Operating Temperature Range: -40C to 50C.

U. Minimum Rated Life: 50,000 hours

V. UL Class I or II output

W. Total Harmonic Distortion Rating: Less than 20 percent.

X. Case temperature shall be rated for –40 deg C through +80 deg C and provided with thermal protection and self-limited short circuit and overload protection.

Y. Output shall be isolated.

Z. Driver Life Rating shall have less than 0.5% failure rate at the LED module's maximum L70 rated life.

AA. Driver manufacturer to be an industry leader, such as Advance or approved equal.

BB. Comply with FCC 47 CFR part 15 non-consumer RFI/EMI standards.

CC. LED dimming driver.

1. Ten-year operational life while operating with a case temperature range of 0 degrees C to 62 degrees C and 90 percent non-condensing relative humidity.
2. Electrostatic Discharge (ESD) testing is done according to the IEC 801-2 standard (human body model). This testing is completed on all user accessible points. Devices that are not protected against static discharges can have intermittent performance or failure due to normal usage and handling (walking across carpet during periods of low humidity).
3. Designed and tested to withstand electrostatic discharges up to 15,000 V without impairment per IEC 801-2.
4. Long term driver failures are due to capacitors "drying up" which is exponentially related to operating temperature. Dimming drivers that run cooler or are made with components with higher temperature ratings will last longer.
5. Electrolytic capacitors are sensitive to heat in a dimming circuit. Their expected lifetime doubles for every 10 degrees C that the component operates below the capacitor's rated operating temperature.
6. A component operated at 10 degrees C above the rated temperature will have HALF the life expectancy. A component operated at 20 degrees C above the rated temperature will have one quarter the life expectancy.

7. A component operated at 10 degrees C below the rated temperature will have DOUBLE the life expectancy. A component operated at 20 degrees C below the rated temperature will have quadruple the life expectancy.
8. The following statement ensures a minimum 10-year operating life under worst case field conditions
9. Electrolytic capacitors to operate at least 20 degrees C below the capacitor's maximum temperature rating when the driver is under fully-loaded conditions and case temperature is 62 degrees C.
10. To reduce false circuit breaker tripping due to turn on inrush, the following statement ensures that electronic dimming ballast will meet NEMA inrush recommendations.
11. Maximum inrush current of 2 amperes for 120V and 277 V drivers.
12. Withstand up to a 4,000 volt surge without impairment of performance as defined by ANSI C62.41 Category A.
13. During manufacturing, drivers are more susceptible to damage by Electrostatic Discharge (ESD). A facility that does not meet this requirement could have excessive defective units delivered to a job site.
14. Manufactured in a facility that employ ESD reduction practices in compliance with ANSI/ESD S20.20.
15. This means that the driver will be inaudible in a general office space (30dBA is a quiet whisper at 5 feet).
16. Line voltage fluctuates throughout the day as equipment (i.e. equipment or other buildings in the vicinity) come on line. Line voltage fluctuations will cause noticeable changes in light output. The driver automatically compensates to variations in voltage to provide constant light output.
17. No visible change in light output with a variation of +/- 10 percent line voltage input.
18. Line voltage fluctuates throughout the day as equipment (i.e. equipment or other buildings in the vicinity) come on line. Line voltage fluctuations will cause noticeable changes in light output. The driver automatically compensates to variations in voltage to provide constant light output.
19. Total Harmonic Distortion less than 10 percent and meet ANSI C82.11 maximum allowable THD requirements
20. In applications with multiple lamp lengths (15 feet pendant with 3 four foot fixtures and 1 three foot fixture), all drivers track together with even illumination.
21. Drivers to track evenly across
22. Multiple fixtures.
23. All light levels.
24. Compatibility of driver and LED light engine must be tested and ensured by driver manufacturer.

2.4 EXIT SIGNS

A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:

1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.

2.5 INTERIOR AREA LED FIXTURES/LAMPS:

A. Kelvin temperature of in the range of 4000k to 4100k

B. 5-year warranty minimum

C. Ability to be used in insulated ceilings

D. Occupancy sensors for each room

E. Modular design for field replacement of parts

F. Series parallel matrix for prevention of LED string outages (not applicable to exit lights and recessed can fixtures).

G. Tool less access to driver and LED modules

H. Cannot have LED pixilation (or commonly called bug eye effect)

I. UL certified up to 90F degrees operating temperature

2.6 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Section 260529 "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.

C. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage.

D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lighting fixtures:

1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
2. Install lamps in each luminaire.
3. Align all fixtures in a given area in the same relative orientation from one fixture to the next.

B. Temporary Lighting: If it is necessary, and approved by Owner, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.

C. Remote Mounting of Ballasts or Drivers: Distance between the ballast and fixture shall not exceed that recommended by ballast manufacturer. Verify, with ballast manufacturers, maximum distance between ballast and luminaire.

D. Lay-in Ceiling Lighting Fixtures Supports: Use grid as a support element.

1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each fixture. Locate not more than 6 inches from lighting fixture corners.
2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.

E. Suspended Lighting Fixture Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.

F. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

G. Cleaning: All luminaires shall be thoroughly cleaned and clear from dust, paint, construction debris and fingerprints after all other trades are complete, but prior to the date of substantial completion.

H. Light fixture whips may be ½” flexible metallic conduit, limited to no longer than 72 inches in length.

3.2 IDENTIFICATION

A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

A. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

B. Cleaning: All luminaires shall be thoroughly cleaned and clear from dust, paint, construction debris and fingerprints after all other trades are complete, but prior to the date of substantial completion.

3.4 SPARE PARTS

A. 10% of each lamp type, minimum of five (5).

B. 10% of each ballast or driver, minimum of five (5).

C. 5% of each LED module type, minimum of two (2) of each. On projects with a large number of a single type, limit the number of spare parts as they will become outdated quickly.

D. 10% of replacement lenses and globes, minimum of three (3) of each. Note specifically to which luminaire types this applies and reference the spare parts in the luminaire schedule. If decorative bowls are large, confirm with the end user whether they have space to store these materials.

3.5 STARTUP SERVICE

A. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Owner.

3.6 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Some of this work may be required after dark.

1. Adjust aimable luminaires in the presence of Owner.

3.7 COMMISSIONING

A. Require that the lighting control elements be properly set and tested for optimal operation. Commissioning agent shall provide a report for the following systems (edit as required for the project):

1. Daylight harvesting
2. Occupancy sensors
3. Dimming Systems

B. Engineering Service shall be invited to attend these sessions. Provide at least 7 days notice prior to any session.

END OF SECTION 265100

CONFIDENTIAL DOCUMENT

270500

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

COMMON WORK RESULTS FOR COMMUNICATIONS

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

270500

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
270500	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 270500 - COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Cutting and Patching.
2. Cleaning, Protecting and Adjusting.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

C. Wiring: Cable and/or wire installed in Raceway.

1.4 CUTTING AND PATCHING

A. Provide cutting and patching necessary to install the work specified herein. Patching shall match adjacent surfaces. Refer to Division 1, Cutting and Patching for specific directions.

B. No structural members shall be cut without prior approval of the Owner; such cutting shall be done in a manner directed by him.

C. Provide ceiling removal and replacement where work above ceilings is required. Replace ceiling components damaged in the process.

1.5 CLEANING, PROTECTING AND ADJUSTING

A. Cleaning

1. General cleaning requirements are specified in Division 1.
2. Upon completion of the work, clean the exterior surface of equipment, accessories, and trim installed. Clean, polish, and leave equipment, accessories, and trim in first-class condition.

B. Protection of Surfaces

1. Protect surfaces from damage during the construction period.
2. Provide plywood or similar material under equipment or materials stored on floors or roofs. Provide protection in areas where construction may damage surfaces.
3. Surfaces damaged during the construction shall be repaired or replaced at the cost of the Contractor at fault. The method or repairing or replacing the surface shall be approved by the Owner.

C. Protection of Services

1. Protect new and existing services from damage during the construction period.
2. Repair, replace, and maintain in service any new or existing utilities, facilities, or services (underground, overground, interior, or exterior) damaged, broken, or otherwise rendered inoperative during the course of construction.
3. Services damaged during the construction shall be replaced at the cost of the Contractor at fault. The method used in repairing, replacing, or maintain the services shall be approved by the Owner.

D. Protection of Equipment and Materials

1. Equipment and materials shall be stored in a manner that shall maintain an orderly, clean appearance. If stored on-site in open or unprotected areas, equipment and material shall be kept off the ground by means of pallets or racks, and covered with tarpaulins.
2. Equipment and material, if left unprotected and damaged, shall be repainted or otherwise refurbished at the discretion of the Owner. Equipment and material is subject to rejection and replacement if, in the opinion of the Owner or the manufacturer's engineering department, the equipment has deteriorated or been damaged to the extent that its immediate use or performance is questionable, or that its normal life expectancy has been curtailed.
3. During the construction period, protect equipment from damage and dirt.

PART 2 - EXECUTION

2.1 COMMON REQUIREMENTS FOR COMMUNICATIONS INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both communications equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Coordinate piping systems installed at a required slope.

F. Apply for detailed and specific information regarding the location of equipment as the final location may differ from that indicated on the drawings. Outlets, equipment or wiring improperly placed because of failure to obtain this information shall be relocated and re-installed without additional expense to the Owner. Determine the actual direction of door swings, so that local switches and other controls shall be installed at the lockside of doors, unless otherwise noted. Improperly located switches shall be relocated without additional expense to the Owner.

G. The design shall be subject to such revisions as may be necessary to overcome building obstructions. No changes shall be made in location of outlets or equipment without written consent of the Owner.

H. Unless otherwise mentioned or indicated, mounting heights of outlets are shown on the drawings or in the specification. Dimensions given shall be considered to be from center of outlet to finished floor.

I. Coordinate the location and elevation of all communications devices and fixtures with the architectural interior elevation plan and reflective ceiling plan prior to installation.

J. Properly rough in for the communications raceways and equipment under this contract and modify as required for coordination during the construction period.

K. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

L. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section “Penetration Firestopping.”

3.7 ENVIRONMENTAL AIR PLENUMS

A. In spaces over hung ceiling which are used for environmental air handling purposes as defined by Article 300.22C of the National Electric Code, power data and communications cable must be in conduit or of the type cable rated for air plenum use. Cable type and/or raceway is generally indicated on the drawings and specifications although the Contractor shall be responsible to clearly define ceiling space used for environmental air purposes.

END OF SECTION 270500

CONFIDENTIAL DOCUMENT

270526

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

270526

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
270526	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 270526 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes methods and materials for grounding systems and equipment.

1.3 DEFINITIONS

A. TMGB: Telecommunications Main Grounding Busbar

B. TGB: Telecommunications Grounding Busbar

C. TBB: Telecommunications Bonding Backbone

D. TBBIBC: Telecommunications Bonding Backbone Interconnecting Bonding Conductor

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Qualification Data: For testing agency and testing agency's field supervisor.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with UL 467 for grounding and bonding materials and equipment.

C. Comply with ANSI J-STD-607-A Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications and BICSI Telecommunications Distribution Methods Manual, latest edition for grounding and bonding installation and methods.

PART 2 - PRODUCTS

2.1 CONNECTORS AND COMPRESSION LUGS

A. Compression Lugs: Comply with BICSI Telecommunications Distribution Methods Manual (TDMM) and ANSI J-STD-607-A.

1. Compression lugs shall connect electrical wires to copper or tinned copper conductors or telecommunications equipment.
2. Compression lugs shall be manufactured from electroplated tinned copper and color coded per cable size.
3. Compression lugs for connections to TMGB or TGB's shall be two-hole lugs with holes spaced at either 5/8 inch or 1 inch per ANSI J-STD-607-A according to size of grounding conductor.
4. Provide stainless steel hardware complete with bolt, nut, and lock washer to fasten the two-hole ground lugs to the busbar.
5. Manufacturers: Subject compliance with requirements, provide products by one of the following.

    a. Chatsworth Products, Inc.
    b. Erico Eritech
    c. Panduit

6. Provide one-hole compression lugs to grounding conductors attached to telecommunications equipment including but not limited to equipment racks, frames, cable tray, conduit, lightning protectors, and other components as required. Where attachment is made to painted surfaces, remove paint to provide bright clean surface for bonding or provide paint piercing washers.

2.2 TELECOMMUNICATIONS GROUNDING BUSBARS

A. Provide UL listed TGB's as required per BICSI TDMM and ANSI J-STD-607-A.

B. All hole patterns on busbars shall accommodate two-hole lugs.

C. Construction

1. Busbars shall be 1/4 inch (6 mm) thick copper conforming to ASTM B187-C11000 and be electro-tin plated. Busbars shall have a predrilled pattern.
2. Insulators shall provide 2 inch (51 mm) standoff height and be manufactured of glass fiber reinforced nylon polyamide. Insulators shall conform to UL 94 VO for self-extinguishing material.
3. Brackets shall be 1/8 inch (3 mm) thick constructed of Type 304 stainless steel.
4. Fasteners shall be constructed of Type 304 stainless steel.

D. Standards and Safety Codes: Conform to the following:

1. UL 467 – Grounding and Bonding Equipment
2. NFPA 70, NEC

3. ANSI J-STD-607-A Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
4. ANSI/IEEE Standard 1100
5. ANSI T1.313

E. The TGB shall be provided with predrilled holes conforming to BICSI and ANSI J-STD-607-A standards. A minimum of ten (10) two-hole lug positions with 5/8" hole centers and a minimum of three (3) two-hole lug positions with 1" hole centers shall be provided on the TGB.

F. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. TGB

a. Erico Eritech model TGB-A18L10PT
b. Chatsworth Products, Inc.
c. Panduit Corp.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Provide solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.

B. Provide a telecommunications grounding and bonding system in accordance with the ANSI J-STD-607-A standard and Article 250 of the National Electrical Code and as described in the contract documents.

C. All communications and electronic safety and security equipment, equipment racks, cabinets, boxes, conduit, and metal raceways shall be grounded in accordance with the NEC and as shown on the drawings and specified herein.

D. All connections to apparatus and conduits shall be made with an approved type of solderless connector. Connectors shall be securely bolted or clamped to the equipment. All contact surfaces shall be thoroughly cleaned and bright before connections are made in order to ensure a good metal-to-metal contact.

E. Tie all grounding systems together at their origins as shown on the Drawings and as called for by the NEC.

F. Provide an insulated ground wire sized as shown, bonding the TMGB and the electric service grounding electrode.

G. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.

2. Connections to Structural Steel: Welded connectors where welding or exothermic welds are permitted within the building by project. Otherwise provide bolted or clamped connectors.

3.2 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

C. When terminal lugs are required on grounding conductors, install using positive compression type tool utilizing proper size fittings to accommodate lugs, for permanent tight connections. Box lugs and set screw lugs are not permitted.

D. Do not run ground wires in Ferrous metal conduit longer than 3 feet. If metal conduit use cannot be avoided, ground both ends of the conduit to the ground conductor.

E. Do not splice grounding conductors.

F. Bond the telecommunications ground buses if shown on drawings to the building steel using bonding connector listed for the purpose. Horizontal steel members may be used to bond to if they are welded to columns.

G. Ground wires required by the National Electrical Code shall be provided.

H. The metallic shield of all entrance cables, backbone cables, cable trays, racks, panels, and protectors shall be bonded to the TMGB with minimum #6 AWG green insulated wire.

I. Install all grounding conductors with sufficient slack to avoid breakage due to settlement or movement of conductors to attached points.

J. Do not make short 90 degree turns in any grounding conductor. Use a radius for making turns.

K. Ground all cable entrance protectors, primary protectors, and metallic cable sheaths used for communications outside plant cabling as close as practical to cabling point of entrance and route ground conductor to TMGB or closer approved ground.

L. Where required by code, provide bare copper grounding conductors in environmental air plenums or provide grounding conductors with plenum rated insulation with approval from the engineer. Where bare copper grounding conductors are used, provide green colored tape for identification at all connection points.

3.3 IDENTIFICATION

A. Provide cable label for all grounding conductors at connection points to busbars indicating the destination location of the grounding conductor.

B. Provide nameplate mounted above each busbar indicating the busbar is a TMGB or TGB.

C. Provide warning cable label per the requirements of ANSI J-STD-607A for each grounding and bonding conductor. Conductor shall be labeled as close as practical to its point of termination in a readable position. Warning label shall read: "IF THIS CONNECTOR OR CABLE IS LOOSE OR MUST BE REMOVED, PLEASE CALL THE BUILDING TELECOMMUNICATIONS MANAGER."

END OF SECTION 270526

CONFIDENTIAL DOCUMENT

270800

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

TESTING OF COMMUNICATIONS CABLING SYSTEMS

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
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The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

270800

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
270800	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 270800 - TESTING OF COMMUNICATIONS CABLING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This section describes the requirements for the testing of the technology system cabling plants including Category 6 systems, UTP backbones, and optical fiber systems.

B. Section includes:

1. Category 6 cable plant testing and documentation.
2. Fiber Optic System cabling plant testing and documentation.
3. Copper UTP backbone cabling plant testing and documentation.

C. Provide all labor, materials, tools, field-test instruments and equipment required for the complete testing, identification and administration of the work called for in the Contract Documents.

1.3 DEFINITIONS

A. OTDR: Optical Time Domain Reflectometer

B. NEXT: Near End Cross-Talk

C. ELFEXT: Equal Level Far End Cross Talk

D. ACR: Attenuation to Cross-Talk Ratio

E. UTP: Unshielded Twisted Pair

1.4 STANDARDS AND CODES

A. ANSI/TIA/EIA 568-B.2-1 Category 6 and ISO Class D.

B. ANSI/TIA/EIA 606a.

C. ISO-IEC 11801 2nd Edition and EN 50173 Class C and D: Permanent Link Channel.

D. ANSI/TIA/EIA 568B Category 3 and Category 6.

E. TIA Level IIE accuracy.

F. ANSI Z136.2 ANS for Safe Use of Optical Fiber Communication Systems Utilizing Laser Diode and LED Sources.

G. ANSI/EIA/TIA-455-50B, Light Launch Conditions for Long-Length Graded-Index Optical Fiber Spectral Attenuation Measurements.

H. ANSI/TIA/EIA-455-59A, Measurement of Fiber Point Discontinuities Using an OTDR.

I. ANSI/TIA/EIA-455-60A, Measurement of Fiber or Cable Length Using an OTDR.

J. ANSI/TIA/EIA-455-61A, Measurement of Fiber or Cable Attenuation Using an OTDR.

K. ANSI/TIA/EIA-526-7, Optical Power Loss Measurements of Installed Singlemode Fiber Cable Plant.

L. ANSI/TIA/EIA-526-14-A, Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant.

M. ANSI/TIA/EIA-568-B.1, Commercial Building Telecommunications Cabling Standard, Part 1, General Requirements.

N. ANSI/TIA/EIA-568-B-3, Optical Fiber Cabling Components Standard.

O. TIA/EIA TSB-140, Additional Guidelines for Field-Testing Length, Los and Polarity of Optical Fiber Cabling Systems.

P. ANSI/TIA/EIA-606-A, Administration Standard for Commercial Telecommunications Infrastructure, including the requirements specified by the customer, unless the customer specifies their own labeling requirements.

1.5 SUBMITTALS

A. Product Data: For copper and optical fiber cabling testing equipment and documentation reports. Include the following information:

1. Complete data sheet and specifications for all cable testing equipment to be used by the Contractor.
2. List of cable types equipment is designed to test.
3. List of test standards equipment will test to.
4. List of testing parameters equipment will support.
5. Letters from approved manufacturers of all components of the installed cabling plants to be tested and verified. The letter shall be an endorsement of the cable testing equipment for use with testing the specific products installed and approval for using cable testing equipment to verify performance and installation requirements for issuing product warranties. These letters shall be directly issued from the manufacturers on their letterhead to the approved cable testing equipment manufacturer.

B. Sample Test Reports: Provide a sample test report sheet for each type of cable test required to be performed. The sample test reports shall indicate the format and all test parameters that are required to be provided.

C. Equipment Calibration Certificates: Provide certificate indicating date and procedures used to calibrate all test equipment used. Provide verification that equipment has been calibrated according to manufacturer's recommendations.

D. Testing Procedures: Provide a description of cable testing procedures to be used for each type of cable test required. List applicable standards and methodologies to be implemented in the testing processes.

1.6 QUALITY ASSURANCE

A. Source Limitations: All cable tests of same type shall be performed by identical cable test equipment from the same manufacturer.

B. Independent Verification: Cabling test equipment shall be verified to comply with the TIA/EIA-568-B.2-1 standard by an independent third party agency.

C. Application Assurance Warranties: The entire cabling plant shall be warrantied as required by the approved manufacturers. The specified warranties shall require full repair or replacement of defective material and labor that does not perform to project specifications.

1.7 COORDINATION

A. Notify the Owner, Engineer, and Construction Manager a minimum of seven days prior to performing cable testing and provide a schedule indicating cables and locations that will be tested. The Owner or Engineer may observe testing at their discretion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Category 6 Test Equipment

1. Manufacturers: Subject to compliance with requirements, provide required cable testing and documentation with cable testing equipment by one of the following:

    a. Agilent Technologies Wire Scope 350
    b. Fluke Networks DSP-4300 or DTX Cable Analyzer
    c. JDSU LANTEK 6

B. Optical Fiber Cable Test Equipment

1. Manufacturers: Subject to compliance with requirements, provide required cable testing and documentation with cable testing equipment by one of the following:

a. Agilent Technologies
b. Fluke Networks
c. JDSU

2.2 OPTICAL FIBER CABLE TEST EQUIPMENT REQUIREMENTS

A. Optical loss test set (OLTS)

1. Multimode optical fiber light source

a. Provide dual LED light sources with central wavelengths of 850 nm (±30 nm) and 1300 nm (±20 nm)
b. Output power of -20 dBm minimum.
c. The light source shall meet the launch requirements of ANSI/EIA/TIA-455-50B, Method A. This launch condition can be achieved either within the field test equipment or by use of an external mandrel wrap (as described in clause 11 of ANSI/TIA/EIA-568-B.1) with a Category 1 light source.

2. Singlemode optical fiber light source

a. Provide dual laser light sources with central wavelengths of 1310 nm (±20 nm) and 1550 nm (±20 nm).
b. Output power of -10 dBm minimum.

3. Power Meter

a. Provide 850 nm, 1300/1310 nm, and 1550 nm wavelength test capability.
b. Power measurement uncertainty of ±0.25 dB.
c. Store reference power measurement.
d. Save at least 100 results in internal memory.
e. PC interface (serial or USB).

4. Optional length measurement

a. Use an OLTS that is capable of measuring the optical length of the fiber using time-of-flight techniques.

B. Optical Time Domain Reflectometer (OTDR)

1. Internal non-volatile memory and removable memory device with at least 16 MB capacity for results storage.
2. Serial and USB ports to transfer data to a PC.
3. Multimode OTDR

a. Wavelengths of 850 nm (± 20 nm) and 1300 nm (±20 nm).
b. Event deadzones of 1m maximum at 850 nm and 2 m maximum at 1300 nm.
c. Attenuation deadzones of 6 m maximum at 850 nm and 15 m maximum at 1300 nm.
d. Distance range not less than 2000 m.
e. Dynamic range at least 10 dB at 850 nm and 1300 nm.

4. Singlemode OTDR

    a. Wavelengths of 1310 nm (±20 nm) and 1550 nm (±20 nm).
    b. Event deadzones of 2 m maximum at 1310 nm and 2 m maximum at 1550 nm.
    c. Attenuation deadzones of 15 m maximum at 1310 nm and 15 m maximum at 1550 nm.
    d. Distance range not less than 10000 m.
    e. Dynamic range at least 10 dB at 1310 nm and 1550 nm.

C. Fiber Microscope

1. Magnification of 250X or 400X for endface inspection.
2. Use test equipment capable of saving and reporting the endface image.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Category 6 Installation: Field test requirements upon completion of the installation.

1. General Requirements

    a. Every cabling link in the installation shall be tested in accordance with the Telecommunications Industry Association (TIA) standard ANSI/TIA/EIA-568-B.1 (March 2001) Section 11.2: 100-Ohm twisted-pair transmission performance and field test requirements.
    b. One hundred percent of the installed cabling links must be tested and must pass the requirements of the standards mentioned above. Any failing link must be diagnosed and corrected. The corrective action shall be followed with a new test to prove that the corrected link meets the performance requirements. The final and passing result of the tests for all links shall be provided in the test results documentation in accordance with project requirements.
    c. Trained technicians who have successfully attended an appropriate training program and have obtained a certificate as proof thereof shall execute the tests. Appropriate training programs include, but are not limited to, installation certification programs provided by BICSI or the ACP (Association of Cabling Professionals).
    d. The test equipment (tester) shall comply with or exceed the accuracy requirements for enhanced level IIE (Level IIE) field testers as defined in TIA-568-B; Annex 1: Section 1.4. The tester including the appropriate interface adapter must meet the specified accuracy requirements. The accuracy requirements for the permanent link test configuration (baseline accuracy plus adapter contribution) are specified in Table 1.4 of Annex 1 of TIA/EIA-568-B.2. (Table 1.5 in this TIA document specifies the accuracy requirements for the Channel configuration.)
    e. The tester shall be within the calibration period recommended by the vendor in order to achieve the required measurement accuracy.

f. The tester interface adapters must be of high quality and the cable shall not show any twisting or kinking resulting from coiling and storing of the tester interface adapters. In order to deliver optimum accuracy, use a permanent link interface adapter for the tester that can be calibrated to extend the reference plane of the Return Loss measurement to the permanent link interface. The contractor shall provide proof that the interface has been calibrated within the period recommended by the vendor. To ensure that normal handling on the job does not cause measurable Return Loss change, the adapter cord cable shall not be of twisted-pair construction.

g. The Pass or Fail condition for the link-under-test is determined by the results of the required individual tests. Any Fail result yields a Fail for the link-under-test. In order to achieve an overall Pass condition, the results for each individual test parameter must Pass.

2. Performance Test Parameters

a. The test parameters for Category 6 are defined in TIA Cat 6 standard, which refers to the ANSI/TIA/EIA-568-B.2 standard. The test of each link shall contain all of the following parameters as detailed below. In order to pass the test, all measurements (at each frequency in the range from 1 MHz through 100 MHz) must meet or exceed the limit value determined in the above-mentioned standard.

1) Wire Map
2) Length
3) Insertion Loss (Attenuation)
4) NEXT Loss
5) PSNEXT Loss
6) ELFEXT Loss, pair-to-pair
7) PSELFEXT Loss
8) Return Loss
9) ACR
10) PSACR
11) Propagation Delay
12) Delay Skew

B. Optical Fiber Installation: Field test requirements upon completion of the installation.

1. General Requirements

a. Testing shall be carried out in accordance with this document. This includes testing the attenuation and polarity of the installed cable plant with an optical loss test set (OLTS) and the installed condition of the cabling system and its components with an optical time domain reflectometer (OTDR). The condition of the fiber endfaces shall also be verified.

b. Testing shall be performed on each cabling link (connector to connector).

c. Testing shall be performed on each cabling channel (equipment to equipment) that is identified by the owner.

1) Testing shall not include any active devices or passive devices within the link or channel other than cable, connectors, and splices, i.e. link attenuation does not include such devices as optical bypass switches, couplers, repeaters, or optical amplifiers.

d. All tests shall be documented including OLTS dual wavelength attenuation measurements for multimode and singlemode links and channels and OTDR traces and event tables for multimode and singlemode links and channels.

e. Trained technicians who have successfully attended an appropriate training program, which includes testing with an OLTS and an OTDR and have obtained a certificate as proof thereof shall execute the tests. These certificates may have been issued by any of the following organizations or an equivalent organization.

1) Manufacturer of the fiber optic cable and/or the fiber optic connectors.
2) Manufacturer of the test equipment used for the field certification.
3) Training organizations (e.g. BICSI, A Telecommunications Association headquarters in Tampa, Florida; ACP (Association of Cabling Professionals) Cabling Business Institute located in Dallas, Texas)

f. All outlets, cables, patch panels and associated components shall be fully assembled and labeled prior to field-testing. Any testing performed on incomplete systems shall be redone on completion of the work.

2. Optical Fiber Cable Testing Parameters

a. Field-test instruments shall have the latest software and firmware installed.

b. Link and channel test results from the OLTS and OTDR shall be recorded in the test instrument upon completion of each test for subsequent uploading to a PC in which the administrative documentation (reports) may be generated.

c. Fiber endfaces shall be inspected at 250X or 400 X magnifications. 250X magnification is suitable for inspecting multimode and singlemode fibers. 400X magnification may be used for detailed examination of singlemode fibers. Scratched, pitted or dirty connectors shall be diagnosed and corrected.

d. Testing shall be performed on each cabling segment (connector to connector).

e. Testing of the cabling shall be performed using high-quality test cords of the same fiber type as the cabling under test. The test cords for OLTS testing shall be between 1 m and 5 m in length. The test cords for OTDR testing shall be approximately 100 m for the launch cable and at least 25 m for the receive cable.

f. Optical loss testing

1) Backbone link

a) Multimode backbone links shall be tested at 850 nm and 1300 nm in accordance with ANSI/EIA/TIA-526-14A, Method B, One Reference Jumper or the equivalent method.
b) Singlemode backbone links shall be tested at 1310 nm and 1550 nm in accordance with ANSI/TIA/EIA-526-7, Method A.1, One Reference Jumper or the equivalent method.

c) Link attenuation does not include any active devices or passive devices other than cable, connectors, and splices, i.e. link attenuation does not include such devices as optical bypass switches, couplers, repeaters, or optical amplifiers.
d) Use the One Reference Jumper Method specified by ANSI/TIA/EIA-526-14A, Method B and ANSI/TIA/EIA-526-7, Method A.1 or the equivalent method. The user shall follow the procedures established by these standards or application notes to accurately conduct performance testing.

g. OTDR Testing

1) Backbone links shall be tested at the appropriate operating wavelengths for anomalies and to ensure uniformity of cable attenuation and connector insertion loss.

a) Backbone multimode: 850 nm and 1300 nm
b) Backbone singlemode: 1310 nm and 1550 nm

2) Each fiber link and channel shall be tested in one direction.
3) A launch cable shall be installed between the OTDR and the first link connection.
4) A receive cable shall be installed after the last link connection.

h. Magnified Endface Inspection

1) Fibers shall be inspected at 250X or 400X magnification. 250X magnification is suitable for inspecting multimode and singlemode fibers. 400X magnification may be used for detailed examination of singlemode fibers.

i. Length Measurement

1) The length of each fiber shall be recorded.
2) It is preferable that the optical length be measured using an OLTS or OTDR.

j. Polarity Testing

1) Paired duplex fibers in multi-fiber cables shall be tested to verify polarity in accordance with subclause 10.3 of ANSI/TIA/EIA-568-B.1. The polarity of the paired duplex fibers shall be verified using an OLTS.

3.2 TEST RESULT DOCUMENTATION

A. Category 6 Test Result Documentation

1. The test results information for each link shall be recorded in the memory of the field tester upon completion of the test.

2. The test results recorded saved by the tester shall be transferred into a Windows-based database utility that allows for the maintenance, inspection and archiving of these test records. The measurement results must be transferred to the PC unaltered, i.e. "as saved in the tester" at the end of each test and that these results cannot be modified at a later time.
3. The database for the completed job shall be stored and delivered on CD-ROM including the software tools required to view, inspect, and print any selection of test reports. Provide two (2) CD-ROM sets with all required test results to Engineer and Owner for approval.
4. A paper copy of the test results shall be provided that lists all the links that have been tested with the following summary information:

    a. The identification of the link in accordance with the naming convention defined in the overall system documentation.
    b. The overall Pass/Fail evaluation of the link-under-test including the NEXT Headroom (overall worst case) number.
    c. The date and time the test results were saved in the memory of the tester.

5. General information to be provided in the electronic data base with the test results information for each link:

    a. The identification of the Owner site as specified by the end-user.
    b. The identification of the link in accordance with the naming convention defined in the overall system documentation.
    c. The overall Pass/Fail evaluation of the link-under-test.
    d. The name of the standard selected to execute the stored test results.
    e. The cable type and the value of NVP used for length calculations.
    f. The date and time the test results were saved in the memory of the tester.
    g. The brand name, model and serial number of the tester.
    h. The identification of the tester interface.
    i. The revision of the tester software and the revision of the test standards database in the tester.
    j. The test results information must contain information on each of the required test parameters that are listed in this Section.

6. The detailed test results data to be provided in the electronic database for each tested link must contain the following information:

    a. For each of the frequency-dependent test parameters, the value measured at every frequency during the test is stored. In this case, the PC-resident database program must be able to process the stored results to display and print a color graph of the measured parameters. The PC-resident software must also provide a summary numeric format in which some critical information is provided numerically as defined by the summary results (minimum numeric test results documentation) as outlined above for each of the test parameters.

        1) Length: Identify the wire-pair with the shortest electrical length, the value of the length rounded to the nearest 0.1 m (1) and the test limit value.
        2) Propagation delay: Identify the pair with the shortest propagation delay, the value measured in nanoseconds (ns) and the test limit value.

3) Delay Skew: Identify the pair with the largest value for delay skew, the value calculated in nanoseconds (ns) and the test limit value.
4) Attenuation: Minimum test results documentation for the worst pair.
5) Return Loss: Minimum test results documentation for the worst pair as measured from each end of the link.
6) NEXT, ELFEXT, ACR: Minimum test results documentation for the worst pair combination as measured from each end of the link.
7) PSNEXT, PSELFEXT, AND PSACR: Minimum test results documentation for the worst pair as measured from each end of the link.

B. Optical Fiber Test Result Documentation

1. Test results saved within the field-test instrument shall be transferred into a Windows-based database utility that allows for the maintenance, inspection and archiving of the test records. These test records shall be uploaded to the PC unaltered, i.e. "as saved in the field-test instrument". The file format, CSV (comma separated value), does not provide adequate protection of these records and shall not be used.

2. The test results documentation shall be available for inspection by the Owner or the Owner's representative during the installation period and shall be passed to the Owner's representative within 5 working days of completion of tests on cabling served by a telecommunications room or of backbone cabling. The installer shall retain a copy to aid preparation of as-built information.

3. The database for the complete project shall be stored and delivered on two sets of CD-ROM's prior to Owner acceptance of the building. This CD-ROM shall include the software tools required to view, inspect, and print any selection of the test reports.

4. Circuit IDs reported by the test instrument should match the specified label ID.

5. The detailed test results documentation data is to be provided in an electronic database for each optical fiber and shall contain the following information:

a. The identification of the Owner site as specified by the end-user.
b. The name of the test limit selected to execute the stored test results.
c. The name of the personnel performing the test.
d. The date and time the test results were saved in the memory of the tester.
e. The manufacturer, model and serial number of the field-test instrument.
f. The version of the test software and the version of the test limit database held within the test instrument.
g. The fiber identification number.
h. The length for each optical fiber.

1) Optionally the index of refraction used for length calculation when using a length capable OLTS.

i. Test results to include OLTS attenuation link and channel measurements at the appropriate wavelength(s) and the margin (difference between the measured attenuation and the test limit value).
j. Test results to include OTDR link and channel traces and event tables at the appropriate wavelength(s).

k. The length for each optical fiber as calculated by the OTDR.
l. The overall Pass/Fail evaluation of the link-under-test for OLTS and OTDR measurements.

END OF SECTION 270800

CONFIDENTIAL DOCUMENT

271500

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

COMMUNICATIONS HORIZONTAL CABLING

ImmuCell
Portland, ME

Reviews / Approvals

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The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

271500

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
271500	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 271500 - COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pathways.
2. UTP cabling.
3. Telecommunications outlet/connectors.
4. Cabling system identification products.
5. Cable management system.

B. Related Sections:

1. Division 28 Section "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

1.3 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.

B. Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.

C. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

D. EMI: Electromagnetic interference.

E. IDC: Insulation displacement connector.

F. LAN: Local area network.

G. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.

H. RCDD: Registered Communications Distribution Designer.

I. UTP: Unshielded twisted pair.

1.4 HORIZONTAL CABLING DESCRIPTION

A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called "permanent link," a term that is used in the testing protocols.

1. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
2. Bridged taps and splices shall not be installed in the horizontal cabling.

B. The maximum allowable horizontal cable length is 295 feet (90 m). This maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) to the workstation equipment. The maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) in the horizontal cross-connect.

1.5 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-B.1, when tested according to test procedures of this standard.

1.6 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
3. Cabling administration drawings and printouts.

C. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

D. Source quality-control reports.

E. Field quality-control reports.

F. Maintenance Data: For splices and connectors to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings**,** Cabling Administration Drawings, and field testing program development by an RCDD.

2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.
3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

B. Testing Agency Qualifications: An NRTL.

1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

C. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.

F. Grounding: Comply with ANSI-J-STD-607-A.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test each pair of UTP cable for open and short circuits.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.10 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

1.11 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Device Plates: One of each type.

PART 2 - PRODUCTS

2.1 PATHWAYS

A. General Requirements: Comply with TIA/EIA-569-A.

B. Cable Support: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.

1. Support brackets with cable tie slots for fastening cable ties to brackets.
2. Lacing bars, spools, J-hooks, and D-rings.
3. Straps and other devices.

C. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." Flexible metal conduit shall not be used.

1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

2.2 UTP CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Belden CDT Inc.; Electronics Division.
2. Berk-Tek; a Nexans company.
3. CommScope, Inc.
4. Draka USA.
5. Genesis Cable Products; Honeywell International, Inc.
6. KRONE Incorporated.
7. Mohawk; a division of Belden CDT.
8. Nordex/CDT; a subsidiary of Cable Design Technologies.
9. Superior Essex Inc.
10. SYSTIMAX Solutions; a CommScope, Inc. brand.
11. 3M.
12. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

B. Description: 100-ohm, 4-pair UTP, formed into 25-pair, binder groups covered with a blue thermoplastic jacket.

1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA/EIA-568-B.1 for performance specifications.

3. Comply with TIA/EIA-568-B.2, Category 6.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:

    a. Communications, General Purpose: Type CM, CMG, CMP, **or** CMR.
    b. Communications, Plenum Rated: Type CMP, complying with NFPA 262.
    c. Communications, Limited Purpose: Type CMX, CMP, CMR, CM, or CMG.

2.3 TELECOMMUNICATIONS OUTLET/CONNECTORS

A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-B.1.

2.4 IDENTIFICATION PRODUCTS

A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

B. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

2.5 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test UTP cables on reels according to TIA/EIA-568-B.1.

C. Factory test UTP cables according to TIA/EIA-568-B.2.

D. Cable will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 WIRING METHODS

A. Wiring Method: Install cables in raceways except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.2 INSTALLATION OF PATHWAYS

A. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.

B. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.

C. Install manufactured conduit sweeps and long-radius elbows whenever possible.

D. Pathway Installation in Communications Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
2. Secure conduits to backboard when entering room from overhead.
3. Extend conduits 3 inches (76 mm) above finished floor.
4. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

3.3 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. Consolidation points may be used only for making a direct connection to telecommunications outlet/connectors:

    a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.
    b. Locate consolidation points for UTP at least 49 feet (15 m) from communications equipment room.

5. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
6. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
7. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.

8. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
9. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
10. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
11. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
12. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.
2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

D. Group connecting hardware for cables into separate logical fields.

E. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-A for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: No requirement.

b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.4 FIRESTOPPING

A. Comply with requirements in Division 07 Section "Penetration Firestopping."

B. Comply with TIA/EIA-569-A, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.5 IDENTIFICATION

A. Cable and Wire Identification:

1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
3. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

B. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.

1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Visually inspect UTP and jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.

2. Visually confirm Category 6, marking of outlets, cover plates, outlet/connectors, and patch panels.
3. Visually inspect cable placement, cable termination and labeling of all components.
4. UTP Performance Tests:

    a. Test for each outlet. Perform the following tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.2:

        1) Wire map.
        2) Length (physical vs. electrical, and length requirements).
        3) Insertion loss.
        4) Near-end crosstalk (NEXT) loss.
        5) Power sum near-end crosstalk (PSNEXT) loss.
        6) Equal-level far-end crosstalk (ELFEXT).
        7) Power sum equal-level far-end crosstalk (PSELFEXT).
        8) Return loss.
        9) Propagation delay.
        10) Delay skew.

D. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

E. End-to-end cabling will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION 271500

CONFIDENTIAL DOCUMENT

275116

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

PUBLILC ADDRESS AND MASS NOTIFICATION SYSTEMS

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

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Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
275116	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 275116 - PUBLIC ADDRESS AND MASS NOTIFICATION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Preamplifiers.
2. Power amplifiers.
3. Transfer to standby amplifier.
4. Microphones.
5. Volume limiter/compressors.
6. Control console.
7. Equipment cabinet.
8. Equipment rack.
9. Telephone paging adapters.
10. Tone generator.
11. Monitor panel.
12. Loudspeakers.
13. Noise-operated gain controllers.
14. Microphone and headphone outlets.
15. Battery backup power unit.
16. Conductors and cables.
17. Raceways.

1.3 DEFINITIONS

A. Channels: Separate parallel signal paths, from sources to loudspeakers or loudspeaker zones, with separate amplification and switching that permit selection between paths for speaker alternative program signals.

B. VU: Volume unit.

C. Zone: Separate group of loudspeakers and associated supply wiring that may be arranged for selective switching between different channels.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design supports and seismic restraints for control consoles, equipment cabinets and racks, and components, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Seismic Performance: Supports and seismic restraints for control consoles, equipment cabinets and racks, and components shall withstand the effects of earthquake motions determined according to SEI/ASCE 7

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For supports and seismic restraints for control consoles, equipment cabinets and racks, and components. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, required clearances, method of field assembly, components, and location and size of each field connection.
2. Console layouts.
3. Control panels.
4. Rack arrangements.
5. Calculations: For sizing backup battery.
6. Wiring Diagrams: For power, signal, and control wiring.

    a. Identify terminals to facilitate installation, operation, and maintenance.
    b. Single-line diagram showing interconnection of components.
    c. Cabling diagram showing cable routing.

C. Delegated-Design Submittal: For supports and seismic restraints for control consoles, equipment cabinets and racks, and components indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of supports and seismic restraints for control consoles, equipment cabinets and racks, and components.

D. Qualification Data: For qualified Installer and testing agency.

E. Seismic Qualification Certificates: For control consoles, equipment cabinets and racks, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

F. Field quality-control reports.

G. Operation and Maintenance Data: For public address and mass notification systems to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

1. Personnel certified by NICET as Audio Systems Level II Technician.

B. Testing Agency Qualifications: Qualified agency, with the experience and capability to conduct testing indicated.

1. Testing Agency's Field Supervisor: Currently certified by NICET at Level III to supervise on-site testing.

C. Source Limitations: Obtain public address and mass notification systems from single source from single manufacturer.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with NFPA 70.

1.7 COORDINATION

A. Coordinate layout and installation of system components and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Alpha Communications.
2. Altec Lansing Technologies, Inc.
3. Atlas Sound LP.
4. Bogen Communications, Inc.

5. Dukane Communication Systems; part of GE Infrastructure, Security.
6. Edwards Signaling & Security Systems; part of GE Infrastructure, Security.
7. Electro-Voice; Telex Communications, Inc.
8. Federal Signal Corporation; Electrical Products Division.
9. Peavey Electronics.
10. Rauland-Borg Corporation.
11. Whelen Engineering Company, Inc.

2.2 FUNCTIONAL DESCRIPTION OF SYSTEM

A. System Functions:

1. Selectively connect any zone to any available signal channel.
2. Selectively control sound from microphone outlets and other inputs.
3. "All-call" feature shall connect the all-call sound signal simultaneously to all zones regardless of zone or channel switch settings.
4. Telephone paging adapter shall allow paging by dialing an extension from any local telephone instrument and speaking into the telephone.
5. Produce a program-signal tone that is amplified and sounded over all speakers, overriding signals currently being distributed.
6. Reproduce high-quality sound that is free of noise and distortion at all loudspeakers at all times during equipment operation including standby mode with inputs off; output free of nonuniform coverage of amplified sound.

2.3 GENERAL EQUIPMENT AND MATERIAL REQUIREMENTS

A. Compatibility of Components: Coordinate component features to form an integrated system. Match components and interconnections for optimum performance of specified functions.

B. Equipment: Comply with UL 813. Equipment shall be modular, using solid-state components, and fully rated for continuous duty unless otherwise indicated. Select equipment for normal operation on input power usually supplied at 110 to 130 V, 60 Hz.

C. Equipment Mounting: Where rack, cabinet, or console mounting is indicated, equipment shall be designed to mount in a 19-inch (483-mm) housing complying with TIA/EIA-310-D.

D. Weather-Resistant Equipment: Listed and labeled by a qualified testing agency for duty outdoors or in damp locations.

2.4 PREAMPLIFIERS

A. Preamplifier: Integral to power amplifier.

B. Output Power: Plus 4 dB above 1 mW at matched power-amplifier load.

C. Total Harmonic Distortion: Less than 1 percent.

D. Frequency Response: Within plus or minus 2 dB from 20 to 20,000 Hz.

E. Input Jacks: Minimum of two. One matched for low-impedance microphone; the other matchable to cassette deck, CD player, or radio tuner signals without external adapters.

F. Minimum Noise Level: Minus 55 dB below rated output.

G. Controls: On-off, input levels, and master gain.

2.5 POWER AMPLIFIERS

A. Mounting: Rack.

B. Output Power: 70-V balanced line. 80 percent of the sum of wattage settings of connected for each station and speaker connected in all-call mode of operation, plus an allowance for future stations.

C. Total Harmonic Distortion: Less than 3 percent at rated power output from 50 to 12,000 Hz.

D. Minimum Signal-to-Noise Ratio: 60 dB, at rated output.

E. Frequency Response: Within plus or minus 2 dB from 50 to 12,000 Hz.

F. Output Regulation: Less than 2 dB from full to no load.

G. Controls: On-off, input levels, and low-cut filter.

H. Input Sensitivity: Matched to preamplifier and to provide full-rated output with sound-pressure level of less than 10 dynes/sq. cm impinging on speaker microphone or handset transmitter.

2.6 MICROPHONES

A. Paging Microphone:

1. Type: Dynamic, with cardioid polar characteristic.
2. Impedance: 150 ohms.
3. Frequency Response: Uniform, 50 to 14,000 Hz.
4. Output Level: Minus 58 dB, minimum.
5. Finish: Satin chrome.
6. Cable: C25J.
7. Mounting: Desk stand with integral-locking, press-to-talk switch.

2.7 VOLUME LIMITER/COMPRESSOR

A. Minimum Performance Requirements:

1. Frequency Response: 45 to 15,000 Hz, plus or minus 1 dB minimum.
2. Signal Reduction Ratio: At least a 10:1 and 5:1 selectable capability.
3. Distortion: 1 percent, maximum.
4. Rated Output: Minimum of plus 14 dB.

5. Inputs: Minimum of two inputs with variable front-panel gain controls and VU or decibel meter for input adjustment.
6. Rack mounting.

2.8 CONTROL CONSOLE

A. Cabinet: Modular, desktop complying with TIA/EIA-310-D.

B. Housing: Steel, 0.0478 inch (1.2 mm) minimum, with removable front and rear panels. Side panels are removable for interconnecting side-by-side mounting.

C. Panel for Equipment and Controls: Rack mounted.

D. Controls:

1. Switching devices to select signal sources for distribution channels.
2. Program selector switch to select source for each program channel.
3. Switching devices to select zones for paging.
4. All-call selector switch.

E. Indicators: A visual annunciation for each distribution channel to indicate source being used.

F. Self-Contained Power and Control Unit: A single assembly of basic control, electronics, and power supply necessary to accomplish specified functions.

G. Spare Positions: 20 percent spare zone control and annunciation positions on console.

H. Microphone jack.

2.9 EQUIPMENT RACK

A. Racks: 19 inches (483 mm) standard, complying with TIA/EIA-310-D.

B. Power-Supply Connections: Compatible plugs and receptacles.

C. Enclosure Panels: Ventilated rear and sides and solid top. Use louvers in panels to ensure adequate ventilation.

D. Finish: Uniform, baked-enamel factory finish over rust-inhibiting primer.

E. Power-Control Panel: On front of equipment housing, with master power on-off switch and pilot light; and with socket for 5-A cartridge fuse for rack equipment power.

F. Service Light: At top rear of rack with an adjacent control switch.

G. Vertical Plug Strip: Grounded receptacles, 12 inches (300 mm) o.c.; the full height of rack.

H. Maintenance Receptacles: Duplex convenience outlets supplied independent of vertical plug strip and located in front and bottom rear of rack.

I. Spare Capacity: 20 percent in rack for future equipment.

2.10 TELEPHONE PAGING ADAPTER

A. Adapters shall accept voice signals from telephone extension dialing access and automatically provide amplifier input and program override for preselected zones.

1. Minimum Frequency Response: Flat, 200 to 2500 Hz.
2. Impedance Matching: Adapter matches telephone line to public address equipment input.
3. Rack mounting.

2.11 TONE GENERATOR

A. Generator shall provide clock and program interface with public address and mass notification system.

B. Signals: Minimum of seven distinct, audible signal types including wail, warble, high/low, alarm, repeating and single-stroke chimes, and tone.

C. Pitch Control: Chimes and tone.

D. Volume Control: All outputs.

E. Activation-Switch Network: Establishes priority and hierarchy of output signals produced by different activation setups.

F. Mounting: Rack.

2.12 MONITOR PANEL

A. Monitor power amplifiers.

B. Components: VU or dB meter, speaker with volume control, and multiple-position rotary selector switch.

C. Selector Switch and Volume Control: Selective monitoring of output of each separate power amplifier via VU or dB meter and speaker.

D. Mounting: Rack.

2.13 LOUDSPEAKERS

A. Cone-Type Loudspeakers:

1. Minimum Axial Sensitivity: 91 dB at one meter, with 1-W input.
2. Frequency Response: Within plus or minus 3 dB from 50 to 15,000 Hz.
3. Size: 8 inches (200 mm) with 1-inch (25-mm) voice coil and minimum 5-oz. (140-g) ceramic magnet.

4. Minimum Dispersion Angle: 100 degrees.
5. Rated Output Level: 10 W.
6. Matching Transformer: Full-power rated with four taps. Maximum insertion loss of 0.5 dB.
7. Surface-Mounting Units: Ceiling, wall, or pendant mounting, as indicated, in steel back boxes, acoustically dampened. Front face of at least 0.0478-inch (1.2-mm) steel and whole assembly rust proofed and shop primed for field painting.
8. Flush-Ceiling-Mounting Units: In steel back boxes, acoustically dampened. Metal ceiling grille with white baked enamel.

B. Horn-Type Loudspeakers:

1. Type: Single-horn units, double-reentrant design, with minimum full-range power rating of 15 W.
2. Matching Transformer: Full-power rated with four standard taps. Maximum insertion loss of 0.5 dB.
3. Frequency Response: Within plus or minus 3 dB from 250 to 12,000 Hz.
4. Dispersion Angle: 130 by 110 degrees.
5. Mounting: Integral bracket.
6. Units in Hazardous (Classified) Locations: Listed and labeled for environment in which they are located.

2.14 NOISE-OPERATED GAIN CONTROLLER

A. Gain controller shall be designed to continuously sense space noise level and automatically adjust signal level to local speakers.

B. Frequency Response: 20 to 20,000 Hz, plus or minus 1 dB.

C. Level Adjustment Range: 20 dB minimum.

D. Maximum Distortion: 1 percent.

E. Control: Permits adjustment of sensing level of device.

2.15 OUTLETS

A. Volume Attenuator Station: Wall-plate-mounted autotransformer type with paging priority feature.

1. Wattage Rating: 10 W unless otherwise indicated.
2. Attenuation per Step: 3 dB, with positive off position.
3. Insertion Loss: 0.4 dB maximum.
4. Attenuation Bypass Relay: Single pole, double throw. Connected to operate and bypass attenuation when all-call, paging, program signal, or prerecorded message features are used. Relay returns to normal position at end of priority transmission.
5. Label: "PA Volume."

B. Microphone Outlet: Three-pole, polarized, locking-type, microphone receptacles in single-gang boxes. Equip wall outlets with brushed stainless-steel device plates. Equip floor outlets with gray tapered rubber or plastic cable nozzles and fixed outlet covers.

C. Headphone Outlet (for the Hearing Impaired): Microphone receptacles in single-gang boxes. Equip wall outlets with brushed stainless-steel device plates. Equip floor outlets with gray tapered rubber or plastic cable nozzles and fixed-outlet covers.

2.16 BATTERY BACKUP POWER UNIT

A. Unit shall be rack mounted, consisting of time-delay relay, sealed lead-calcium battery, battery charger, on-off switch, "normal" and "emergency" indicating lights, and adequate capacity to supply maximum equipment power requirements for one hour of continuous full operation.

B. Unit shall supply public address equipment with 12- to 15-V dc power automatically during an outage of normal 120-V ac power.

C. Battery shall be on float charge when not supplying system and to transfer automatically to supply system after three to five seconds of continuous outage of normal power, as sensed by time-delay relay.

D. Unit shall automatically retransfer system to normal supply when normal power has been reestablished for three to five seconds continuously.

2.17 CONDUCTORS AND CABLES

A. Jacketed, twisted pair and twisted multipair, untinned solid copper.

1. Insulation for Wire in Conduit: Thermoplastic, not less than 1/32 inch (0.8 mm) thick.
2. Microphone Cables: Neoprene jacketed, not less than 2/64 inch (0.8 mm) thick, over shield with filled interstices. Shield No. 34 AWG, tinned, soft-copper strands formed into a braid or approved equivalent foil. Shielding coverage on conductors is not less than 60 percent.
3. Plenum Cable: Listed and labeled for plenum installation.

2.18 RACEWAYS

A. Conduit and Boxes: Comply with Division 26 Section "Raceway and Boxes for Electrical Systems."

1. Outlet boxes shall be not less than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

PART 3 - EXECUTION

3.1 WIRING METHODS

A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters**,** Conceal raceway and cables except in unfinished spaces.

1. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."

B. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.2 INSTALLATION OF RACEWAYS

A. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.

B. Install manufactured conduit sweeps and long-radius elbows whenever possible.

3.3 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Cable Installation Requirements:

1. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at outlets and terminals.
2. Splices, Taps, and Terminations: Arrange on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Cables may not be spliced.
3. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
4. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
5. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
6. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used.

C. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.

2. Suspend speaker cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceiling by cable supports not more than 60 inches (1524 mm) apart.
3. Cable shall not be run through structural members or be in contact with pipes, ducts, or other potentially damaging items.

D. Separation of Wires: Separate speaker-microphone, line-level, speaker-level, and power wiring runs. Install in separate raceways or, where exposed or in same enclosure, separate conductors at least 12 inches (300 mm) apart for speaker microphones and adjacent parallel power and telephone wiring. Separate other intercommunication equipment conductors as recommended by equipment manufacturer.

3.4 INSTALLATION

A. Match input and output impedances and signal levels at signal interfaces. Provide matching networks where required.

B. Identification of Conductors and Cables: Color-code conductors and apply wire and cable marking tape to designate wires and cables so they identify media in coordination with system wiring diagrams.

C. Equipment Cabinets and Racks:

1. Group items of same function together, either vertically or side by side, and arrange controls symmetrically. Mount monitor panel above the amplifiers.
2. Arrange all inputs, outputs, interconnections, and test points so they are accessible at rear of rack for maintenance and testing, with each item removable from rack without disturbing other items or connections.
3. Blank Panels: Cover empty space in equipment racks so entire front of rack is occupied by panels.

D. Volume Limiter/Compressor: Equip each zone with a volume limiter/compressor. Install in central equipment cabinet. Arrange to provide a constant input to power amplifiers.

E. Wall-Mounted Outlets: Flush mounted.

F. Floor-Mounted Outlets: Conceal in floor and install cable nozzles through outlet covers. Secure outlet covers in place. Trim with carpet in carpeted areas.

G. Conductor Sizing: Unless otherwise indicated, size speaker circuit conductors from racks to loudspeaker outlets not smaller than No. 18 AWG and conductors from microphone receptacles to amplifiers not smaller than No. 22 AWG.

H. Weatherproof Equipment: For units that are mounted outdoors, in damp locations, or where exposed to weather, install consistent with requirements of weatherproof rating.

I. Speaker-Line Matching Transformer Connections: Make initial connections using tap settings indicated on Drawings.

J. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.5 GROUNDING

A. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

B. Signal Ground Terminal: Locate at main equipment cabinet. Isolate from power system and equipment grounding.

C. Install grounding electrodes as specified in Division 26 Section "Grounding and Bonding for Electrical Systems."

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Tests and Inspections:

1. Schedule tests with at least seven days' advance notice of test performance.
2. After installing public address and mass notification systems and after electrical circuitry has been energized, test for compliance with requirements.
3. Operational Test: Perform tests that include originating program and page messages at microphone outlets, preamplifier program inputs, and other inputs. Verify proper routing and volume levels and that system is free of noise and distortion.
4. Signal-to-Noise Ratio Test: Measure signal-to-noise ratio of complete system at normal gain settings as follows:

    a. Disconnect microphone at connector or jack closest to it and replace it in the circuit with a signal generator using a 1000-Hz signal. Replace all other microphones at corresponding connectors with dummy loads, each equal in impedance to microphone it replaces. Measure signal-to-noise ratio.
    b. Repeat test for each separately controlled zone of loudspeakers.
    c. Minimum acceptance ratio is 50 dB.

5. Distortion Test: Measure distortion at normal gain settings and rated power. Feed signals at frequencies of 50, 200, 400, 1000, 3000, 8000, and 12,000 Hz into each preamplifier channel. For each frequency, measure distortion in the paging and all-call amplifier outputs. Maximum acceptable distortion at any frequency is 3 percent total harmonics.
6. Acoustic Coverage Test: Feed pink noise into system using octaves centered at 500 and 4000 Hz. Use sound-level meter with octave-band filters to measure level at five locations in each zone. For spaces with seated audiences, maximum permissible variation in level is plus or minus 2 dB. In addition, the levels between locations in same zone and between locations in adjacent zones must not vary more than plus or minus 3 dB.
7. Power Output Test: Measure electrical power output of each power amplifier at normal gain settings of 50, 1000, and 12,000 Hz. Maximum variation in power output at these frequencies must not exceed plus or minus 1 dB.

8. Signal Ground Test: Measure and report ground resistance at pubic address equipment signal ground. Comply with testing requirements specified in Division 26 Section "Grounding and Bonding for Electrical Systems."

C. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified. Prepare a list of final tap settings of paging speaker-line matching transformers.

D. Public address and mass notification systems will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

1. Include a record of final speaker-line matching transformer-tap settings, and signal ground-resistance measurement certified by Installer.

3.7 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements.
2. Complete installation and startup checks according to manufacturer's written instructions.

3.8 ADJUSTING

A. On-Site Assistance: Engage a factory-authorized service representative to provide on-site assistance in adjusting sound levels, resetting transformer taps, and adjusting controls to meet occupancy conditions.

B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the public address and mass notification systems and equipment.

END OF SECTION 275116

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280500

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

ImmuCell

Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

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280500

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
280500	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 280500 - COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Cutting and Patching.
2. Cleaning, Protecting and Adjusting.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

C. Wiring: Cable and/or wire installed in Raceway.

1.4 CUTTING AND PATCHING

A. Provide cutting and patching necessary to install the work specified herein. Patching shall match adjacent surfaces. Refer to Division 1, Cutting and Patching for specific directions.

B. No structural members shall be cut without prior approval of the Owner; such cutting shall be done in a manner directed by him.

C. Provide ceiling removal and replacement where work above ceilings is required. Replace ceiling components damaged in the process.

1.5 CLEANING, PROTECTING AND ADJUSTING

A. Cleaning

1. General cleaning requirements are specified in Division 1.
2. Upon completion of the work, clean the exterior surface of equipment, accessories, and trim installed. Clean, polish, and leave equipment, accessories, and trim in first-class condition.

B. Protection of Surfaces

1. Protect new and existing surfaces from damage during the construction period.
2. Provide plywood or similar material under equipment or materials stored on floors or roofs. Provide protection in areas where construction may damage surfaces.
3. Surfaces damaged during the construction shall be repaired or replaced at the cost of the Contractor at fault. The method or repairing or replacing the surface shall be approved by the Owner.

C. Protection of Services

1. Protect new and existing services from damage during the construction period.
2. Repair, replace, and maintain in service any new or existing utilities, facilities, or services (underground, overground, interior, or exterior) damaged, broken, or otherwise rendered inoperative during the course of construction.
3. Services damaged during the construction shall be replaced at the cost of the Contractor at fault. The method used in repairing, replacing, or maintain the services shall be approved by the Owner.

D. Protection of Equipment and Materials

1. Equipment and materials shall be stored in a manner that shall maintain an orderly, clean appearance. If stored on-site in open or unprotected areas, equipment and material shall be kept off the ground by means of pallets or racks, and covered with tarpaulins.
2. Equipment and material, if left unprotected and damaged, shall be repainted or otherwise refurbished at the discretion of the Owner. Equipment and material is subject to rejection and replacement if, in the opinion of the Owner or the manufacturer's engineering department, the equipment has deteriorated or been damaged to the extent that its immediate use or performance is questionable, or that its normal life expectancy has been curtailed.
3. During the construction period, protect equipment from damage and dirt.

PART 2 - EXECUTION

2.1 COMMON REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both communications equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Coordinate piping systems installed at a required slope.

F. Apply for detailed and specific information regarding the location of equipment as the final location may differ from that indicated on the drawings. Outlets, equipment or wiring improperly placed because of failure to obtain this information shall be relocated and re-installed without additional expense to the Owner. Determine the actual direction of door swings, so that local switches and other controls shall be installed at the lock side of doors, unless otherwise noted. Improperly located switches shall be relocated without additional expense to the Owner.

G. The design shall be subject to such revisions as may be necessary to overcome building obstructions. No changes shall be made in location of outlets or equipment without written consent of the Owner.

H. Unless otherwise mentioned or indicated, mounting heights of outlets are shown on the drawings or in the specification. Dimensions given shall be considered to be from center of outlet to finished floor.

I. Coordinate the location and elevation of all communications devices and fixtures with the architectural interior elevation plan and reflective ceiling plan prior to installation.

J. Properly rough in for the communications raceways and equipment under this contract and modify as required for coordination during the construction period.

K. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section “Penetration Firestopping.”

3.7 ENVIRONMENTAL AIR PLENUMS

A. In spaces over hung ceiling which are used for environmental air handling purposes as defined by Article 300.22C of the National Electric Code, power data and communications cable must be in conduit or of the type cable rated for air plenum use. Cable type and/or raceway is generally indicated on the drawings and specifications although the Contractor shall be responsible to clearly define ceiling space used for environmental air purposes.

END OF SECTION 280500

CONFIDENTIAL DOCUMENT

280513

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY

ImmuCell

Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

280513

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
280513	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 280513 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. UTP cabling.
2. RS-232 cabling.
3. RS-485 cabling.
4. Low-voltage control cabling.
5. Control-circuit conductors.
6. Fire alarm wire and cable.
7. Identification products.

1.3 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.

B. EMI: Electromagnetic interference.

C. IDC: Insulation displacement connector.

D. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

E. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).

F. RCDD: Registered Communications Distribution Designer.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.

C. Source quality-control reports.

D. Field quality-control reports.

E. Operation and Maintenance Data: For wire and cable to include in operation and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Allowable pulling tension of cable.
2. Cable connectors and terminations recommended by the manufacturer.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An NRTL.

1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test each pair of UTP cable for open and short circuits.

1.7 PROJECT CONDITIONS

A. Do not install conductors and cables that are wet, moisture damaged, or mold damaged.

1. Indications that wire and cables are wet or moisture damaged include, but are not limited to, discoloration and sagging of factory packing materials.

B. Environmental Limitations: Do not deliver or install UTP cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 PATHWAYS

A. Support of Open Cabling: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.

1. Support brackets with cable tie slots for fastening cable ties to brackets.
2. Lacing bars, spools, J-hooks, and D-rings.
3. Straps and other devices.

B. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." Flexible metal conduit shall not be used.

C. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.

2.2 UTP CABLE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. ADC.
2. AMP Netconnect; a brand of Tyco Electronics Corporation.
3. Belden CDT Networking Division/NORDX.
4. Belden Inc.
5. Berk-Tek; a Nexans company.
6. CommScope, Inc.
7. Draka Cableteq USA.
8. Genesis Cable Products; Honeywell International, Inc.
9. Mohawk; a division of Belden.
10. Superior Essex Inc.
11. SYSTIMAX Solutions; a CommScope, Inc. brand.
12. 3M; Communication Markets Division.

B. Description: 100-ohm, 4-pair UTP, covered with a blue thermoplastic jacket.

1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA/EIA-568-B.1 for performance specifications.
3. Comply with TIA/EIA-568-B.2, Category 6.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:

a. Communications, General Purpose: Type CM or CMG.
b. Communications, Plenum Rated: Type CMP, complying with NFPA 262.
c. Communications, Limited Purpose: Type CMX.
d. Multipurpose: Type MP or MPG.
e. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.

2.3 RS-232 CABLE

A. Standard Cable: NFPA 70, Type CM.

1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. Polypropylene insulation.
3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
4. PVC jacket.
5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
6. Flame Resistance: Comply with UL 1581.

2.4 RS-485 CABLE

A. Standard Cable: NFPA 70, Type CM.

1. Paired, 2 pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

2.5 LOW-VOLTAGE CONTROL CABLE

A. Paired Cable: NFPA 70, Type CMG.

1. 1 pair, twisted, No. 16 AWG, stranded (19x29) and No. 18 AWG, stranded (19x30**)** tinned copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

B. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.

1. 1 pair, twisted, No. 16 AWG, stranded (19x29) and No. 18 AWG, stranded (19x30) tinned copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with NFPA 262.

2.6 CONTROL-CIRCUIT CONDUCTORS

A. Class 1 Control Circuits: Stranded copper, Type THHN-THWN, complying with UL 83, in raceway.

B. Class 2 Control Circuits: Stranded copper, Type THHN-THWN, complying with UL 83, in raceway.

C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type TW or TF, complying with UL 83.

2.7 FIRE ALARM WIRE AND CABLE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Comtran Corporation.
2. Draka Cableteq USA.
3. Genesis Cable Products; Honeywell International, Inc.
4. Rockbestos-Suprenant Cable Corp.
5. West Penn Wire; a brand of Belden Inc.

B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.

C. Signaling Line Circuits: Twisted, shielded pair, not less than No. 18 AWG or size as recommended by system manufacturer.

1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a 2-hour rating.

D. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.

1. Low-Voltage Circuits: No. 16 AWG, minimum.
2. Line-Voltage Circuits: No. 12 AWG, minimum.

2.8 IDENTIFICATION PRODUCTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Brady Corporation.
2. HellermannTyton.
3. Kroy LLC.
4. PANDUIT CORP.

B. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

C. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

2.9 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test UTP cables on reels according to TIA/EIA-568-B.1.

C. Factory test UTP cables according to TIA/EIA-568-B.2.

D. Cable will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 INSTALLATION OF PATHWAYS

A. Comply with TIA-569-B for pull-box sizing and length of conduit and number of bends between pull points.

B. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." for installation of conduits and wireways.

C. Install manufactured conduit sweeps and long-radius elbows whenever possible.

D. Pathway Installation in Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
2. Secure conduits to backboard when entering room from overhead.
3. Extend conduits 3 inches above finished floor.
4. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

3.2 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements in Division 26 Section "Hangers and Supports for Electrical Systems." for installation of supports for pathways, conductors and cables.

3.3 WIRING METHOD

A. Install wiring in metal raceways and wireways. Conceal raceway except in unfinished spaces and as indicated. Minimum conduit size shall be 3/4 inch. Control and data transmission wiring shall not share conduit with other building wiring systems.

B. Install cable, concealed in accessible ceilings, walls, and floors when possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Use lacing bars and distribution spools. Separate power-limited and non-power-limited conductors as recommended in writing by manufacturer. Install conductors parallel with or at right angles to sides and back of enclosure. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with intrusion system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

3.4 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with NECA 1.

B. Conductors: Size according to system manufacturer's written instructions unless otherwise indicated.

C. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
5. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
6. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
7. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
8. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

D. UTP Cable Installation: Install using techniques, practices, and methods that are consistent with Category 6 rating of components and that ensure Category 6 performance of completed and linked signal paths, end to end.

1. Comply with TIA/EIA-568-B.2.
2. Install 110-style IDC termination hardware unless otherwise indicated.
3. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry.

E. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-B recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.

2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24.

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.

5. Separation between Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
6. Separation between Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.5 FIRE ALARM WIRING INSTALLATION

A. Comply with NECA 1 and NFPA 72.

B. Wiring Method: Install wiring in metal raceway according to Division 26 Section "Raceway and Boxes for Electrical Systems."

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated raceway system. This system shall not be used for any other wire or cable.

C. Wiring Method:

1. Cables and raceways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.
2. Signaling Line Circuits: Power-limited fire alarm cables may be installed in the same cable or raceway as signaling line circuits.

D. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

E. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

F. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.

G. Wiring to Remote Alarm Transmitting Device: 1-inch conduit between the fire alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.6 POWER AND CONTROL-CIRCUIT CONDUCTORS

A. 120-V Power Wiring: Install according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables" unless otherwise indicated.

B. Minimum Conductor Sizes:

1. Class 1 remote-control and signal circuits, No. 14 AWG.
2. Class 2 low-energy, remote-control and signal circuits, No. 16 AWG.
3. Class 3 low-energy, remote-control, alarm and signal circuits, No. 12 AWG.

3.7 CONNECTIONS

A. Comply with requirements in Division 28 Section "Digital Addressable Fire-Alarm System" for connecting, terminating, and identifying wires and cables.

3.8 FIRESTOPPING

A. Comply with requirements in Division 07 Section "Penetration Firestopping."

B. Comply with TIA-569-B, "Firestopping" Annex A.

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.9 GROUNDING

A. For communications wiring, comply with ANSI-J-STD-607-A and with BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. For low-voltage wiring and cabling, comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems."

3.10 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Visually inspect UTP cable jacket materials for NRTL certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA/EIA-568-B.1.
2. Visually inspect cable placement, cable termination, grounding and bonding and labeling of all components.
3. Test UTP cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross connection.

    a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

D. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.

E. End-to-end cabling will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION 280513

CONFIDENTIAL DOCUMENT

280544

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

SLEEVES AND SLEEVE SEALS FOR ELECTRONIC SAFETY AND SECURITY PATHWAYS AND CABLING

ImmuCell

Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
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The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

280544

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
280544	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 280544 - SLEEVES AND SLEEVE SEALS FOR ELECTRONIC SAFETY AND SECURITY PATHWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Sleeves for pathway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

B. Related Requirements:

1. Division 07 Section "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.
2. penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. LEED Submittals:

1. Product Data for Credit EQ 4.1: For sealants, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit EQ 4: For sealants, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

F. Sleeves for Rectangular Openings:

1. Material: Galvanized-steel sheet.
2. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Advance Products & Systems, Inc.
b. CALPICO, Inc.
c. Metraflex Company (The).
d. Pipeline Seal and Insulator, Inc.
e. Proco Products, Inc.

2. Sealing Elements: Nitrile (Buna N) rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

3. Pressure Plates: Stainless steel.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Presealed Systems.

2.4 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
2. Sealant shall have VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Silicone Foams: Multicomponent, silicone-based, liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

a. Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants.".
b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and pathway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at pathway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 280544

CONFIDENTIAL DOCUMENT

282300

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

VIDEO SURVEILLANCE

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

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Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
282300	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 282300 - VIDEO SURVEILLANCE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes a video surveillance system consisting of cameras, digital video recorder, data transmission wiring, and a control station with its associated equipment.

1.3 DEFINITIONS

A. AGC: Automatic gain control.

B. BNC: Bayonet Neill-Concelman - type of connector.

C. B/W: Black and white.

D. CCD: Charge-coupled device.

E. FTP: File transfer protocol.

F. IP: Internet protocol.

G. LAN: Local area network.

H. MPEG: Moving picture experts group.

I. NTSC: National Television System Committee.

J. PC: Personal computer.

K. PTZ: Pan-tilt-zoom.

L. RAID: Redundant array of independent disks.

M. TCP: Transmission control protocol - connects hosts on the Internet.

N. UPS: Uninterruptible power supply.

O. WAN: Wide area network.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Video surveillance system shall withstand the effects of earthquake motions determined according to ASCE/SEI 7

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include dimensions and data on features, performance, electrical characteristics, ratings, and finishes.

B. Equipment List: Include every piece of equipment by model number, manufacturer, serial number, location, and date of original installation. Add pretesting record of each piece of equipment, listing name of person testing, date of test, set points of adjustments, name and description of the view of preset positions, description of alarms, and description of unit output responses to an alarm.

1.6 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For video surveillance, cameras, camera-supporting equipment, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control reports.

C. Warranty: Sample of special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For cameras, power supplies, infrared illuminators, monitors, videotape recorders, digital video recorders, video switches, and control-station components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Lists of spare parts and replacement components recommended to be stored at the site for ready access.

1.8 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NECA 1.

C. Comply with NFPA 70.

1.9 PROJECT CONDITIONS

A. Environmental Conditions: Capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:

1. Interior, Controlled Environment: System components, except central-station control unit, installed in temperature-controlled interior environments shall be rated for continuous operation in ambient temperatures of 36 to 122 deg F (2 to 50 deg C) dry bulb and 20 to 90 percent relative humidity, noncondensing. Use NEMA 250, Type 1 enclosures.
2. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambient temperatures of minus 30 to plus 122 deg F (minus 34 to plus 50 deg C) dry bulb and 20 to 90 percent relative humidity, condensing. Rate for continuous operation when exposed to rain as specified in NEMA 250, winds up to 85 mph (137 km/h) and snow cover up to 24 inches (610 mm) thick. Use NEMA 250, Type 4X enclosures.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of cameras, equipment related to camera operation, and control-station equipment that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM REQUIREMENTS

A. Video-signal format shall comply with NTSC standard, composite interlaced video. Composite video-signal termination shall be 75 ohms.

B. Tamper Protection: Tamper switches on enclosures, control units, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled. Control-station, control-unit alarm display shall identify tamper alarms and indicate locations.

2.2 STANDARD CAMERAS

A. All Cameras will be EIA 330 and UL 1.Minimum Protection for Power Connections 120 V and more: Auxiliary panel suppressors shall comply with requirements in Section 280500 COMMON WORK REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY, Part 2.

B. Minimum Protection for Communication, Signal, Control, and Low-Voltage 983 compliant as well as:

1. Will be charge coupled device (CCD cameras and shall conform to National Television System Committee (NTSC) formatting.
2. Fixed cameras shall be color and the primary choice for monitoring following the activities described below. Pan/Tilt/Zoom (P/T/Z) cameras shall be color and are to be utilized to complement the fixed cameras.
3. Shall be powered by either 12 volts direct current (VDC) or 24 volts alternate current (VAC). Power supplies shall be Class 2 and UL compliant and have a back-up power source to ensure cameras are still operational in the event of loss of primary power to the VASS System.
4. Shall be powered over Ethernet. Network switches supporting PoE cameras shall have a back-up power source to ensure cameras are still operational in the event of loss of primary power to the VASS System.
5. Shall be rated for continuous operation under the environmental conditions listed in Part 1, Project Conditions.
6. Will be home run to a monitoring and recording device via a controlling device such as a matrix switcher or network server and monitored on a 24 hour basis at a designated Security Management System location.
7. Each function and activity shall be addressed within the system by a unique user defined name, with minimum of twenty (20) characters. The use of codes or mnemonics identifying the VASS action shall not be accepted.
8. Shall come with built-in video motion detection that shall automatically monitor and process information from each camera. The camera motion detection shall detect motion within the camera's field of view and provide automatic visual, remote alarms as a result of detected motion.
9. Shall be programmed to digitally flip from color to black and white at dusk and vice versa at low light conditions.
10. Will be fitted with AI/DC lenses to ensure the image quality under different light conditions.
11. P/T/Z cameras shall be utilized in a manner that they complement fixed cameras and shall not be used as a primary means of monitoring activity.
12. Dummy or fake cameras will not be utilized at any time.
13. Appropriate signage shall be designed, provided, and posted that notifies people that an area is under camera surveillance.

2.3 VIDEO CAMERAS

A. The camera shall be a high-resolution color video camera with wide dynamic range capturing capability.

B. Pickup Device: 1/4 CCD interline transfer.

C. Horizontal Resolution: 480 lines.

D. Signal-to-Noise Ratio: Not less than 50 dB, with the camera AGC off.

E. With AGC, manually selectable on or off.

F. Sensitivity: Camera shall deliver 1-V peak-to-peak video signal at the minimum specified light level. The illumination for the test shall be with lamps rated at approximately 2200-K color temperature, and with the camera AGC off.

G. Manually selectable modes for backlight compensation or normal lighting.

H. Pan and Tilt: Direct-drive motor, 360-degree rotation angle, and 180-degree tilt angle. Pan-and-tilt speed shall be variable controlled by operator. Movement from preset positions shall be not less than 300 degrees per second.

I. Preset positioning: 64 user-definable scenes. Controls shall include the following:

1. In "sequence mode," camera shall continuously sequence through preset positions, with dwell time and sequencing under operator control.
2. Motion detection shall be available at each camera position.

J. Scanning Synchronization: Determined by external synch over the coaxial cable. Camera shall revert to internally generated synchronization on loss of external synch signal.

K. White Balance: Auto-tracing white balance, with manually settable fixed balance option.

L. Motion Detector: Built-in digital.

M. Dome shall support multiplexed control communications using coaxial cable recommended by manufacturer.

N. Automatic Color Dome Camera Technical Characteristics:

Effective Pixels	768 (H) x 494 (V)
Scanning Area	1/4-type CCD
Synchronization	Internal/Line-lock/Multiplexed Vertical Drive (VD2)
Video Output	1.0 v[p-p] NTSC composite/75 ohm
H. Resolution	570-line at B/W, or 480-line at color imaging
Signal-to-noise Ratio	50dB (AGC off, weight on)
Super Dynamic II	64 times (36dB) (selectable on/off)
Minimum Illumination	0.06 lx (0.006 fc) at B/W, 1 lx(0.1 fc)
Zoom Speed	Approx. 2.1s (TELE/WIDE) in sequence mode
Focus Speed	Approx. 2s (FAR/NEAR) in sequence mode
Iris	Automatic (Open/Close is possible)/manual

Maximum Aperture Ratio	1:1.6 (Wide) ~ 3.0 (Tele)
Focal Length	3.79 ~ 83.4 mm
Angular Field of View	H 2.6° ~ 51.7° V 2.0° ~ 39.9°
Electronic Shutter	1/60 (off), 1/100, 1/250, 1/500, 1/1,000, 1/2,000, 1/4,000, 1/10,000 s
Zoom Ratio	Optical 22x w/10x electronic zoom
Iris Range	F1.6 ~ 64, Close
Panning Range	360° endless
Panning Speed	Manual: Approx. 0.1°/s ~ 120°/s 16 steps
Tilting Range	0 ~ 90° (Digital Flip off), 0 ~180° (Digital Flip on)
Tilting Speed	Manual: Approx. 0.1°/s ~ 120°/s. 16 steps
Pan/Tilt	Manual/Sequential position/Auto Pan
Controls	Pan/Tilt, Lens, 64 Preset Positions, Home Position
Video Connector	BNC
Controller I/F	Multiplex-coaxial

2.4 INDOOR/OUTDOOR FIXED MINI DOME SYSTEM

A. The indoor/outdoor fixed mini dome system shall include a built-in 100Base-TX network interface for live streaming to a standard Web browser.

B. The network mini dome shall be integrated into the back box design to accept multiple camera options without modification. The network mini dome shall operate in open architecture connectivity for third-party software recording solutions.

C. The indoor/outdoor fixed mini dome system shall meet or exceed the following design and performance specifications.

Imaging Device	1/3-inch imager
Picture Elements	NTSC/PAL 720 (H) x 540 (V) 720 (H) x 540 (V)
Dynamic Range	102 dB typical/120 dB maximum (DW/CW models only)
Scanning System	2:1 interlace (progressive option on CW/DW models only
Synchronization	Internal
Electronic Shutter Range	Auto (1/15–1/22,000)
Lens Type	Varifocal with auto iris
Format Size	1/3-inch

Focal Length	3.0 mm–9.5 mm 9.0 mm–22.0 mm
Operation	Iris Auto (DC-drive) Focus Manual Zoom Manual
Minimum Illumination	Color (day): 0.8 lux, SENS 8X: 0.2 lux, B-W (night): 0.08 lux, SENS 8X: 0.02 lux (F1.0, 40 IRE, AGC on, 75% scene reflectance) Color (day): 0.15 lux, B-W (night): 0.015 lux (F1.0, 40 IRE, AGC on, 75% scene reflectance) Color (day): 0.8 lux, SENS 8X: 0.2 lux (F1.0, 40 IRE, AGC on, 75% scene reflectance) 0.2 lux (F1.0, 40 IRE, AGC on, 75% scene reflectance)
Compression	MPEG-4, MJPEG in Web viewing mode
Video Streams	3, simultaneous
Video Resolutions	NTSC PAL 4CIF 704 x 480 704 x 576 2CIF 704 x 240 704 x 288 CIF 352 x 240 352 x 288 QCIF 176 x 120 176 x 144
Bit Rate	Configurable, 20 kbps to 2 Mpbs per stream
Web User Interface	
Environment	Low temperature, indoor/outdoor
Connectors	RJ-45 for 100BASE-TX, Auto MDI/MDI-X
Cabling	CAT5 cable or better for 100BASE-TX
Input Voltage	24 VAC (18-36) or PoE input voltage
Power Consumption	<7.5 Watts,<13 Watts with heaters 24VAC: <0.5 Amps, <0.9 Amps with heaters
Alarm Input	10 VDC maximum, 5 mA maximum
Alarm Output	0 to 15 VDC maximum, 75 mA maximum
Service Connector	Internal to housing for 2.5 mm connector for NTSC/PAL video outputs
Service Connector	3-conductor, 2.5 mm connector for video output to optional (IS-SC cable)
Pan/Tilt Adjustment	Pan 360°, tilt 80° (20° to 100° range), and rotation 360°

Light Attenuation	smoked bubble, f/1.5 light loss; clear bubble, zero light loss
CERTIFICATIONS	CE, Class B UL Listed Meets NEMA Type 4X and IP66 standards

2.5 CAMERA-SUPPORTING EQUIPMENT

A. Manufacturers:

1. A & S Security Products, Inc.
2. Alpha Systems Lab, Inc.
3. CBC (America) Corp.
4. COP-USA.
5. Crest Electronics, Inc.
6. ElbexLimited.
7. ELMO.
8. EverFocus Electronics Corp.
9. GENWAC, Inc.; a division of Watec Co. Ltd.
10. Ikegami Electronics (USA) Inc.
11. Kalatel Inc.; an Interlogix company.
12. Merit Li-Lin Ent. Co., Ltd.
13. Panasonic Security Systems Group.
14. Pelco.
15. Philips Communication, Security & Imaging; Philips Electronics N.V.
16. Samsung Opto-Electronics America, Inc.
17. SANYO Fisher Company; SANYO North America Corporation.
18. Sensormatic Electronics Corporation.
19. Telpix Inc.
20. Ultrak, Inc.
21. Veltek International, Inc.
22. Vicon Industries, Inc.
23. Video Mount Products.
24. Videolarm.
25. Visiontech.
26. Wren Associates Limited.

B. Minimum Load Rating: Rated for load in excess of the total weight supported times a minimum safety factor of two.

C. Pan Units: Motorized automatic-scanning units arranged to provide remote-controlled manual and automatic camera panning action, and equipped with matching mounting brackets.

1. Scanning Operation: Silent, smooth, and positive.
2. Stops: Adjustable without disassembly, to limit the scanning arc.

D. Pan-and-Tilt Units: Motorized units arranged to provide remote-controlled aiming of cameras with smooth and silent operation, and equipped with matching mounting brackets.

1. Panning Rotation: 0 to 355 degrees, with adjustable stops.
2. Tilt Movement: 90 degrees, plus or minus 5 degrees, with adjustable stops.
3. Speed: 12 degrees per second in both horizontal and vertical planes.
4. Wiring: Factory prewired for camera and zoom lens functions and pan-and-tilt power and control.
5. Pan-and-tilt unit shall be available with preset positioning capability to recall the position of a specific scene.

E. Mounting Brackets for Fixed Cameras: Type matched to items supported and mounting conditions. Include manual pan-and-tilt adjustment.

F. Protective Housings for Fixed and Movable Cameras: 6061 T6 aluminum enclosures with internal camera mounting and connecting provisions that are matched to camera/lens combination and mounting and installing arrangement of camera to be housed.

1. Camera Viewing Window: Lexan window, aligned with camera lens.
2. Duplex Receptacle: Internally mounted.
3. Alignment Provisions: Camera mounting shall provide for field aiming of camera and permit removal and reinstallation of camera lens without disturbing camera alignment.
4. Built-in, thermostat-activated heater and blower units. Units shall be automatically controlled so the environmental limits of the camera equipment are not exceeded.
5. Sun shield shall not interfere with normal airflow around the housing.
6. Mounting bracket and hardware for wall or ceiling mounting of the housing. Bracket shall be of same material as the housing; mounting hardware shall be stainless steel.
7. Finish: Housing and mounting bracket shall be factory finished using manufacturer's standard finishing process suitable for the environment.
8. Enclosure Rating: as required for environment

2.6 DIGITAL SWITCHERS

A. Quad Switch: For displaying images from four cameras on a single monitor. Provide color switcher if one or more cameras or monitors are in color.

1. Controls: Unit-mounted front panel.
2. Resolution: 720 lines
3. Modes: Auto, manual, and alarm. In manual mode, each channel can also be viewed in single display mode. In the event of an alarm, alarming channel shall automatically switch to full screen. If several alarms are activated, channels in alarm shall be in auto-switching mode.
4. Channel Loss Alarm: Audible buzzer; occurrence details shall be recorded.
5. Time: Indicate date and time.
6. Timing of Auto-Switcher: 1 to 30 seconds, selectable.
7. Mounting: Standard 19-inch (483-mm) rack complying with CEA 310-E, or freestanding desktop.

B. Manual Switch Bank: Low-loss, high-isolation, multiple-video switch to allow manual switching of multiple quad switches and cameras to a single output. Switches shall be illuminated.

C. Sequential Switchers: Automatically sequence outputs of multiple cameras to single monitor and videotape recorder.

1. Switching Time Interval: Continuously adjustable, 5 to 20 seconds minimum, with manual override.
2. Skip-Sequential-Hold Switch: One for each camera, with LED to indicate active camera.
3. Camera Identification Legend: Either on-screen message or label at skip-sequential switch.
4. Alarm Switching: In the event of an alarm, alarming channel shall automatically switch the monitor to full screen.
5. Mounting: Standard 19-inch (483-mm) rack complying with CEA 310-E.

D. PTZ Controls: Arranged for multiple-camera control, with switches to select camera to be controlled.

1. Pan-and-Tilt Control: Joystick type.
2. Zoom Control: Momentary-contact, "in-out" push button.
3. Automatic-Scan Control: A push button for each camera with pan capability that places camera in automatic-scanning mode.

2.7 IP VIDEO SYSTEMS

A. Description:

1. System shall provide high-quality delivery and processing of IP-based video, audio, and control data using standard Ethernet-based networks.
2. System shall have seamless integration of all video surveillance and control functions.
3. Graphical user interface software shall manage all IP-based video matrix switching and camera control functions, two-way audio communication, alarm monitoring and control, and recording and archive/retrieval management. IP system shall also be capable of integrating into larger system environments.
4. System design shall include all necessary compression software for high-performance, dual-stream, MPEG-2/MPEG-4 video. Unit shall provide connections for all video cameras, camera PTZ control data, bidirectional audio, discreet sensor inputs, and control system outputs.
5. All camera signals shall be compressed, encoded, and delivered onto the network for processing and control by the IP video-management software.
6. Camera system units shall be ruggedly built and designed for extreme adverse environments, complying with NEMA Type environmental standards.
7. Encoder/decoder combinations shall place video, audio, and data network stream that can be managed from multiple workstations on the user's LAN or WAN.
8. All system interconnect cables, workstation PCs, PTZ joysticks, and network intermediate devices shall be provided for full performance of specified system.

2.8 SIGNAL TRANSMISSION COMPONENTS

A. Cable: Coaxial cable elements have 75-ohm nominal impedance. Comply with requirements in Section 280513 "Conductors and Cables for Electronic Safety and Security."

B. Video Surveillance Coaxial Cable Connectors: BNC type, 75 ohms. Comply with requirements in Section 280513 "Conductors and Cables for Electronic Safety and Security."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine pathway elements intended for cables. Check raceways and other elements for compliance with space allocations, installation tolerance, hazards to camera installation, and other conditions affecting installation.

B. Examine roughing-in for LAN, WAN, and IP network before device installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 WIRING

A. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems."

B. Wiring Method: Install cables in raceways unless otherwise indicated.

1. Conceal raceways and wiring except in unfinished spaces.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

D. Splices, Taps, and Terminations: For power and control wiring, use numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

E. For LAN connection and fiber-optic and copper communication wiring, comply with Section 271500 "Communications Horizontal Cabling."

F. Grounding: Provide independent-signal circuit grounding recommended in writing by manufacturer.

3.3 VIDEO SURVEILLANCE SYSTEM INSTALLATION

A. Install cameras and infrared illuminators level and plumb.

B. Install cameras with 84-inch- (2134-mm-) minimum clear space below cameras and their mountings. Change type of mounting to achieve required clearance.

C. Set pan unit and pan-and-tilt unit stops to suit final camera position and to obtain the field of view required for camera. Connect all controls and alarms, and adjust.

D. Install power supplies and other auxiliary components at control stations unless otherwise indicated.

E. Install tamper switches on components indicated to receive tamper switches, arranged to detect unauthorized entry into system-component enclosures and mounted in self-protected, inconspicuous positions.

F. Avoid ground loops by making ground connections only at the control station.

1. For 12- and 24-V dc cameras, connect the coaxial cable shields only at the monitor end.

G. Identify system components, wiring, cabling, and terminals according to Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Tests and Inspections:

1. Inspection: Verify that units and controls are properly installed, connected, and labeled, and that interconnecting wires and terminals are identified.
2. Pretesting: Align and adjust system and pretest components, wiring, and functions to verify that they comply with specified requirements. Conduct tests at varying lighting levels, including day and night scenes as applicable. Prepare video-surveillance equipment for acceptance and operational testing as follows:

    a. Prepare equipment list described in "Informational Submittals" Article.
    b. Verify operation of auto-iris lenses.
    c. Set back-focus of fixed focal length lenses. At focus set to infinity, simulate nighttime lighting conditions by using a dark glass filter of a density that produces a clear image. Adjust until image is in focus with and without the filter.
    d. Set back-focus of zoom lenses. At focus set to infinity, simulate nighttime lighting conditions by using a dark glass filter of a density that produces a clear image. Additionally, set zoom to full wide angle and aim camera at an object 50 to 75 feet away. Adjust until image is in focus from full wide angle to full telephoto, with the filter in place.
    e. Set and name all preset positions; consult Owner's personnel.
    f. Set sensitivity of motion detection.
    g. Connect and verify responses to alarms.
    h. Verify operation of control-station equipment.

3. Test Schedule: Schedule tests after pretesting has been successfully completed and system has been in normal functional operation for at least 14 days. Provide a minimum of 10 days' notice of test schedule.

4. Operational Tests: Perform operational system tests to verify that system complies with Specifications. Include all modes of system operation. Test equipment for proper operation in all functional modes.

D. Video surveillance system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.5 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Tasks shall include, but are not limited to, the following:

1. Check cable connections.
2. Check proper operation of cameras and lenses. Verify operation of auto-iris lenses and adjust back-focus as needed.
3. Adjust all preset positions; consult Owner's personnel.
4. Recommend changes to cameras, lenses, and associated equipment to improve Owner's use of video surveillance system.
5. Provide a written report of adjustments and recommendations.

3.6 CLEANING

A. Clean installed items using methods and materials recommended in writing by manufacturer.

B. Clean video-surveillance-system components, including camera-housing windows, lenses, and monitor screens.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain video-surveillance equipment.

END OF SECTION 282300

CONFIDENTIAL DOCUMENT

283111

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
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Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

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Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

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283111	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 283111 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fire-alarm control unit.
2. Manual fire-alarm boxes.
3. System smoke detectors.
4. Non-system smoke detectors.
5. Heat detectors.
6. Notification appliances.
7. Firefighters' two-way telephone communication service.
8. Remote annunciator.
9. Addressable interface device.
10. Digital alarm communicator transmitter.
11. Radio alarm transmitter.
12. System printer.

1.3 DEFINITIONS

A. LED: Light-emitting diode.

B. NICET: National Institute for Certification in Engineering Technologies.

1.4 SYSTEM DESCRIPTION

A. Non-coded, UL-certified addressable system, with multiplexed signal transmission, dedicated to fire-alarm service only.

1.5 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Fire-alarm control unit and raceways shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event.

1.6 SUBMITTALS

A. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Owner.
2. Shop Drawings shall be prepared by persons with the following qualifications:

a. Trained and certified by manufacturer in fire-alarm system design.
b. NICET-certified fire-alarm technician, Level III minimum.
c. Licensed or certified by authorities having jurisdiction.

B. Product Data: For each type of product indicated.

C. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.

1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
2. Include voltage drop calculations for notification appliance circuits.
3. Include battery-size calculations.
4. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
5. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
6. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
7. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.

D. Delegated-Design Submittal: For smoke and heat detectors indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Drawings showing the location of each smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the detector.
2. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72.

E. Qualification Data: For qualified Installer.

F. Seismic Qualification Certificates: For fire-alarm control unit, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

G. Field quality-control reports.

H. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
3. Record copy of site-specific software.
4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:

    a. Frequency of testing of installed components.
    b. Frequency of inspection of installed components.
    c. Requirements and recommendations related to results of maintenance.
    d. Manufacturer's user training manuals.

5. Manufacturer's required maintenance related to system warranty requirements.
6. Abbreviated operating instructions for mounting at fire-alarm control unit.
7. Copy of NFPA 25.

I. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level III technician.

C. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer. Components shall be compatible with, and operate as, an extension of existing system.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

1.8 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning with Substantial Completion, provide software support for two years.

C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

1.9 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
3. Smoke Detectors, Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than 1 unit of each type.
4. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but no fewer than 1 unit of each type.
5. Keys and Tools: One extra set for access to locked and tamper proofed components.
6. Audible and Visual Notification Appliances: One of each type installed.
7. Fuses: Two of each type installed in the system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. NOTIFIER; a Honeywell company.
2. SimplexGrinnell LP; a Tyco International company.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:

1. Manual stations.
2. Heat detectors.
3. Smoke detectors.
4. Duct smoke detectors.
5. Verified automatic alarm operation of smoke detectors.
6. Automatic sprinkler system water flow.
7. Heat detectors in elevator shaft and pit.
8. Fire-extinguishing system operation.
9. Fire standpipe system.

B. Fire-alarm signal shall initiate the following actions:

1. Continuously operate alarm notification appliances.
2. Identify alarm at fire-alarm control unit and remote annunciator.
3. Transmit an alarm signal to the remote alarm receiving station.
4. Unlock electric door locks in designated egress paths.
5. Activate voice/alarm communication system.
6. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
7. Close smoke dampers in air ducts of designated air-conditioning duct systems.
8. Recall elevators to primary or alternate recall floors.
9. Record events in the system memory.
10. Record events by the system printer.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Valve supervisory switch.
2. Low-air-pressure switch of a dry-pipe sprinkler system.
3. Elevator shunt-trip supervision.

D. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of primary power at fire-alarm control unit.
4. Ground or a single break in fire-alarm control unit internal circuits.
5. Abnormal ac voltage at fire-alarm control unit.
6. Break in standby battery circuitry.
7. Failure of battery charging.
8. Abnormal position of any switch at fire-alarm control unit or annunciator.
9. Fire-pump power failure, including a dead-phase or phase-reversal condition.
10. Low-air-pressure switch operation on a dry-pipe or preaction sprinkler system.

E. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators. Record the event on system printer.

2.3 FIRE-ALARM CONTROL UNIT

A. General Requirements for Fire-Alarm Control Unit:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864 and listed and labeled by an NRTL.

    a. System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.
    b. Include a real-time clock for time annotation of events on the event recorder and printer.

2. Addressable initiation devices that communicate device identity and status.

    a. Smoke sensors shall additionally communicate sensitivity setting and allow for adjustment of sensitivity at fire-alarm control unit.
    b. Temperature sensors shall additionally test for and communicate the sensitivity range of the device.

3. Addressable control circuits for operation of mechanical equipment.

B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, 2 line(s) of 40 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.

C. Circuits:

1. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class B.

    a. Initiating Device Circuits: Style B.
    b. Notification Appliance Circuits: Style Z.
    c. Signaling Line Circuits: Style 6.
    d. Install no more than 30 addressable devices on each signaling line circuit.

2. Serial Interfaces: Two RS-232 ports for printers.

D. Smoke-Alarm Verification:

1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
2. Activate an NRTL-listed and -approved "alarm-verification" sequence at fire-alarm control unit and detector.
3. Record events by the system printer.
4. Sound general alarm if the alarm is verified.
5. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.

E. Notification Appliance Circuit: Operation shall sound in a warp.

F. Elevator Recall:

1. Smoke detectors at the following locations shall initiate automatic elevator recall. Alarm-initiating devices, except those listed, shall not start elevator recall.

    a. Elevator lobby detectors except the lobby detector on the designated floor.
    b. Smoke detector in elevator machine room.
    c. Smoke detectors in elevator hoistway.

2. Elevator lobby detectors located on the designated recall floors shall be programmed to move the cars to the alternate recall floor.
3. Water-flow alarm connected to sprinkler in an elevator shaft and elevator machine room shall shut down elevators associated with the location without time delay.

    a. Water-flow switch associated with the sprinkler in the elevator pit may have a delay to allow elevators to move to the designated floor.

G. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.

H. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

I. Voice/Alarm Signaling Service: Central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators provided as a special module that is part of fire-alarm control unit.

1. Indicated number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall comply with UL 1711 and be listed by an NRTL.

    a. Allow the application of and evacuation signal to indicated number of zones and, at same time, allow voice paging to the other zones selectively or in any combination.
    b. Programmable tone and message sequence selection.
    c. Standard digitally recorded messages for "Evacuation" and "All Clear."
    d. Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification appliance circuits of fire-alarm control unit.

2. Status Annunciator: Indicate the status of various voice/alarm speaker zones and the status of firefighters' two-way telephone communication zones.
3. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.

J. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also print system reset event, including same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.

K. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory signals shall be powered by 24-V dc source.

1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

L. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

1. Batteries: Sealed, valve-regulated, recombinant lead acid.

M. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.4 MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Single-action mechanism, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
2. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
3. Station Reset: Key- or wrench-operated switch.
4. Indoor Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.
5. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

2.5 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be four-wire type.

3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.
7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.

    a. Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for 15 or 20 deg F per minute.

B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

    a. Primary status.
    b. Device type.
    c. Present average value.
    d. Present sensitivity selected.
    e. Sensor range (normal, dirty, etc.).

C. Ionization Smoke Detector:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

    a. Primary status.
    b. Device type.
    c. Present average value.
    d. Present sensitivity selected.
    e. Sensor range (normal, dirty, etc.).

D. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

    a. Primary status.
    b. Device type.

c. Present average value.
d. Present sensitivity selected.
e. Sensor range (normal, dirty, etc.).

3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.
4. Each sensor shall have multiple levels of detection sensitivity.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
6. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

2.6 NONSYSTEM SMOKE DETECTORS

A. Single-Station Smoke Detectors:

1. Comply with UL 217; suitable for NFPA 101, residential occupancies; operating at 120-V ac.
2. Auxiliary Relays: One Form C rated at 0.5 A.
3. Audible Notification Appliance: Piezoelectric sounder rated at 90 dBA at 10 feet according to UL 464.
4. Visible Notification Appliance: 177-cd strobe.
5. Heat sensor, 135 deg F combination rate-of-rise and fixed temperature.
6. Test Switch: Push to test; simulates smoke at rated obscuration.
7. Tandem Connection: Allow tandem connection of number of indicated detectors; alarm on one detector shall actuate notification on all connected detectors.
8. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
9. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.
10. Integral Visual-Indicating Light: LED type indicating detector has operated.

B. Single-Station Duct Smoke Detectors:

1. Comply with UL 268A; operating at 120-V ac.
2. Sensor: LED or infrared light source with matching silicon-cell receiver.

    a. Detector Sensitivity: Smoke obscuration between 2.5 and 3.5 percent/foot when tested according to UL 268A.

3. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. The fixed base shall be designed for mounting directly to air duct. Provide terminals in the fixed base for connection to building wiring.

    a. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.

4. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.

5. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

2.7 HEAT DETECTORS

A. General Requirements for Heat Detectors: Comply with UL 521.

B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or a rate of rise that exceeds 15 deg F per minute unless otherwise indicated.

1. Mounting: Adapter plate for outlet box mounting.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.8 NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Individually addressed, connected to a signaling line circuit, equipped for mounting as indicated and with screw terminals for system connections.

B. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.

C. Chimes, Low-Level Output: Vibrating type, 75-dBA minimum rated output.

D. Chimes, High-Level Output: Vibrating type, 81-dBA minimum rated output.

E. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn, using the coded signal prescribed in UL 464 test protocol.

F. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch high letters on the lens.

1. Rated Light Output:

a. 15/30/75/110 cd, selectable in the field.

2. Mounting: Wall mounted unless otherwise indicated.
3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
4. Flashing shall be in a temporal pattern, synchronized with other units.
5. Strobe Leads: Factory connected to screw terminals.
6. Mounting Faceplate: Factory finished, red.

G. Voice/Tone Notification Appliances:

1. Appliances shall comply with UL 1480 and shall be listed and labeled by an NRTL.
2. High-Range Units: Rated 2 to 15 W.
3. Low-Range Units: Rated 1 to 2 W.
4. Mounting: surface mounted and bidirectional.
5. Matching Transformers: Tap range matched to acoustical environment of speaker location.

2.9 REMOTE ANNUNCIATOR

A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.

1. Mounting: Flush cabinet, NEMA 250, Type 1.

B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.10 ADDRESSABLE INTERFACE DEVICE

A. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.

B. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall and to circuit-breaker shunt trip for power shutdown.

2.11 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632 and be listed and labeled by an NRTL.

B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture one telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.

C. Local functions and display at the digital alarm communicator transmitter shall include the following:

1. Verification that both telephone lines are available.
2. Programming device.

3. LED display.
4. Manual test report function and manual transmission clear indication.
5. Communications failure with the central station or fire-alarm control unit.

D. Digital data transmission shall include the following:

1. Address of the alarm-initiating device.
2. Address of the supervisory signal.
3. Address of the trouble-initiating device.
4. Loss of ac supply or loss of power.
5. Low battery.
6. Abnormal test signal.
7. Communication bus failure.

E. Secondary Power: Integral rechargeable battery and automatic charger.

F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.12 SYSTEM PRINTER

A. Printer shall be listed and labeled by an NRTL as an integral part of fire-alarm system.

2.13 DEVICE GUARDS

A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.

1. Factory fabricated and furnished by manufacturer of device.
2. Finish: Paint of color to match the protected device.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Comply with NFPA 72 for installation of fire-alarm equipment.

B. Equipment Mounting: Install fire-alarm control unit on concrete base with tops of cabinets not more than 72 inches above the finished floor. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."

1. Install seismic bracing. Comply with requirements in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.

C. Equipment Mounting: Install fire-alarm control unit on finished floor with tops of cabinets not more than 72 inches above the finished floor.

1. Comply with requirements for seismic-restraint devices specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
2. Comply with requirements for seismic-restraint devices specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

D. Smoke- or Heat-Detector Spacing:

1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
3. Smooth ceiling spacing shall not exceed 30 feet.
4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix A in NFPA 72.
5. HVAC: Locate detectors not closer than 3 feet from air-supply diffuser or return-air opening.
6. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture.

E. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.

F. Heat Detectors in Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.

G. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.

H. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.

I. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.

J. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling.

K. Device Location-Indicating Lights: Locate in public space near the device they monitor.

L. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than 72 inches above the finished floor.

M. Annunciator: Install with top of panel not more than 72 inches above the finished floor.

3.2 CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Division 08 Section "Door Hardware." Connect hardware and devices to fire-alarm system.

1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

1. Smoke dampers in air ducts of designated air-conditioning duct systems.
2. Alarm-initiating connection to elevator recall system and components.
3. Supervisory connections at valve supervisory switches.
4. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
5. Supervisory connections at elevator shunt trip breaker.
6. Supervisory connections at fire-pump power failure including a dead-phase or phase-reversal condition.
7. Supervisory connections at fire-pump engine control panel.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

B. Install framed instructions in a location visible from fire-alarm control unit.

3.4 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.5 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by the owner’s representative and authorities having jurisdiction.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. Visual Inspection: Conduct visual inspection prior to testing.

a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

F. Fire-alarm system will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

H. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

I. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 283111

CONFIDENTIAL DOCUMENT

323113

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

CHAIN LINK FENCES AND GATES

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
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The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

323113

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
323113	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 323113 - CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Chain-Link Fences: Industrial.
2. Gates: swing.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide chain-link fences and gates capable of withstanding the effects of gravity loads and interior secure storage forces.

1.4 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for chain-link fences and gates.

1. Fence and gate posts, rails, and fittings.
2. Chain-link fabric, reinforcements, and attachments.
3. Gates and hardware.

B. Shop Drawings: Show locations of fences, gates, posts, rails, tension wires, details of extended posts, extension arms, gate swing, or other operation, hardware, and accessories. Indicate materials, dimensions, sizes, weights, and finishes of components. Include plans, gate elevations, sections, details of post anchorage, attachment, bracing, and other required installation and operational clearances.

C. Product Certificates: For each type of chain-link fence, and gate, signed by product manufacturer.

1. Strength test results for framing according to ASTM F 1043.

D. Qualification Data: For Installer.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed chain-link fences and gates similar in material, design, and extent to those indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Emergency Access Requirements: Comply with requirements of authorities having jurisdiction for automatic gate operators serving as a required means of access.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

B. Interruption of Existing Utility Service: Do not interrupt utility services to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of utility services.
2. Do not proceed with interruption of utility services without Owner 's written permission.

PART 2 - PRODUCTS

2.1 CHAIN-LINK FENCE FABRIC

A. General: 10 feet high fence. Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist. Comply with ASTM A 392, CLFMI CLF 2445, and requirements indicated below:

1. Steel Wire Fabric: Metallic-coated wire with a diameter of 0.192 inch.

a. Mesh Size: 1 inch.
b. Weight of Metallic (Zinc) Coating: ASTM A 392, Type II, Class 1, 1.2 oz. /sq. ft. with zinc coating applied before weaving.
c. Coat selvage ends of fabric that is metallic coated before the weaving process with manufacturer's standard clear protective coating.

2.2 INDUSTRIAL FENCE FRAMING

A. Posts and Rails: Comply with ASTM F 1043 for framing, ASTM F 1083 for Group IC round pipe, and the following:

1. Group: IA, round steel pipe, Schedule 40.
2. Fence Height: 10 feet.
3. Strength Requirement: Heavy industrial according to ASTM F 1043.

4. Post Diameter and Thickness: According to ASTM F 1043.

    a. Swing Gate Post: According to ASTM F 900

5. Coating for Steel Framing:

    a. Metallic Coating:

        1) Type A, consisting of not less than minimum 2.0-oz./sq. ft. average zinc coating per ASTM A 123/A 123M or 4.0-oz./sq. ft. zinc coating per ASTM A 653/A 653M.
        2) Type B, zinc with organic overcoat, consisting of a minimum of 0.9 oz./sq. ft. of zinc after welding, a chromate conversion coating, and a clear, verifiable polymer film.
        3) External, Type B, zinc with organic overcoat, consisting of a minimum of 0.9 oz./sq. ft. of zinc after welding, a chromate conversion coating, and a clear, verifiable polymer film. Internal, Type D, consisting of 81 percent, not less than 0.3-mil- thick, zinc pigmented coating.
        4) Type C, Zn-5-Al-MM alloy, consisting of not less than 1.8-oz./sq. ft. coating.
        5) Coatings: Any coating above.

2.3 TENSION WIRE

A. General: Provide horizontal tension wire at the following locations:

1. Location: Extended along top and bottom of fence fabric.

B. Metallic-Coated Steel Wire: 0.177-inch- diameter, marcelled tension wire complying with ASTM A 817, ASTM A 824, and the following:

2.4 INDUSTRIAL SWING GATES

A. General: Comply with ASTM F 900 for double swing gate types.

1. Metal Pipe and Tubing: Galvanized steel. Comply with ASTM F 1043 and ASTM F 1083 for materials and protective coatings.

B. Frames and Bracing: Fabricate members from round tubing with outside dimension and weight according to ASTM F 900 and the following:

1. Gate Fabric Height: 2 inches less than adjacent fence height.
2. Leaf Width: 36 inches.
3. Frame Members:

    a. Tubular Steel: 1.90 inches.

C. Frame Corner Construction:

1. Welded.

2.5 LOCKING DEVICES

A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.

B. Safety Interlock Switch: Equip power-operated grilles with safety interlock switch to disengage power supply when grille is locked.

C. Coiling Grill operation to be connected to card reader outside of space and push button operation from inside of space.

2.6 FITTINGS

A. General: Comply with ASTM F 626.

B. Post and Line Caps: Provide for each post.

1. Line post caps with loop to receive tension wire or top rail.

C. Rail and Brace Ends: Attach rails securely to each gate, corner, pull, and end post.

D. Rail Fittings: Provide the following:

1. Top Rail Sleeves: Pressed-steel or round-steel tubing] not less than 6 inches long.
2. Rail Clamps: Line and corner boulevard clamps for connecting intermediate and bottom rails in the fence line-to-line posts.

E. Tension and Brace Bands: Pressed steel.

F. Tension Bars: Steel, length not less than 2 inches shorter than full height of chain-link fabric. Provide one bar for each gate and end post, and two for each corner and pull post, unless fabric is integrally woven into post.

G. Tie Wires, Clips, and Fasteners: According to ASTM F 626.

1. Standard Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, complying with the following:

H. Finish:

1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz. /sq. ft. zinc.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.3 INSTALLATION, GENERAL

A. Install chain-link fencing to comply with ASTM F 567 and more stringent requirements specified.

1. Install fencing on where indicated on the drawings with manufacturer's recommended base plate anchored to concrete slab.

3.4 CHAIN-LINK FENCE INSTALLATION

A. Post Setting: Set posts in concrete at manufacturers indicated spacing on concrete slab.

1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position.

B. Terminal Posts: Locate terminal end, corner, and gate posts per ASTM F .

C. Line Posts: Space line posts uniformly at manufacturers recommendations.

D. Post Bracing and Intermediate Rails: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Install braces at end and gate posts and at both sides of corner and pull posts.

1. Locate horizontal braces at midheight of fabric, on fences with top rail and at 2/3 fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.

E. Top Rail: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer.

F. Bottom Rails: Install, spanning between posts.

G. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave 1 inch between finish floor or surface and bottom selvage, unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.

H. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts with tension bands spaced not more than 15 inches o.c.

I. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at 1 end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric per ASTM F 626. Bend ends of wire to minimize hazard to individuals and clothing.

1. Maximum Spacing: Tie fabric to line posts at 12 inches o.c. and to braces at 24 inches o.c.

3.5 GATE INSTALLATION

A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

3.6 ADJUSTING

A. Gate: Adjust gate to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

END OF SECTION 323113

CONFIDENTIAL DOCUMENT

400513

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

COMMON WORK RESULTS FOR PROCESS PIPING

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

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Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
400513	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 400513 - COMMON WORK RESULTS FOR PROCESS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Reference Specifications

1. 400513.13 - Steel Process Piping
2. 400513.19 - Stainless Steel Process Piping
3. 400513.33 - Copper and Copper Alloys Process Piping
4. 400529 - Pipe Hangers and Supports
5. 400610 - Schedules for Gas and Vapor Process Piping
6. 400620 - Schedules for Liquids Process Piping
7. 404200 - Process Piping and Equipment Insulation

C. Reference Codes and Standards

1. ASTM - Standards for Materials
2. ANSI - American National Standard Institute
3. ASME Code for Pressure Piping B31.3 - “Process Piping”
4. ASME BPE - Standard for Bioprocessing Equipment
5. Pipe Fabrication Institute Standard ES-3
6. ASME B&PV Code Section VIII - Pressure Vessels.
7. ASME B&PV Code Section IX - Welding and Brazing Qualifications.
8. AWS A3.0 Terms and Definitions, latest edition
9. ASNT-TC-1A
10. FDA Guidelines & Current Good Manufacturing Practices (cGMP) compliance

D. The Contractor shall submit their SOP’s for approval for:

1. Pressure Testing
2. Welding
3. Welding Inspection
4. Examination and Testing Requirements
5. Cleaning and Passivation Procedure

1.2 SUMMARY

A. This Section includes the following:

1. This specification describes the requirements for fabrication and erection of all piping, including the furnishing or materials for the piping, and any prefabrication that may be needed.

2. Nothing in this specification shall be interpreted as in any way relieving a Contractor of the responsibility for complete compliance with the referenced codes wherever they apply.
3. This covers piping material fabrication (prefabricated or on site fabrication), storage, handling, layout, cutting, fitting up, welding, joints, support, inspection, testing, cleaning, and flushing.

1.3 SUBMITTALS

A. For the purpose of engineering checkout and validation, the Contractor shall submit material documentation, welding and inspection records, and test reports for completed systems. Turnover packages shall include:

1. Welding certification and inspection records (See section 4.10)
2. Cleaning and passivation certification
3. Pressure test certification
4. Surface finish certification
5. Insulation certification
6. Drainability test results (line slope verification).
7. Isometric and orthographic piping as-built drawings
8. As-built P&ID drawings

B. As-built drawings required for construction turnover packages are considered to be prints of the latest issued construction design drawings, suitably marked-up where appropriate, representing the actual installed system configuration including all changes and as-built conditions. Formal preparation of “final record drawings” for the project is normally not the responsibility of the installation contractor, and shall be performed by others unless specifically included in the contract package.

1.4 QUALITY ASSURANCE

A. All conflicts between requirements of this specification, related specifications, standards, or purchase orders shall be referred to the Owner or the Owner's Representative prior to shipment.

B. All work within the scope of this specification shall be performed in accordance with this specification and all applicable related documents. No deviations shall be made from this specification or any applicable related documents, without the prior written authorization. The application for each deviation shall completely and specifically define the location of, the nature of, and the reason for the proposed deviation.

C. In general, fabrication, of any part may be prefabricated at a pipe fabrication shop or at an on-site pipe shop at the option of the Contractor subject to the approval of the owner or his Representative provided pre-assembly does not conflict with erection requirements and sequence of erection hereinafter specified. All drawings required for shop fabrication shall be the responsibility of the Contractor.

D. If piping drawings were issued, it shall be the fabricator’s responsibility in dimensioning and fabricating assemblies to conform to the overall piping dimensions as shown on the piping drawings.

E. All dimensions and locations of piping shall be field verified prior to fabrication and erection to assure accuracy of critical dimensions and freedom from interferences. Minimum slopes are critical to process operation and validation, and cannot be compromised.

F. The Contractor shall make allowances for normal field corrections which should be expected for this type of project. No extras will be paid for any portion of additional work required because of the Contractor's failure to field check dimensions and finalize penetration locations prior to fabrication.

G. The Contractor shall allow for field fit-up of piping in order to align with final locations of drilled concrete core holes or chases.

H. The Contractor shall obtain clearance from the Owner's plant site personnel prior to drilling, cutting, or welding any existing structures, piping, or equipment. The Contractor shall consult with the Owner's plant site personnel prior to drilling into walls to assure that there are not embedded interferences.

I. All wall and floor penetrations shall be filled and sealed by the Contractor per Architectural Finish Specifications. Firestopping materials may be required to maintain boundary wall rating.

J. Where noted on drawings, the piping layout design shall allow for future installation of automated equipment, e.g. space for actuators/automated topworks on manual valves.

K. The Owner or the Owner's Representative reserves the right to reject any piping materials if it has not been demonstrated to the Owner's or the Owner's Representative's satisfaction that the requirements of all applicable specifications, purchase orders, and inspection and examination procedures have been met.

L. The Contractor shall generate isometric spool drawings for all hygienic/ sanitary process tubing systems to be built using SST1, SST2, SST4, and SST7 specifications.

1.5 GENERAL REQUIREMENTS

A. All conflicts between requirements of this specification, related specifications, standards, or purchase orders shall be referred to the Owner or the Owner's Representative prior to shipment.

B. All specifications, standards, codes, etc. referred to and designated herein, together with all addenda, revisions and supplements shall be considered part of this specification. Specifications referred to shall be of the latest edition, as of the date of the purchase order.

C. Any documentation required shall be readily identified with the piping material to which it corresponds.

D. All conflicts between the requirements of this specification, related specifications, standards, purchase orders or design drawings shall be referred to the Owner or his Representative for clarification before proceeding with work on the affected parts.

1.6 CODES AND STANDARDS

A. All materials shall be furnished in accordance with this Specification and the requirements of the Code for Pressure Piping ASME B31.3, "Process Piping". In addition, all materials shall be manufactured in accordance with the following Codes and Standards.

Table 1: MATERIAL STANDARDS		
Pipe	Carbon Steel (CS) Stainless Steel (SS)	ASME B36.10M ASME B36.19M
Valves	Dimensions	ASME B16.10
	Flanged & Butt Weld Ends	ANSI B16.34
Fittings	Malleable Iron Threaded Fittings	ASME B16.3
	Wrought Carbon and Stainless Steel Butt Welding Fittings	ASME B16.9
	Forged Fittings, Socket Welded & Threaded	ANSI B16.11
	Ferrous Pipe Plugs and Bushings	ANSI B16.14
	Butt Welding Ends	ASME B16.25
	Butt Welding Short Radius Elbows and Returns	ASME B16.28
Flanges	Carbon & Stainless Steel Pipe Flanges and Flanged Fittings	ANSI B16.5
	Orifice Flanges	ANSI B16.36
Bolting	Hex Bolts and Screws	ASME B18.2.1
	Hex Nuts	ANSI B18.2.2
Gaskets	Nonmetallic Gaskets	ANSI B16.21
Threads	Pipe Threads	ASME B1.20.1
Misc. Materials	As specified in Material Specification or Purchase Order	ASME/FDA Req's
	Material for Product Contact Surfaces	ASME BPE
	Bioprocessing Equipment and Piping	ASME BPE
	Food, Drug, and Beverage Equipment	ANSI F2.1a

B. Nothing in this specification shall be interpreted as in any way relieving a supplier of the responsibility for complete compliance with the aforementioned codes and standards where they apply.

1.7 PROCUREMENT

A. All pipe is to be furnished in mill standard lengths except where specifically modified in the requisition and/or purchase order.

B. A Manufacturer's Certificate of Compliance shall accompany all welded pipe, certifying that the pipe has been manufactured and tested in accordance with the applicable ASTM standard. The certificate shall identify the items it covers.

C. Mill certificates with heat numbers (copies of certified Mill Test Reports) are required for all stainless steel pipe and tubing. These documents are important to weld performance and validation of critical systems.

D. High purity tubing for clean gas distribution shall be purchased separately from tubing for use in other applications. Terms of purchase shall assure compliance to special handling and care during manufacture, cleaning, passivation and packaging. A certificate of analysis shall be provided certifying tubing is free of hydrocarbon oil and contaminants greater than 1 ppm.

1.8 CLEANING

A. All piping materials shall be thoroughly cleaned to remove all grease, oil, loose mill scale and other foreign matter. Surfaces shall be free of residual quantities of cleaning media such as grit, aluminum oxide or silica prior to packing and/or shipping.

B. Special cleaning and packaging shall be required for materials used in certain clean gas distribution systems or hygienic tubing systems, which meet oxygen service specifications. All tubing shall be purged with high purity 99.99% filtered nitrogen gas and flush cleaned with de-ionized water.

C. The use of cleaning fluids containing free chloride shall be prohibited on stainless steel unless specifically approved by the Owner or the Owner's Representative.

D. All materials shall be thoroughly dried after cleaning, and prior to packaging.

E. If passivation is required; the seller shall submit a cleaning and passivation procedure traceable to ASTM Passivation standards ASTM A380 and A967-05 for approval prior to the actual factory passivation procedure.

1.9 MARKING

A. Piping materials shall be identified in accordance with the applicable ASTM specifications and inspected, controlled, and protected in a manner that will assure the proper identification of all materials and conformance with the applicable codes and specifications. Incoming materials shall be placed in designated areas for inspection and release per Owner's procedures. If cleaning is performed on the materials and markings are removed, the materials shall be suitably remarked.

B. Valves shall be permanently stamped or tagged with their appropriate identification numbers, valve manufacturer, model number, body, trim and seal materials. Where equipment tag numbers are required, they will be included in the purchase order.

C. Tubing and fittings for hygienic process systems and assembly by automatic welding shall meet the identification and marking requirements in BPE.

1.10 PACKAGING

A. All pipe fittings size 2 inches and smaller shall be containerized according to material type and size. Each container shall be marked to completely identify the quantity, type and size of the materials within.

B. Before shipping, all flange faces shall be protected with plastic or soft metal to prevent damage to these surfaces during shipping and handling. The use of wood and its derivative by-products is prohibited on site.

C. Before shipping, all threaded ends of pipe shall be protected by plastic thread protectors to prevent damage to the threads during shipping and handling.

D. Materials for hygienic tubing systems shall be packaged in a way that ensures their cleanliness integrity is maintained during all phases of shipping and handling.

E. High purity tubing and components for clean gas distribution shall be packaged using protective 6 mil poly sleeving along with air tight plastic end caps to ensure the maintenance of purity standards. High purity tubing shall be placed in non- wooden containers suitable for maximum protection during shipment.

1.11 SHIPPING AND HANDLING

A. The manufacturer or vendor shall be responsible for delivery of all materials to the designated delivery point in clean, undamaged and workable condition.

B. Materials shall be handled and stored in such a manner to eliminate foreign material and contamination, including iron oxide contamination of stainless steel by contact with carbon steel pipes or storage racks.

C. Stainless steel tube and fittings for hygienic tubing systems shall not come in contact with carbon steel, carbon containing materials, or bare concrete.

D. Precision cleaned stainless tubing for clean gas distribution systems shall be stored and handled separately from other hygienic tubing systems as not to come into contact or cross contamination.

1.12 STORAGE

A. Piping and tubing materials shall be identified in accordance with the applicable ASTM specifications and inspected, controlled, and protected in a manner that will assure the proper identification of all materials and conformance with the applicable codes and specifications. Incoming materials shall be placed in designated areas for inspection and release per Owner’s procedures.

B. Where the Contractor is furnishing piping and tubing materials, such materials shall be delivered in a clean and protected condition. End seals of pipe, flange covers, valve covers, and similar protection shall not be removed until necessary for fabrication or erection.

C. All incoming materials for use in hygienic/ sanitary tubing systems, including valves and instruments, shall be placed in quarantined areas for inspection and release.

D. Care shall be exercised in the handling and storage of all piping and tubing materials, including prefabricated and pre-assembled piping, to prevent contamination by grease, moisture, or foreign matter and to avoid physical damage.

E. Prior to being placed in storage, whether for a short or long period of time, all stainless steel pipe and fittings shall be color coded, with a non-contaminating, non-corrosive, chloride-free marking medium. Precautions shall be taken not to contaminate the product contact surface areas of pipe and fittings with marking medium.

F. Stainless steel pipe, tubing and fittings should preferably be stored indoors and in approved nonmetallic, non-wood storage racks or shelving. For long term (6 months or more) storage in temporary outdoor shelters, it shall be fully wrapped in polyethylene film and sealed with tape.

G. A chloride-free (halogen-free) marking medium shall be used for identification or marking of stainless steel tubing materials. Marking medium shall be independently certified to contain less than 200 ppm total halogens (Sanford Fine Point Tec-13401, or equal). No paint is to be used for identification or marking of stainless steel sanitary tubing.

H. No asbestos is permitted in any piping or piping components.

I. Handling procedures, which include the aforementioned listed criteria, shall be developed by Contractor and submitted to the Owner for approval prior to receiving materials of any kind.

1.13 SUBSTITUTIONS

A. Substitution of materials or equipment considered by the Seller to be equal to that specified in the Piping Materials Specifications shall be subjected to approval by the Owner or the Owner's Representative. In some cases, particular brands and figure numbers have been requested by the Owner in the design, and cannot be substituted.

1.14 INSPECTION

A. The Owner or the Owner's Representative reserves the right to inspect all material prior to shipment. The Seller shall notify the Owner or the Owner's Representative when material is to be shipped in order to make arrangements for inspection.

B. No material shall be shipped without written permission of the Owner or his Representative.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Refer to individual piping line class specifications for detailed descriptions of each piping material. Line class specifications can be found in Section 400513.19.

2.2 PIPING SYSTEM CLASSES

A. Piping material systems in this specification are identified with a unique 4- character "Piping Class Spec" designation.

B. The first three characters refer to a general material class or type.

C. The last character is used to distinguish specific material, component, and assembly details among similar piping class materials.

D. The following table can be used as a guide to identify the general material type and the corresponding line class designation.

Table 2: GENERAL MATERIAL TYPES	
Material Type	Designation
Copper, B280 ACR / Type L, Clean, Brazed	CPK2
Carbon Steel, 150#RF, Sch. 40/80, SW / BW	CRB2
Stainless Steel, 316L Hygienic Tube, 20 Ra EP	SST1
Stainless Steel, 316L Hygienic Tube, 20 Ra MP	SST4
Stainless Steel, 316L Tube, BW	SST7
Stainless Steel, SCH 10S Pipe, 304L, SW / BW	SSP4

2.3 FABRICATION

A. Where specific details of fabrication are not shown on the drawings or specified, fabrication shall be in accordance with the requirements of the Codes for Pressure Piping, ASME B31.3 and ASME-BPE standards.

B. Unless otherwise specified in design documents, dimensional tolerances on prefabricated piping assemblies supplied or fabricated by the Contractor shall be in accordance with Pipe Fabrication Institute Standard ES-3.

C. Springing or forcing is not required to make up joints when assembling the system. This is extremely important in achieving lineup of clamped joint faces. Dimensional tolerances for automatic welding fittings shall be in accordance with the applicable sections of BPE.

D. Prefabricated piping and tubing shall provide sufficient field welds to permit the completion of flanged terminal connections without strain on equipment or piping. Piping should not require connection to equipment for support. Provide sufficient external supports. Refer to Section 400529 - Hangers and Supports for Process Piping for guidance.

E. When fabricating thermoplastic piping systems, the Contractor shall be required to obtain all necessary instructions in proper fabrication procedures and techniques from a representative of the manufacturer.

F. All piping material shall be identified and mill certificates are required for all stainless steel and special alloy pipe. No material of unknown specification or reclaimed material shall be used.

G. All tubing material shall be identified. Mill certificates, Certificates of Compliance, and copies of purchase orders are required for all stainless steel tubing, fittings and valves. Materials shall be marked in such a way that they are easily traceable to their corresponding mill certificates. No material of unknown specification or reclaimed material shall be used.

H. In general, all sanitary tubing joints are to be welded, except fittings immediately adjacent to equipment or valves that must be removed for maintenance, or sections of tubing that may require removal for cleaning. Hygienic/sanitary tubing clamps, per material specification, shall be used at these points or as indicated on contract drawings.

I. All completed piping systems shall be permanently labeled to indicate fluid service and direction of flow, in accordance with Section 400553 – Identification for Process Piping and Equipment. Proposed system marking scheme and permanent valve & equipment tagging requirements shall be approved by the Owner.

J. In general, all piping shall be tagged with service and direction of flow approximately every 20 feet, at change of direction, near main/ branch line shutoff valve, and each side of a wall or floor penetration. When services are supplied at different pressures, piping shall be labeled additionally with the corresponding header pressure.

2.4 LAYOUT, CUTTING AND FITTING UP

A. Pipe shall be cut accurately to measurements shown on drawings and to suit field conditions. Approved pipe cutters or other methods approved by the Owner's Representative shall be used. Use full lengths of pipe where distance between fittings is less than the mill-random lengths of pipe. Avoid extra joints unless disassembly for maintenance is a consideration.

B. A template shall be used in laying out headers, miters, laterals and other irregular details to ensure accurate cutting and a proper fit-up.

C. Pipe ends that are to be butt welded shall be beveled in accordance with ANSI B16.25 and applicable welding specification. When necessary to cut pipe in the field for specific pipe dimensions, machined bevels to form the welding groove are preferred, but smooth, clean, slag-free, flame cut, or power cut, bevels are acceptable, matching as near as possible, bevels in accordance with ANSI B16.25.

D. Threading of steel pipe shall preferably be done after bending, forging, heat treating or welding operations. Where subsequent threading is very difficult and threads are cut first, they shall be fully protected during such operations. Threads shall be concentric with the outside of the pipe and shall conform to ASME B1.20.1.

E. Pipe ends that are to be socket welded shall be square cut to within the tolerances specified in ANSI B16.11.

F. Misalignment or improper fit up of piping and components is not acceptable. Flanged faces shall be parallel prior to bolt-up. Connections to equipment shall be made without forcing or springing the piping.

G. When welded joints involving two different pipe wall thicknesses are to be made, a 4 to 1 taper shall be made on the inside of the thicker pipe to avoid any detrimental mechanical notches in the piping system.

H. Flange bolt holes shall straddle the established centerline, unless other orientation is required to match the flange connections on equipment.

I. In general, piping shall be installed without forcing or springing. Where cold springing is required for reduction of thermally induced stress, the cut-short or cold spring location and gap distance will be indicated on the design drawings.

J. It is not acceptable to perform carbon steel work and stainless steel work in the same area. Cutting, grinding, welding, etc. of carbon steel is prohibited in areas when sanitary tubing systems are being fabricated. Work shall be coordinated, and separate “shop areas” set up, to achieve this requirement.

K. Grinding of stainless steel pipe shall be done with a non-carbonaceous wheel. Low alloy steel files or hacksaws shall not be used on stainless steel pipe. Chipping will not be permitted on stainless steel pipe. High alloy tool steel files or stainless steel wire brushes shall be used on stainless steel pipe.

L. Branch connections shall be made using manufactured fittings, unless otherwise indicated on the piping design drawings. Refer to applicable branch connection charts in the Reference Specifications.

M. Burrs on the I.D. shall be removed by reaming. Other objectionable defects shall be removed by machining, chipping or grinding, as applicable.

N. Care shall be taken to remove all dirt, scale, and foreign matter from inside the piping before welding. Where flame cutting is used, all oxidized metal shall be removed prior to welding. Welds shall be free from projections beyond acceptable reinforcements.

O. Install unions where dismantling of pipe is required to permit maintenance, repair or replacement of equipment and flanged connections are not available.

P. All sanitary tube ends to be welded shall be deburred and have square cut edges, free of shear radii, and free of embedded particles.

Q. The cutting tool employed shall be of a type that will not alter the ovality tolerances stated in the materials specification, and provide minimum burring while attaining a square cut. Abrasive tools shall not be used.

R. The cut end of the tube shall be checked to ensure that the cutting tool is cutting squarely.

S. Burrs shall be removed in such a manner as to not bevel ID or OD, or damage the polished interior surface of the tubing. Use of a specially developed end-prep tool is recommended to both deburr and square the ends to be welded. Burrs may be removed with a clean stainless steel knife or titanium carbide deburring tool. Files are not acceptable for end prep.

T. Any dust or debris that has accumulated should be wiped clean and completely removed from tubing subassemblies, especially the ID, prior to installing them in the system. Isopropyl alcohol (IPA) and soft, clean, lint-free cloth is generally recommended.

U. All tools, wire brushes, etc., that are to be used in the fabrication and erection of sanitary tubing must be made of or compatible with stainless steel, and not stored with tools used on metals other than stainless steel. There should be no contamination with dirt, sulfur or halogen bearing material. Tools used for preparing or cutting tubing shall be kept segregated from other tools and shall not be used for other work. Tools, equipment, and machinery should be protected from airborne contaminants when not in use.

V. All rollers used in the fabrication of sanitary tubing must be stainless steel.

2.5 WELDING PROCEDURES AND QUALIFICATION

A. All procedures and welders should be qualified in accordance with ASME Code, Section IX. Each welder should have an up-to-date certificate, including the welder's name, stencil number, and performance qualification, which are to be on file at the work site and available to the Owner or his Representative upon request. The Contractor shall submit all weld procedures to the Owner or his Representative for approval prior to the start of any work. No welding shall begin until the welding procedures have been approved.

B. Fabrication, assembly, erection, and/or repair of pipe, and pipe supports or their related system components shall be performed in accordance with the provisions of the applicable code or standard as follows:

1. Building Services Piping - ASME Code for Pressure Piping - Section B31.9
2. Power Piping - ASME Code for Pressure Piping - Section B31.1
3. Process Piping - ASME Code for Pressure Piping - Section B31.3
4. ASME Boiler & Pressure Vessel Code - Section VIII - Pressure Vessels

C. All dirt, scale, and foreign matter, including oxidized metal, should be removed from the piping prior to welding. For welding stainless steel, the area should be clear at least 6" from the site of the weld. All flux, slag, and spatter (including the metal surface after welding) will also be completely removed by grinding or brushing.

D. In the event that new or repair work on piping or piping components must be done at facilities other than the jobsite by others, for the Owner or his Contractor, welding procedures qualifications shall be in compliance with Paragraph A.

E. Carbon steel welding shall be done by the gas tungsten arc (GTAW), shielded metal arc (SMAW), gas metal arc (GMAW), or a combination of those processes.

F. Stainless steel welding shall be done by the gas tungsten arc (GTAW) shielded metal arc (SMAW), gas metal arc (GMAW), or a combination of these processes. Where GTAW is used for the root pass, the inside of the pipe shall be protected with an inert gas purge maintained until the root pass has been completed and cooled.

G. Stainless steel socket and butt welds in pipe sizes 4" and smaller shall be made using the gas tungsten arc (GTAW) process.

H. No welding is to be done until welding procedures have been approved.

I. When welding stainless steel, all foreign matter including marking chalk and paint must be removed for a distance of at least 6 inches from the weld. Stainless steel shall not be welded to galvanized steel.

J. In fitting up preparatory to final welding, the proper gap shall be maintained while tack welding the pipe and connections in position so that a proper gap is made for a full penetration weld.

K. Tack welds, line-up clamps, and welded braces may be used for temporary joint alignment. If metal braces are used, defects resulting from their attachment or removal, these defects shall be repaired to the satisfaction of the Owner or his Representative. Braces shall be of the same material as the piping.

L. Small, sound tack welds that penetrate to the bottom of the welding groove may become a part of the finished weld. Tack welds lacking penetration are not acceptable and must be chipped or ground out. Large tack welds that almost fill the welding groove are not acceptable and must be removed.

M. Tack welds shall be of the same quality and made by the same process as the rest of the weld (root pass) or they shall be removed from the weld prior to the completion of the weld.

N. Permanently welded-in backing rings shall not be used. If, in certain instances, backing rings are, in the opinion of the Contractor, necessary or desirable, he shall so indicate on the drawings and submit a request to the Owner or his Representative for specific approval.

O. Welds shall exhibit complete penetration and fusion, including single welded butt joints without backing strips. All longitudinal and circumferential pressure retaining joints shall be of the butt type. Longitudinal joints shall be full penetration welds.

P. Flux and slag shall be completely removed from the surface of all welds (before the next successive layer is applied), by grinding, sand blasting with clean sand, or brushing, using materials of a composition which will not contaminate the surface of the welds to the extent that corrosion resistance is decreased. Any defects shall be removed from each completed pass prior to starting a subsequent pass. The completed weld shall be cleaned of slag and spatter metal on the surface.

Q. Arc strikes and weld starts shall not be made purposely on the base metal outside the weld groove nor outside an area that will be encompassed by a fillet or socket weld. Inadvertent arc strikes outside of a weld zone shall be removed by grinding or filing and the arc strike area shall be visually examined under 5X magnification or liquid penetrant examination.

R. Branch connections will be done in accordance with ANSI B31.3 (the latest edition at the time of design). The welds will merge smoothly with the surface of the pipe. The branch joints should be prepared to permit full penetration welds that are comparable to circumferential welds in the same piping system.

S. The opening for a branch connection in a header will be located 180 degrees from the longitudinal seam in the welded pipe run. If any openings for the branches are cut into pipe runs, all material falling into the pipe should be removed.

T. All filler metals shall be properly packaged and stored to prevent damage and deterioration of the materials prior to and during application in welding. Coated electrodes shall be stored in heated cabinets.

U. For welding of stainless steel to carbon steel, an alloy electrode shall be used which is recommended for the intended purpose and will produce a sound ductile weld. Owner's approval is required prior to welding stainless steel to carbon steel and a qualified welding procedure shall be followed.

V. Galvanized carbon steel that has been welded, shall be given a high zinc content protective coating (3-4 mils), by painting with “Galvicon” cold galvanizing compound or equal, on those exterior surfaces of the piping from which the galvanizing has been disturbed during the welding process. Surfaces to be coated shall be cleaned of any slag, rust, and flux residue prior to applying the zinc-rich coating. Proper ventilation shall be provided when welding galvanized carbon steel. Welding of galvanized metal shall not be done in close proximity to stainless steel. Contractor shall follow fabrication procedures and techniques in strict accordance with manufacturer’s recommendations for welding valves, in order not to damage valve linings or soft seats. This should include: a) limit on welding time, b) wrapping pipe with wet cloth to dissipate heat, c) attaching to the valve a surface temperature indicating marker material (indicating range: 375 to 400 degrees F). When the indicating mark starts melting, welding should be stopped. Diaphragm valves shall be disassembled and diaphragms removed prior to welding.

W. The purge gas flow rate and sequence shall be maintained during tacking and welding in the range developed by the Contractor under the Welding Procedures.

X. No slag nor spatter metal is acceptable on any weld.

Y. All welds rejected by the inspector shall be rewelded at no cost to the owner. Those welds still rejected shall be removed and the joint shall be properly prepared and rewelded at no cost to the Owner.

2.6 HEAT TREATMENT

A. Preheating and post weld heat treatment shall be in accordance with the applicable code or piping material specifications.

B. Preheating is not normally required, but when temperatures are below 50 degrees F, the pipe shall be warmed before welding.

2.7 BENDING

A. Where approved by the Owner, pipe may be bent in lieu of using welded fittings. Pipe may be bent by any hot or cold method that is suitable for the material, the fluid service, and the severity of the bending or forming process. The finished surface shall be free of cracks and substantially free from buckling. Thickness after bending shall not be less than required by the design.

B. Flattening of a bend, the difference between maximum and minimum diameters at any cross section, shall not exceed 8% of nominal outside diameter for internal pressure and 3% for external pressure. Removal of metal shall not be used to achieve these requirements.

C. Cold bending of ferritic materials shall be done at a temperature below the transformation range.

D. Hot bending shall be done at a temperature above the transformation range and in any case within a temperature range consistent with the material and the intended service.

2.8 JOINING OF THERMOPLASTIC PIPING

A. All procedures for joining shall satisfy this specification.

B. Joints shall be made using fusion joining process in strict conformance with the manufacturer's instructions. The surfaces to be jointed must be dry.

C. Use caution when using torch or any open flame around plastic piping systems. Solvents and adhesives used in making joints are flammable.

2.9 COPPER TUBING FABRICATION

A. All bores and depths of soldered fittings shall conform to the dimensions in ANSI B16.18 and ANSI B16.22.

B. The filler metal shall be a non-ferrous metal having a solidus above 400 degrees F for soldering, and above 800 degrees F for brazing. Refer to piping material specifications for copper tubing systems in Section 400513.33 - Copper and Copper Alloys Process Piping.

C. The flux shall be fluid and chemically active at the soldering/brazing temperature, as applicable.

D. The surfaces to be soldered or brazed shall be clean and free from grease, oxides, paint, scale and dirt of any kind. Any suitable method may be used to provide a clean wettable surface for soldering.

E. The average clearance between surfaces to be joined shall not be greater than .004 inches or a diametral clearance of .008 inches.

F. The joint shall be brought to soldering or brazing temperature in as short a time as possible to minimize oxidation without localized underheating or overheating.

G. Solderers and braziers shall follow the procedures as outlined in the Copper Tube Handbook published by the Copper Development Association.

H. Filler metal selection shall be submitted for approval prior to application.

I. Flux residue shall be removed from piping external surfaces after soldering or brazing.

J. Inert gas purge is required to prevent internal surface oxidation when brazing lines to be used for clean/filtered air or other gases. Nitrogen is a suitable purge gas for this application.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. For pipe support hardware and materials, refer to specification the Preferred Suppliers list.

B. Structural and support components needing fabrication shall be built using ASTM A36 carbon steel material, or appropriate stainless steel material as required in clean areas, except as otherwise indicated in the purchase order or on the design drawings. Where carbon steel supporting structures are required, stainless steel pipelines shall be isolated from physical contact with the support steel by use of the appropriate stainless steel or non-metallic spacers.

C. Exposed supports in clean areas shall be fabricated from appropriate stainless steel structural shapes, plate, pipe, or tubing, in lieu of carbon steel.

D. Steel plates to be used for pressure retaining components in piping systems shall be in accordance with the applicable material requirements of ASME Section VIII. The following table may be used as a guide, except as otherwise indicated on the design drawings:

Table 3: STEEL PLATE MATERIAL	
Piping System	Steel Plates
Carbon Steel	ASME SA516 or SA515, depending on temperature
304L Stainless Steel	ASME SA240 Grade 304L
316L Stainless Steel	ASME SA240 Grade 316L

E. For insulating materials, refer to specification Section 404200 – Process Piping and Equipment Insulation.

F. Never use grinding wheels, sanding materials, or wire brushes made of iron, iron oxide, steel or zinc, or other undesirable materials that may cause contamination of the stainless steel surface.

G. Passivation may be applied to tubing, spool pieces, cut sections and weldments as specified to eliminate and remove potential iron containing contaminants from cutting tools and machinery affecting the surface finish of the stainless steel hygienic tubing.

H. All sanitary tubing lines are to be sloped as indicated on drawings to provide for complete drainage. Unless otherwise directed, a minimum slope of 1/8 inch per foot shall be maintained.

I. Drain lines shall be as short as practical.

J. Sanitary diaphragm valves shall be installed at the proper manufacturer specified free-draining angle, unless otherwise directed. Any discrepancy noted in reference to the correct installation angle shall be brought to the attention of the Engineer, prior to welding. Caution: Not all valves are alike. Recommended drainage angle may be different for valves from each manufacturer, and even for different valve sizes from the same manufacturer.

K. Deadlegs shall not exceed two (2) times branch pipe internal diameter in length, as measured from the ID surface of the main pipe to the midpoint of the branch valve. (For diaphragm valves, the edge of the weir or sealing surface can be considered as the boundary.)

3.2 ERECTION

A. Piping connections to equipment, vessels and machinery shall be made in conformity with details shown on the drawings. Piping connections to equipment shall be installed such that no excessive stresses shall be transferred from the piping system to the equipment.

B. All assembled piping shall be installed without springing or forcing, and so as to properly clear all openings and equipment. Cutting or other weakening of structural members to facilitate piping installation shall not be permitted.

C. All piping shall be installed to permit free expansion and contraction without damage to joints or supports.

D. Thermal expansions of pipe shall be provided for as shown on drawings. Expansion loops shall be installed as shown on drawings. Welding elbows in expansion loops shall have a minimum radius of 1-1/2 pipe diameters.

E. Where called for on drawings, the Contractor shall install masonry or concrete piers and anchors to support and anchor pipelines. Supports, anchors, or stays which may deform or alter the shape of the piping, during or after installation, shall not be used.

F. Anchors may be welded directly to carbon steel pipe. Anchors for stainless steel piping shall be attached by clamps or “U” bolts, unless shown otherwise on drawings.

G. Bond of concrete to pipe will not be acceptable as anchorage to resist longitudinal thrust.

H. Suction and intake lines to pumps and compressors shall be installed with temporary line strainers, prior to hydrostatic testing and flushing. Use 1/32 inch wire by No. 10 mesh basket type.

I. Drain lines shall be as short as practical.

J. Drip pan elbows shall be installed between the pressure relief valve and the relief valve discharge (vent line) piping, for all steam system pressure relief valves having a discharge line size 2-1/2 inches and larger.

3.3 WELDED JOINTS

A. Welded joints shall be prepared and made in accordance with Part 2 of this Section.

B. In general, all production welds for joints in hygienic/sanitary tubing systems are to be made using programmable orbital welding machines in accordance with an approved welding procedure. Manual welds shall be utilized when minimum distance requirements prevent the use of automatic welding apparatus. For welding process in which filler wire is necessary, such as for manual TIG, filler wire material recommended for joining the base metals, providing the correct admixture and resultant physical properties, shall be used.

C. Shielded metal arc welding (SMAW), commonly referred to as stick welding, is specifically prohibited on tubing systems.

3.4 FLANGED JOINTS

A. Flanged joints shall be made with new gaskets as specified and new bolting materials of uniform material as specified.

B. Care shall be taken to assure that gaskets are properly positioned prior to tightening of the bolts.

C. Flanged joints shall be bolted up in a manner that will assure even and adequate pressure on the gaskets, and uniform stresses in the bolts. Some gasketing materials require high bolting loads to adequately seat. A calibrated torque wrench and a defined pattern tightening sequence shall be used to verify seating force on bolted joints in steam systems, high temperature systems, and other systems where the Engineer considers it necessary.

D. Care shall be taken to avoid over-torqueing any bolts. All bolts and nuts that have been overstressed due to over-torqueing shall be replaced.

E. Flanges shall be made up with mating face in a plane that is exactly perpendicular to the axis of the pipe. Upon erection, flanges shall be so positioned in rotation that the bolt holes shall straddle the vertical flange centerline. All gaskets shall be evenly centered between the flange faces with ring gaskets engaging fully upon raised flange facings, and full face gaskets to OD of flat flange facing. The mating flanges shall mate flush and true, and the bolts shall be tightened uniformly to draw the flanges evenly and firmly upon the gasket. When made up, the bolts shall extend through nuts by at least one full thread.

F. Prior to installation, bolts shall be lubricated with a graphite and oil mixture anti-seize compound suitable for use up to 500 degrees F.

G. No flanged joints shall be made up if misalignment exceeds the following limits:

1. Alignment - Flange facings shall not be more than 3/64" per foot out of line, measured across any diameter.
2. Lateral Displacement - The lateral distance between the center of the flanges shall not exceed 1/8 of one inch in any direction.
3. Rotation - The distance between any two mating bolt holes, after one pair of mating bolt holes has been lined up shall not exceed 1/16 of one inch.

H. Class 125 cast iron integral or screwed companion flanges shall be assembled with a full-face gasket to O.D. of flange. Class 150 steel flanges may be bolted to cast iron valves, fittings or other parts, having either integral Class 125 cast iron flanges or screwed Class 125 companion flanges. When such construction is used, the 1/16 inch raised faces on the steel flanges shall be removed and a full face gasket used.

I. Raised-face steel and alloy flanges may be bolted to flat-face steel and alloy flanges on equipment without removing the raised face. Raised face flanges are not generally permitted for mating with nonmetallic flanges. Instances requiring the mating of raised facings against plastic or soft metal flat facings shall be brought to the attention of the Engineer. With approval, specially fabricated backup spacer rings may be required to assemble the dissimilar flanged joint.

J. Flat washers shall be used under the bolt heads and nuts on all nonmetallic flanges.

K. On stainless steel piping or tubing systems where lap-joint type flanges are permitted, flanges and bolting shall be stainless steel where the flanged joints reside in a clean area or any area where high humidity or corrosive fluids are expected.

L. Care shall be exercised in tightening of nonmetallic joints to avoid over-tightening and deformation of flanges or extruding the gasket. Use fiber or metal compression limiting spacers to eliminate any potential flange warping or gaps where necessary

M. Nuts, bolts, and gaskets at flange joints between dissimilar metals shall be provided with a dielectric coating intended for the prevention of galvanic corrosion.

3.5 THREADED JOINTS

A. Care shall be taken to avoid over tightening of threaded joints and care shall be taken to avoid damaging the pipe exterior with the pipe wrench.

B. Backing off of made-up threaded joints to facilitate fit-up or alignment is not permitted.

C. Pipe in screwed flanges shall seat within 1/16 inch to 1/8 inch of face.

D. On steel and copper lines under vacuum or instrument air service cutting thread lubricant shall be soap and water. These lines shall be oil free.

E. Threaded joints shall be seal-welded only when specifically called for in Piping Material Specification or on the design drawings. Thread removal prior to welding shall be in compliance with applicable code.

F. Threaded joints which are to be seal-welded shall be made up without the use of any joint compound or sealing tape.

G. Threaded joints which are not to be seal-welded shall be made leak-tight by use of Teflon paste or Teflon tape for temperature up to 400 °F. Threaded joints on sanitary systems, such as relief valves on clean steam lines, shall be made up with Teflon tape only.

H. Teflon tape is not permitted on gas piping threads. Use pipe compound.

I. Threaded joints are not recommended for systems that undergo wide-range routine temperature cycling, or between dissimilar materials which have differing thermal expansion characteristics. Where a threaded joint under either of these conditions has been called for in the design, or seems to be necessary for system assembly, notify the Owner for resolution.

3.6 MECHANICAL JOINTS (FERRULES/CLAMPS)

A. All sanitary clamped joints shall be made with new gaskets as specified and new clamps of uniform material as specified.

B. Care shall be taken to assure that all gaskets are properly positioned prior to tightening of the clamps.

C. Gaskets for clamped joints have a manufacturer's recommended seating force, or clamping force, which varies depending on material and size. Clamp nut torque shall be monitored to provide the required range of seating force and gasket compression to achieve proper seal against leakage while avoiding ID bore constriction and creation of internal high points that can restrict free-draining ability of sloped horizontal lines.

D. Care shall be taken to avoid over-torqueing any bolts. All bolts and nuts that have been over-stressed due to over-torqueing shall be replaced.

3.7 ERECTION OF COPPER TUBING

A. All vertical lines shall be run plumb and straight, and parallel to walls.

B. Sufficient unions, flanges, or mechanical joint type fittings shall be provided for disconnecting equipment, controls, etc. All mechanical connections shall be accessible for maintenance.

C. Sleeves placed in floors and walls through which tube lines pass shall extend 1 inch minimum on each side. Sleeves may be made of pipe, or formed galvanized steel, and should be sized to allow insulated lines to pass through unobstructed. Floor sleeves intended to be relied on for vertical riser weight support shall be made of pipe or formed steel of at least the same thickness, and shall be suitably secured to the building structure.

D. Openings shall be properly filled between sleeve and (or) pipe and wall, floor or ceiling opening, to maintain fire rating of same.

3.8 SUPPORTING OF PIPE

A. Refer to Section 400529 – Hangers and Supports for Process Piping.

3.9 SUPPORTING OF TUBING

A. All tubing supports are to be located and installed by Contractor.

B. In general, supports for tubing are only shown on drawings when special conditions must be met. Such supports will be located on the piping drawings.

C. Supports for hygienic/sanitary tubing shall be fabricated, and installed in accordance with the details and parameters established by the pipe support Vendor, and in accordance with Section 400529 - Hangers and Supports for Process Piping.

D. In general, tubing should be supported to allow flexibility in order to accommodate thermal expansion. Limit stops, anchors, and guides may be required at changes in direction and other locations to control flow-induced movement.

E. All exposed supports in the sterile and ultra-clean areas shall be stainless steel with at least a smooth mill finish, with easily cleanable plastic or elastomeric components, unless otherwise directed. Polished stainless steel surfaces may be required in specific areas.

F. Where tubing passes through walls, ceilings, and floors, clearance is required around the tube to allow it to move during contraction and expansion. Approved grommets or penetration seals may be required, especially where area boundaries change.

G. Hygienic/sanitary tubing shall be supported in such a manner as to allow the line to slope as shown on piping drawings. If no drawings are provided or if no slope is specified, the absolute minimum requirements for drainability are 1/8" per foot for process lines (1:70 slope), and 1/16” per foot for clean steam supply mains (1:140 slope). The minimum slope must be maintained for any hot service once the tubing has reached operating temperature.

3.10 INSPECTION AND TESTING

A. All fabricated piping and tubing shall, as a minimum, meet the examination, inspection and testing requirements of the applicable ANSI/ASME B31 piping code.

B. Inspectors representing the Owner or his Representative shall have access at all times while work on their Contract is being performed to all sections of the worksite that concern the fabrication and erection of the piping on their Contract. The inspectors shall be afforded all reasonable facilities to satisfy them that the work is being performed in accordance with all requirements and specifications. The owner should be notified prior to all testing.

C. All welding performed under this specification shall be subject to visual inspection. This visual inspection shall include an examination of joint details prior to welding, inspection for defects during welding and for defects, undercut, overlay and reinforcement dimensions after welding.

D. All Fabricated tubing shall as a minimum meet the examination, inspection and testing requirements as in the Procedures and Inspection section, Appendix A of this specification.

E. All welded joints (other than sanitary tubing) shall require 10 percent random visual inspection.

F. In general, sanitary tubing will require 100 percent external visual inspection of all welded joints, and up to 100 percent internal visual inspection, in accordance with the Inspection Plan as approved by the Owner. (Refer Appendix A for details.)

G. Non-destructive examination and testing shall be performed in accordance with the Contractor's S.O.P's.

H. Non-destructive examination shall be performed prior to any hydrostatic pressure tests.

I. Pressure testing shall be performed prior to covering pipe with insulation.

3.11 PRESSURE TESTING

A. As far as is practicable, all pressure tests shall be complete system tests conducted with all parties present. Pressure vessels, instruments and equipment connected to the piping may be included in the test if their rated test pressure is not exceeded by the piping system test pressure. It is the Owner's option to exclude certain equipment or devices from testing based on practicality or manufacturer's recommendations.

B. Every precaution shall be taken during testing to ensure the safety of the test operator and other personnel working in the area. Systems to be pressurized shall be provided with appropriate gauges and pressure relieving devices.

C. All joints, including welds, are to be left uninsulated, unpainted, and exposed for examination during testing.

D. Equipment and/or instrumentation which are not to be subjected to the pressure test shall be either disconnected from the piping or isolated by blinds or other means during the test. Valves may be used provided the valve is suitable for the proposed test pressure.

E. Expansion joints shall be provided with temporary restraint, if required, for the additional pressure load under test, or shall be isolated from the test.

F. Pressure gauges shall not be subjected to pressure in excess of their scale range. All pieces of equipment which do not have their test pressured indicated or whose test pressures are below the piping system test pressure shall be excluded from these tests.

G. Pressure relief and thermal relief devices which are part of the piping system shall be excluded from these tests either by removal or isolated by test blinds.

H. Before every test the piping and tubing systems shall be visually inspected to assure that there are no obvious defects and that all connections are tight.

I. Control valves, unless being tested, shall be set and maintained in the open position.

J. Lines that are spring or counterweight supported and all vapor or gas lines shall be temporarily supported during the test in order to support the test fluid load, if necessary.

K. All plastic lines shall be hydrostatically tested. An exception to this will be pneumatic hookup lines to instruments, which will receive an in-service pneumatic test.

L. Lines containing check valves shall have the pressure applied upstream of the check valve so that pressure is applied under the seat. If this is not practical, the check valve disc shall be locked open or removed for the test.

M. All in-line instruments, gauge glasses, flow meter pots, liquid level float gauges, and all other pressure parts of instruments shall be included in these tests, where feasible.

N. Joints found to be defective shall be repaired and retested.

O. Retesting of lines after repairs shall be done at pressure originally specified for the test.

P. At the completion of the test; all blinds, plugs, caps, etc., used to isolate vessels, instruments, etc. shall be removed; flange faces and threads inspected for damage and piping reconnected. Gaskets removed after tests shall not be reused. Special care shall be exercised when reconnecting these points to avoid leaks.

3.12 TEST REPORTS AND PROCEDURES

A. The Contractor shall make a record of the test on the Contractor's submitted S.O.P. or similar test report for each piping system tested which shall, as a minimum, consist of the following data:

1. Line designation number
2. Date of test
3. Type of test, pressure applied, and length of time at test pressure
4. Tested by
5. Tests witnessed by (Owner's Representative).
6. Comments, if any

B. A written Safe Work Procedure shall be submitted by the Contractor for approval prior to beginning of pneumatic tests if the test pressure is to exceed 25 psig. The procedure shall cover a minimum of the following items: Pretest visual inspection, areas to be roped off, time schedule for incremental pressure increases, and indoctrination of personnel on hazards on hazards involved, facilities at site for medical care, and fire fighting in case of an emergency.

C. System diagrams or P&ID's shall be suitable marked showing the boundaries or extent of the test for each system to be tested. These documents are normally included as turnover documents submitted to the Owner subsequent to piping system completion.

D. Owner's Representative shall signify his acceptance of the tested system by initialing the approved portions of the piping system on the Constructor's record of test, and by any other definite means mutually agreed upon.

E. All tests shall be performed using a certified pressure gauge having a minimum face diameter of 3 inches and in current calibration. The scale range of the test instrument used for any particular test shall be such that the required test pressure falls between 1/3 and 2/3 full scale reading for best accuracy.

3.13 HYDROSTATIC TESTING

A. The hydrostatic test pressure shall be calculated in accordance with the applicable section of ASME B31.3 but shall not exceed the maximum test pressure of any vessels or components included in the test.

B. All hydrostatically tested systems shall be tested to 1.3 times the design pressure or to a minimum pressure of fifty (50) psig, whichever is greater. Design pressure is defined herein as the maximum operating pressure shown in Specification 400513.19. All test pressures shall be maintained for a minimum of ten (10) minutes before examination of joints begins. All joints shall be visually examined for any signs of leakage.

C. No sanitary tubing or diaphragm valves shall be tested in excess of 150 psig.

D. When design temperatures are above the test temperatures, adjustments shall be made in accordance with ASME B31.3.

E. Hydrostatic test pressures shall not be applied until the piping system and the testing medium have reached thermal equilibrium. Pressure shall be applied in reasonable increments until specified test pressure is attained.

F. When setting the system test pressure, the test gauge shall be monitored and corrections made for any pressure changes due to thermal expansion or contraction. By this procedure the test pressure shall be kept within five (5) psig or one (1) percent, whichever is greater, of the intended value. After the test pressure is set, the pressure source shall be disconnected from the fill point prior to examination for leakage.

G. Tested systems shall be vented and drained immediately upon successful completion of the test. All process and solvent lines shall be dried by passing clean, oil-free inert gas through them.

H. No repair welding shall be done on any section of piping that contains water.

I. Potable water shall be used as the test medium when testing piping systems handling potable or safety shower water.

J. Water used for testing product contact surfaces shall be clean purified or deionized water filtered at 0.2 microns per ASME BPE. In addition, water used for testing austenitic stainless materials shall be free from chloride (less than 100 PPM). Verify water source and quality with Owner. The Owner is responsible for furnishing acceptable water.

K. Stainless steel lines shall be emptied and dried immediately after hydrostatic test are completed. To avoid the possibility of pitting due to chloride content in water, the time lapse between hydrostatic testing and start-up of the plant should not exceed one month or demineralized water that meets current USP requirements should be used as the testing medium.

L. For hydrostatic tests, every precaution shall be taken for the removal of trapped air. The Contractor shall be responsible for properly venting piping systems for testing, and after testing while draining to insure against collapse by vacuum.

M. The Contractor shall be responsible for the removal of water used in testing piping systems. The owner shall be responsible for disposal of this water.

3.14 PNEUMATIC TESTS

A. Air tests, when specified, shall be performed with clean, dry air, or nitrogen, as required by process consideration. The source shall be equipped with appropriate pressure regulators, relief valves and gauges.

B. Air tests shall be performed at the test pressure specified in the Examination and Testing Requirements Tables. If not specified, the test pressure shall be in accordance with ASME B31.3.

C. Pneumatically testing systems shall include a preliminary check at not more than 25 psig. The system shall then be brought up to test pressure in 10 psig increments. Enough time shall be allowed for thermal equilibrium for each incremental step up to and including the final test pressure.

D. The pressure source shall be disconnected from the test apparatus fill connection prior to examination for leakage. All joints shall be inspected with an approved solution formulated for soap bubble testing.

E. The system under test shall hold the test pressure, with no indication of pressure loss according to test gauge, for a minimum period of one (1) hour prior to formal inspection of joints.

F. Tested systems shall be vented immediately upon successful completion of the test.

G. No repair welding shall be performed on a pressurized system.

H. Where both hydrostatic and pneumatic tests are run on a section of pipe, the pneumatic test shall precede the hydrostatic.

I. On tested systems which do not complete their test successfully, the leaks shall be located, marked, and repaired immediately after depressurizing the test section. Tested systems which fail the pressure test and have been repaired, shall be retested using original test pressures and procedures.

3.15 VACUUM TESTING

A. System requiring a vacuum test shall be tested by the following procedure:

1. The system shall receive a preliminary pneumatic pressure test at a minimum internal pressure of 15 psig in accordance with Paragraph 3.11 of this specification.
2. The system shall be given an operational vacuum test using the operating vacuum pump or a special test pump. The system shall be considered acceptable if vacuum of 20" Hg (5 psia pressure) is maintained for a period of four (4) hours and if the pressure does not rise more than one inch Hg (0.5 psia) with the pump shut-off.
3. If step 2 is not successful, the system shall be retested per step 1 to locate the leak, using soap and water at all joints, then repaired and given another vacuum test.
4. Process vacuum systems normally operating at vacuum levels approaching absolute vacuum shall be tested to maintain the required higher vacuum level.

3.16 STANDING WATER TEST

A. Systems operating at pressures no greater than atmospheric pressure, such as certain process waste and vent lines, shall be tested by the following procedure:

1. All portions of the system under test shall be completely filled with Owner furnished water. Care shall be taken to eliminate all air pockets. A considerable amount of time is sometimes required for this step, especially if soluble paper dams have been used for inert gas purge.

2. Water shall stand for a period of not less than two (2) hours, prior to inspection of joints.
3. If the system loses water faster than the rate specified, the leaking component shall be repaired and the system retested.
4. System will have a minimum of 10'-0" head pressure.

B. The leak rate shall not exceed values specified by AWWA Spec. C600-64, Section 137. Steel piping systems shall be leak tight. Vent or drain systems fabricated of pressure piping components, either metallic or plastic, shall be leak tight.

C. Process drain or vent systems which are designed to contain pressure under certain operating conditions, or designed to control environmental leakage, shall be pressure tested in accordance with the Owner’s instructions.

3.17 SYSTEM CLEANING AND FLUSHING

A. The interior of all pipes shall be free from loose mill scale, sand, dirt, slag, weld splatter, rust and other foreign matter when erected. Slight oxidation is permitted on carbon steel pipes.

B. After erection and welding of piping, lines requiring hydrostatic testing shall be flushed with clean low-chloride water (chloride content shall not exceed 100 PPM). The test shall be conducted in the presence and to the satisfaction of the Owner or his Representative.

C. After erection and welding of piping, all lines requiring pneumatic testing shall be blown free of dirt and debris with clean, dry air, to the satisfaction of the Owner or his Representative, in lieu of water flush.

D. When flushing has been completed, lines shall be drained, permanent strainers shall be cleaned and replaced and any temporary strainers, connections, valves or related items shall be removed. Piping systems shall be placed in normal operating condition including necessary adjustments that may be required to the system.

E. System flushing may be performed before or after pressure testing, but shall be completed prior to any passivation is performed.

F. Disinfecting of potable water pipes shall be done in accordance with the requirements of any local and state codes.

3.18 PASSIVATION

A. Compliance with ASTM A 967-96: Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts, and ASTM A 380-96: Standard Practice for Cleaning and Descaling Stainless Steel Parts, Equipment and Systems shall be required.

B. All welding and pressure testing of system and/or components shall be completed prior to passivation.

C. Passivation is a process by which a solution of a mineral or organic acid in water, in combination with a wetting agent or detergent or both, is employed to remove iron and other metallic contamination, light oxide films, shop soil, soluble salts, and other corrosion products, leaving a chromium-rich surface for increased corrosion resistance.

D. Current industry practice is to use the nitric acid passivation process, the citric acid passivation process, or other proven proprietary solutions and methods. The Owner has the option to request and approve a passivation process, which can be shown to produce satisfactory results, and meet his particular requirements.

E. Contractor shall submit and have approved his detailed procedures for the passivation of all hygienic/sanitary tubing and equipment delineated on the flow diagrams prior to commencing work.

F. The procedure shall name chemical ingredients and detergents, etc., by trade name and/or chemical formula.

G. The procedure shall indicate the strength/concentration of all solutions to be circulated in tubing system, and also the temperature, pressure, and duration of use.

H. An adequate supply of demineralized or R.O. water must be available on-site for solution make-up and flushing. Contractor to verify the source and supply of water with the Owner.

I. The final post-acid treatment rinse shall be done with demineralized water. Owner's Representative may verify water quality by sample analysis.

J. Tubing systems to be passivated may be joined in series circuit by flexible hoses in order to affect economies, but on no account may be split and run in parallel flow paths, unless required flow velocities can be verified in all branches.

K. All systems that have been passivated must be thoroughly dried using clean, oil-free, dried, filtered air, then capped or reconnected to the main system unless otherwise implied in contract documents.

L. Passivation data shall be recorded and initialed on a Passivation Log Sheet per contractor's submitted S.O.P.

M. The Contractor shall furnish test coupons to be included in the circulating system, and they shall be Ferroxyl tested for passivation results. The location of the coupons will be determined and agreed upon by the Owner and the Contractor. If no location has been specified or agreed upon, place the test spool in line at downstream end of the passivation stream.

N. Detergent, water rinse, and passivating agent shall not enter processing equipment unless otherwise noted. Sanitary clamp connections at inlet nozzles to equipment are to be broken, and connected with hoses, which will be run to drains (for rinsing step) or to acid-resistant collection containers (for detergent wash and passivation). All tanks and equipment are assumed to be passivated by the manufacturer unless included in the passivation system as shown on flow diagrams. Pumps should be passivated with the piping system. Tubing shall be re-connected to excluded equipment upon completion of passivation procedure.

O. Contractor shall identify a sanitary tubing system from the flow diagrams and use it in a sample procedure, detailing all the steps to be taken from start to finish to render these systems passivated in accordance with this specification. The sample procedure should also detail any additional work the Contractor deems necessary, desirable, or is part of his standard operating procedures to achieve the required results.

P. The Contractor shall submit a procedure for passivating singular components, or spool pieces, that are not included in the circulating flow of the complete system.

3.19 SAFETY

A. The chemicals used in cleaning and passivation procedures are potentially dangerous. Precautions shall be taken to protect all personnel, equipment and facilities. Proper attire, including but not limited to: boots, rubber suits, rubber gloves, rubber head coverings, goggles, face masks and respirators, shall be available to Contractor and owner personnel as required. Contractor shall ensure that adequate safety showers and eye wash stations are provided in the vicinity of the operations.

B. In addition to the above, the Owner’s site safety rules shall be in total compliance.

3.20 WASTE DISPOSAL

A. Compliance to federal, provincial and local pollution control regulations is essential. Contractor shall consult with Owner on approved methods of disposing of large volumes of chemical solutions.

B. The Contractor must confirm with the Owner that it is acceptable to use existing building infrastructure drainage system. Any use of the Owner’s systems must be coordinated with the Owner.

3.21 QUALITY ASSURANCE

A. The Contractor shall maintain all records of field fabrication including records of fabrication steps and all tests and inspection data and all records of cleaning and passivation procedures.

B. The Contractor shall maintain and utilize a quality control system, which will establish that all contractual requirements are met. This shall include requirements for material, fabrication, welding, erection and examination procured and/or performed by the Contractor; and material and/or inspection provided by the Owner.

C. A written description of the quality control system shall be developed and submitted for review and acceptance by Construction Manager before work is commenced.

D. The necessary scope and details of the QC system shall be a function of the complexity and extent of the work to be performed and the circumstances of the Contractor's organization, but as a minimum, cover the features outlined herein. This information will be treated as confidential and of proprietary nature, and will be returned to the Contractor at the conclusion of the project.

E. The authority and responsibility of those administering and performing the activities of the quality control system shall be delineated clearly. Persons performing quality control functions shall have sufficient and well-defined responsibility, the authority and the organizational freedom to identify quality control problems, and to initiate, recommend and provide solutions.

F. The Quality Control System

1. An organization chart showing the relationship between management, purchasing, receiving, document control, supervision, fabrication (and welding), pipe fitter labor, non-destructive examination (NDE), inspection and quality control is required to identify the actual portion of the organization with the particular function for which it is responsible.
2. The Contractor shall have a system of material control which will ensure the following:
3. That the proper material is ordered
4. That the correct material has been received
5. That the material is identified properly
6. That documentation (material certifications and/or mill test reports) when required, are received and that they validate the material satisfactorily.

G. The Contractor shall have a quality control system that indicates that fabrication, welding and erection conform to specification requirements and ASME B31.3 -latest edition. This shall include examination and inspection to verify that contractual requirements have been met.

APPENDIX A – AUTOMATIC WELDING PROCEDURE AND INSPECTION

4.1 SUMMARY

A. The section describes the inspection requirements for automatic orbital welding of thin wall stainless steel tube and fittings.

B. Weld Verification Checklist per Contractor's submitted S.O.P. shall be used to verify the principal information, preparation, and quality requirements. The Contractor shall check dimensions and setup and make appropriate entries onto this checklist, or a similar approved form.

C. The Welding Inspector shall prepare the required records, and visually inspect the welds. Inspectors shall be certified by the American Welding Society as Certified Welding Inspectors (CWI) in accordance with DI.1 and/or by ASNT-TC-1A as a Level II or III Visual Inspector.

D. Non-destructive tests shall be performed by an independent testing agency with qualified personnel.

4.2 WELDED JOINTS

A. In general, all production welds for joints in hygienic/ sanitary tubing systems are to be made using programmable orbital welding machines in accordance with an approved welding procedure.

B. Manual TIG welds, necessary where automatic welding is not possible, shall be approved on a case-by-case basis.

C. Shielded metal arc welding (SMAW), or stick welding, is specifically prohibited.

4.3 PREREQUISITES

A. Contractors involved in a project that references welds to a section of A.S.M.E. must understand what is being requested. Typical specifications for certification and/or qualification are as follows:

1. Welders must be certified to A.S.M.E. - Section IX. The Contractor must have:

    a. A quality assurance (QA) manual and Program in effect. A copy of the QA program shall be made available to the Owner for review prior to award of the contract.
    b. A set of General Weld Standards. Contents may include:
    c. Method(s) of verifying material, i.e., MTR's.
    d. Method(s) of verifying tube ends are cut square.
    e. Method(s) of verifying tube cleanliness.
    f. Tungsten electrode length verification per manufacturer's recommendation.
    g. Tungsten electrode tip preparation per manufacturing recommendations.

2. Qualified procedures in place.

    a. Generate test coupons that are sent to a qualified test lab for destructive testing (bend and tensile tests).
    b. Bend tests are predetermined over a certain sized radius. Two each root and face bends must be performed. Careful examination must be done at the Heat Affected Zone (HAZ) to inspect for possible cracking.

3. Tensile tests performed must be examined for the following:

    a. PSI at which the specimen breaks must equal or exceed the tensile stress of the base materials being joined together.
    b. Should the specimen break on the weld, as opposed to being adjacent, (but still meet the base criteria in PSI) the sample is considered good.

4. Standard Operation Procedures (S.O.P.'s) for purge gas certification and acceptance criteria including:

    a. Calibrated oxygen analyzer and moisture meter, and a method of recording initial fill and purge of distribution system. Sample at bulk tank.
    b. An acceptance criteria defining maximum impurities by volume of oxygen and moisture.

5. By ASME code, the Contractor must prove that the process and techniques used meet ASME criteria for procedure qualifications.
6. Each time the Contractor certifies a new welder, that welder shall follow an approved welding procedure. Completed sample coupons shall be evaluated by either a bend test or x-ray. Prequalified welders with current certification from other projects are acceptable.
7. References:

    a. ASME BPE-2012
    b. ASME Boiler and Pressure Vessel Code, Section IX, latest edition.
    c. AWS A3.0 Terms and Definitions, latest edition.
    d. ASME B31.3 - Process Piping Code.
    e. ASNT-TC-1A

4.4 COMPONENT AND WELD IDENTIFICATION

A. Each weld is to be numbered on a weld map drawing. This identification shall be marked on the tubing, near the weld, with a permanent chloride free maker or approved mechanical or electrical etching method. The weld number consists of the document drawing number followed by a sequential weld identification number. Primarily this number shall identify the weld inspection checklist, weld trace, and the actual weld. Per contractor's submitted S.O.P.

B. The control documentation record for each weld shall include:

    1. Welder's identification symbol or initials.
    2. Location where the weld is made.

3. Welding machine used.
4. Size, type, and heat number of components to be welded.
5. Weld identification number.
6. Weld inspected by QA/QC Representative.

C. The inspector shall verify that the tube adjacent to the weld is marked, or labeled by an approved method, with the weld number.

1. Random cutout may be an option

4.5 WELD PREPARATION

A. Each welder shall produce one acceptable weld coupon prior to the start of any production welding for each welding machine, welding procedure, welding specification, welding position, nominal pipe/tube size and wall thickness change.

1. In addition, the Contractor shall produce one acceptable weld coupon when welder changes heat, tube size, changes power source, or shuts off machine. Test coupon for this routine verification can be “bead on tube”.
2. The coupons shall be cut about 1/2 inch on each side of the weld to allow for visual examination of the root side of the weld.
3. Coupons shall be identified by a permanent marking method. Identification shall include: Welder’s initials, machine number, date and time. This information shall be entered in the weld log. The inspector shall initial and date the coupon upon acceptance. If the coupon is rejected the inspector shall so note on the coupon. No production welding will proceed until an acceptable welded coupon is provided. The client or his inspection agent shall retain all coupons.

B. Tube sections verification (By Contractor):

1. The length of tube is as required to give spool dimensions as shown on the document drawing.
2. Tube ends are machined using a special tool to assure squareness.
3. Burrs are removed from machined ends.
4. No tool has been contaminated by contact with carbon steel.
5. Verify tube roundness is to specified tolerances.

C. Cleaning Verification:

1. Components to be joined are cleaned with isopropyl alcohol (IPA). The cleaned ends shall not be touched by the skin (fingers) before welding. Welders, fitters, etc. shall wear cotton gloves when handling sanitary tube ends. If this is impractical, then the tube ends shall be cleaned after handling with IPA immediately prior to welding.
2. No visible foreign material is acceptable at the weld ends of the components. This includes lint from cleaning cloths.
3. Tungsten electrode must be clean and uncontaminated.

D. Joint Fit-up:

1. A joint fit-up should exhibit a square tight joint. However, if this is not possible the gap between ends of welding components shall not exceed .005" for .065" wall and .083" wall; .003" for .035" wall and .004" for .049" wall.
2. The joint shall be centered on the tungsten electrode.

E. Weld Machine Settings:

1. The Contractor shall set the machine in accordance with appropriate welding schedule as shown in the welding procedure. Settings cannot deviate more than 10 percent without prior approval of the Welding Inspector.
2. The Welding Inspector shall verify machine settings are in accordance with the procedure requirements (located at each machine).
3. The Contractor shall assure that the electrode has been rotated to proper start position.
4. The Contractor shall assure purge gas meets the required quality with respect to purity and moisture content.
5. The Contractor shall not use purge gas from the cylinder when pressure gage indicator falls below 400 psig.
6. The Contractor shall assure that the purge flow is in accordance with the qualified weld procedure, and that minimum required flow is apparent exiting from the end opposite the purge source of the tube being welded. Each purge gas manifold shall be fitted with a 2 micron filter.

F. Weld Identification

1. A permanent identification mark is normally required near each weld for the purpose of initial weld acceptance and subsequent system validation. The Owner may decide, however, that permanent marks at each weld or at welds in certain systems are not desirable, and may choose to rely on the completed weld map records as an acceptable method for location of each weld and system validation.
2. The identification marking shall be made using one or more of the currently acceptable methods:

    a. Permanent black marking pen, certified by the manufacturer to contain less than 200 ppm halogens. (Sanford TEC/13401 or equal)
    b. Mechanical marking, using a vibrating etching tool, where the markings made penetrate the tubing surface no deeper than .005 inch.
    c. Electrolyte discharge stencil marking, which leaves a smooth, dark colored stain on the outer surface of the tube.

3. The Owner shall concur with the marking scheme chosen to facilitate his periodic in-service inspection and validation program, prior to use of such marking scheme.
4. Vibro-etching may be used, in general, on any tubing that will be insulated. Where tubing is exposed and subject to routine cleaning or wipe-down of the external surface, the Owner may require that polished surfaces cannot tolerate scratch-marking and in those cases another marking method shall be used.

5. Where vibro-etching is used, the Contractor shall maintain documented proof that the tool is stored in a manner that prevents the tool from being in contact with carbon steel or other contaminants. Markings shall be of low penetration, and only as aggressive as necessary for clear identification, to prevent stress raisers and encroachment on minimum tubing wall thickness

4.6 WELD INSPECTION

A. Frequency of ID inspection required for "shop" or "field" production welds is as follows:

1. 100% of all production welds performed in the controlled shop environment shall receive ID inspection (boroscopic or direct visual).
2. NOTE: With the Owner's approval, the rate for a shop welder may be reduced to a random 20% of production welds after a minimum of (55) consecutive acceptable welds are performed by that welder. (Based on ANSI Z1.4-2013)
3. Upon a rejectable weld, the rate of inspection for that welder returns to 100% until again fifty-five (55) consecutive acceptable welds are produced. At which time, the rate of boroscopic inspection may again drop to 20%.

B. A minimum of 20% of all production welds performed in the field environment shall receive ID inspection (boroscopic or direct visual), and accepted or rejected. Any rejects at the 20% level shall constitute a 50% inspection level. Additional rejects will constitute a 100% inspection level. Welders shall use the following procedure to ensure welds not inspected on the ID are of acceptable quality.

1. Welds to be made are pre-tacked and a constant ID purge is maintained through the fit-up.
2. A closing and an opening coupon are required. One opening coupon must be performed, inspected and approved prior to any production welding.
3. Production welds are completed (beginning at the end closest to the purge inlet) using an approved weld program, then followed by the performance of the closing coupon at the end of the fit-up.
4. The closing coupon shall be inspected and approved, AND at least one (20% minimum) accessible production weld shall be inspected and approved using the ID borescope.
5. The weld program used, purge flows, electrical characteristics, and other essential welding variables must remain constant from the time of the opening coupon to completion of the closing coupon for all welds to be accepted. Retain printouts from the welding machine for each weld coupon to prove they were performed in a controlled series.

C. All boroscopic inspections shall be recorded on the "Visual Examination Report".

D. If required by the Owner, boroscopic inspections shall be recorded on videotape and retained for turnover to the Owner with the final document package.

E. Frequency of OD inspection shall be 100 percent. The outside of the weld is visually inspected after the spool is removed from the welding machine.

1. The weld bead should be full and even on the inside, with no sign of oxidation. An occasional light blue tint outside the weld may be noticeable, which is normally acceptable. Dark bluing or black in the weld, or adjacent to the weld, is unacceptable and will be cause for rejection.
2. The pulse rate and pulse width should be even and symmetrical with no signs of being erratic.
3. Five (5) percent random radiography is a customer option and may be used if other than 100 percent ID boroscopic inspection is employed.

F. Standard weld acceptance criteria shall be per BPE Part MJ, as summarized below:

1. Oxidation: The interior surface of the weldment shall be free of heavy black, dark blue grain-type (sugaring) oxidation.
2. Discoloration: The discoloration of the interior surface of the weld and heat affected zone is to be minimized or eliminated (light blue to light straw color maximum).
3. Lack of Fusion: No lack of fusion is permitted.
4. Undercut: No undercut, as defined in ANSI B31.3, shall be permitted on the interior or exterior of the weld.
5. Outside Diameter Misalignment (Hi-Low) shall be held within the following maximum dimensions for various tube sizes:

    a. 1/2" thru 2-1/2" 10% of nominal wall thickness
    b. 3" and 4" OD 15% of nominal wall thickness

6. Heat Cracking (checking): Not permitted.
7. Porosity: No visually detectable surface porosity is permitted.
8. Concavity and Convexity for both OD and ID surfaces of orbital welds shall be held within the tolerance limits described in MJ-6.4 of the materials joining section of the BPE standard. Acceptable weld profiles for orbital welds are shown in Fig. MJ-1. (Note: Slight ID convexity shall be preferred over ID concavity in hygienic process systems.) For manual welds, acceptable tolerance shall be +/-0.20” for tube sizes 1/2” thru 1-1/2” OD, and +/-0.025” for tube sizes 2” thru 4” OD.
9. Meandering of Weld Bead: No more than that which creates a lack of fusion

4.7 PROTECTION OF SPOOLS

A. All openings shall be kept plugged at all times with approved plastic caps and taped.

B. Clamp ends and flange faces shall be protected from damage in handling by approved protective devices.

C. During handling and storage other than on work tables, spool shall be on wooden skids or coated racks in a protected area. Exposure to carbon steel or bare concrete during storage is prohibited.

D. When a spool is completed it shall be clean and dry. If a visual exam proves otherwise, efforts to clean and dry the spool shall be made.

E. Owner shall have the right to reject any material for installation, or already installed material, that has been improperly stored or handled.

4.8 ACCEPTANCE

A. The Contractor shall complete the Weld Verification Check List per Contractor's submitted S.O.P. When it has been completed, it shall be signed and dated. If at any place the weld is rejected, the reason for rejection shall be recorded in the Welding Inspection Log per Contractor's submitted S.O.P. The welding inspector shall sign/ initial each checklist at the time the weld is inspected.

B. The Owner or his Representative may also sign the checklist. This signature does not verify the recorded data, but rather, verifies that it is mechanically complete.

4.9 OTHER REQUIREMENTS

A. All tools and/or machines required to fabricate in accordance with this specification are the responsibility of the Contractor.

B. All material (tubing and fittings) required is the responsibility of the Vendor. Inspection of same for conformity to specifications is responsibility of the Contractor. The third party inspector shall spot check the materials to assure Contractor inspection meets the intent of the specification. A five (5) percent re-inspection of material not included in the Contractor's inspection should be sufficient to assure quality, unless a more stringent level is requested.

C. Materials of non-conformance to specifications are to be replaced, at no cost to the Owner or their Representative, by the Vendor.

D. Any testing or cost for same which is required due to suspected material composition, make-up deficiency or non-conformance to mill specifications is the sole responsibility of the Vendor.

E. All welds are to be labeled by number using an appropriate permanent marking method that clearly identifies each and every weld and does not interfere with the integrity of the system specification. Acceptable marking methods are described in section 4.5-F.

F. It is the intent of any welding on stainless steel system for installation in a Bio-pharmaceutical facility meets all of the requirements as set forth in cGMP, FDA Validation Requirements.

4.10 SUBMITTALS

A. For the purpose of engineering checkout and validation, the Contractor shall provide the following in his turnover package:

1. Weld Inspection Records, including isometric weld maps.
2. Weld Procedure Specifications.
3. Weld Procedure Qualification and Welder Qualification Records.
4. Material Documentation.
5. Welding equipment description and calibration certificates.
6. Certificate of Analysis for purge gas purity.

END OF SECTION 400513

CONFIDENTIAL DOCUMENT

40051319

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

STAINLESS STEEL PROCESS PIPING

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

40051319

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
40051319	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 400513.19 – STAINLESS STEEL PROCESS PIPING AND TUBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Reference Specifications

1. 400513 - Common Work Results for Process Piping
2. 400610 - Schedules for Gas and Vapor Process Piping
3. 400620 - Schedules for Liquids Process Piping
4. 400529 - Hangers and Supports for Process Piping
5. 400553 - Identification for Process Piping and Equipment
6. 404200 - Process Piping and Equipment Insulation

C. Reference Codes and Standards

1. ASTM - Standards for Materials
2. ANSI - American National Standard Institute
3. ASME Code for Pressure Piping B31.3 - “Process Piping”
4. Pipe Fabrication Institute Standard ES-3
5. ASME B&PV Code Section VIII - Pressure Vessels.
6. ASME B&PV Code Section IX - Welding and Brazing Qualifications.
7. ASME BPE-2014 - Standard for Bioprocessing Equipment
8. FDA Guidelines & Current Good Manufacturing Practices (cGMP) compliance

D. The Contractor shall submit their SOP’s for approval for:

1. Pipe Pressure Test Report
2. Examination and Testing Requirements
3. Welding Inspection Log
4. Proposed Welding Process Checklist

1.2 SUMMARY

A. All work within the scope of this specification shall be performed in accordance with this specification and all applicable referenced documents. No deviations shall be made from this specification or any applicable referenced documents, without the prior written authorization of the owner or his Representative for each deviation. The application for each deviation shall completely and specifically define the location of, the nature of, and the reason for the proposed deviation.

1.3 GENERAL REQUIREMENTS

A. All conflicts between requirements of this specification, related specifications, standards, or purchase orders shall be referred to the Owner or the Owner's Representative prior to shipment.

B. All specifications, standards, codes, etc. referred to and designated herein, together with all addenda, revisions and supplements shall be considered part of this specification. Specifications referred to shall be of the latest edition, as of the date of the purchase order.

C. No deviations shall be made from this specification, referenced specifications or purchase orders without prior written authorization from the Owner or the Owner's Representative for each deviation. The application for each deviation shall completely and specifically define the location of, the nature of, and the reason for the proposed deviation.

D. The Owner or the Owner's Representative reserves the right to reject any piping materials if it has not been demonstrated to the Owner's or the Owner's Representative's satisfaction that the requirements of all applicable specifications, purchase orders, and inspection and examination procedures have been met.

E. Any documentation required shall be readily identified with the piping material to which it corresponds.

1.4 SUBMITTALS

A. Contractor to follow the requirements of Section 400513 - Common Work Results for Process Piping.

1.5 SPECIFICATIONS

A. Specifications, standards, codes, etc., referred to and designated herein, together with all addenda, revisions, and supplements, shall be considered part of this specification. Specifications, standards, codes, etc., referred to shall be of the latest edition.

B. All materials, fabrication, assembly, testing and inspection of the tubing systems within the scope of this specification shall be in accordance with the ASME Code for Pressure Piping B31.3, Local Codes, 3A FDA Sanitary standards, ASME BPE-2014, and the contract piping materials specifications.

C. Conflicts between the requirements of this specification, related specifications, standards, purchase orders or design drawings shall be referred to the Owner or his Representative for clarification before proceeding with work on the affected parts.

PART 2 - PRODUCTS

2.1 SF6 SPECIFICATION

A. Refer to Section 400610 – Schedules for Gas and Vapor Process Piping and Section 400620 – Schedules for Liquids Process Piping for Service List.

SYSTEM RATING
Tubing shall not exceed 150 psig @ 300°F
TUBING CHEMISTRY
Type 316L stainless steel tubing ASTM A269 and A270.
Seamless or Welded
Allowable sulfur range 0.005 - 0.017%
TUBING DIMENSIONS
1/4" and 3/8" OD x 0.035" nominal wall thickness
1/2" through 3" OD x 0.065" nominal wall thickness
4" OD x 0.083" wall thickness
6" OD x 0.109" wall thickness
Tubing dimensions and tolerances shall conform to ASME BPE Part DT
TUBING FINISH
25 Ra µin maximum after electro-polished in accordance to ASME BPE SF6.
FITTINGS
Tube fitting material, thickness, and finish are to be as specified for adjacent tubing. Long tangent type weld fittings are to be utilized for automatic machine welding. All fittings shall comply with ASME BPE Part DT.
Branch connections shall be "tee" fittings (full or reducing).
Custom made fittings are to be manufactured to the material grade and finish as adjacent tubing. Identical heat lot numbers will be used whenever possible. Tolerances, pressure ratings, and markings for fittings and ferrules fabricated from tubing are to conform to ASTM A269/A270 and ASME BPE.
JOINTS
Automatic machine autogenous butt-welding is the preferred method of joining tubing and fittings. All welding shall comply with the ASME BPE.
Tri-Clamp type joints are to be used when connecting to valves, equipment, and accessories with Tri-Clamp type ends.
GASKETS AND ELASTOMERS
Material in contact with the Process shall be USP Class VI Viton. Material in contact with caustic solutions shall be USP Class VI EPDM. Purified Water service shall be USP Class VI Viton and steam service shall be Tuf-Steel or equivalent. Gasket to be matched to fittings and clamps.
VALVES, Diaphragm
Valve material, weld-end thickness, and surface finish are to be compatible with specified adjacent tubing. Valve body end-to-end dimensions shall comply with ASME BPE for buttweld bodies.
½" through 6" diaphragm valve 316L stainless steel body, forged, weir type, with butt weld or clamp ends to match adjacent piping.
Diaphragm in contact with the Process shall be USP Class VI Viton. Diaphragms in contact with caustic solutions shall be USP Class VI EPDM. For Steam service the diaphragm shall be 2 pieces comprised of an EPDM elastomer backing cushion with USP Class VI PTFE diaphragm.

VALVES, Diaphragm (Continued)
Topworks to include a user adjustable travel stop and stainless steel fasteners and sealed bonnets. Topworks material of construction to be Stainless Steel, PPS, PAS or PES and resistant to steam sterilization and typical washdown media. All unused ports in the Topworks must contain a plug to prevent contaminates from entering the bonnet area. Any vent ports/weep holes used for leak detection must contain a sintered/fettered vented plug.
VALVES, Check
½" through 3" 316L stainless steel body, spring loaded, disk type, 316 stainless steel spider, spring and disc, 316L stainless steel body clamped ends. Wall thickness and surface finish to be the same as specified for adjacent tubing.
DOCUMENTATION
All tubing, fittings, and valves to be welded and installed must be traceable to a mill heat number and be supplied with certifying documentation matching the markings on the piece. A chemical analysis is to be furnished for each mill heat number. Certificates of compliance are to be furnished for all equipment, components, and elastomers.
CLEANING & PACKAGING
Tubing, fittings, valves and accessories shall be cleaned of manufacturing oils and debris for use in sanitary/high purity service.
After cleaning, materials shall be sealed and packaged by an acceptable method to maintain the high-purity state until the item is ready for service.
NOTES:
A. All liquid lines of 3/4" diameter and greater shall have positive slope of at least 1/8" per foot. 1/2" diameter lines shall have a positive slope of at least 1/4" per foot. Short runs at valve manifolds can be horizontal.
B. All welded joints to be made with tungsten, inert gas, fusion welding (interior and exterior) machine or machine with equal weld controllability.
C. All piping, components, and fittings shall be passivated after installation.
D. All items that are assigned a tag number on the P&ID shall be permanently identified with stainless steel tags attached with stainless steel wire.
E. Each valve shall be identified per Section 400553 – Identification for Process Piping and Equipment.
F. All diaphragm, O-ring,and gasket material must be approved by the Owner's QA department prior to use.

2.2 SF2 SPECIFICATION

A. Service classes for SF2

1. Refer to Section 400610 – Schedules for Gas and Vapor Process Piping and Section 400620 – Schedules for Liquids Process Piping for Service List.

SYSTEM RATING
Tubing shall not exceed 150 psig @ 300°F
TUBING CHEMISTRY
Type 316L stainless steel tubing ASTM A269 and A270.
Seamless or Welded
Allowable sulfur range 0.005 - 0.017%
TUBING DIMENSIONS
1/4" and 3/8" OD x 0.035” nominal wall thickness
1/2" through 3" OD x 0.065" nominal wall thickness
4" OD x 0.083” wall thickness
6" OD x 0.109” wall thickness
Tubing dimensions and tolerances shall conform to ASME BPE Part DT
TUBING FINISH
25 Ra µin maximum after mechanical polishing in accordance to ASME BPE SF2.
FITTINGS
Tube fitting material, thickness, and finish are to be as specified for adjacent tubing. Long tangent type weld fittings are to be utilized for automatic machine welding. All fittings shall comply with ASME BPE Part DT.
Custom made fittings are to be manufactured to the material grade and finish as adjacent tubing. Identical heat lot numbers will be used whenever possible. Tolerances, pressure ratings, and markings for fittings and ferrules fabricated from tubing are to conform to ASTM A269/A270 and ASME BPE.
JOINTS
Automatic machine autogenous butt-welding is the preferred method of joining tubing and fittings. All welding shall comply with the ASME BPE.
Tri-Clamp type joints are to be used when connecting to valves, equipment, and accessories with Tri-Clamp type ends. High Pressure Tri-Clamps are to be utilized in any clean steam system where operators would not routinely disconnect Tri-Clamp fittings (ex, only disconnected for elastomer changeouts).
GASKETS AND ELASTOMERS
Material in contact with the Process shall be USP Class VI Viton. Material in contact with caustic solutions shall be USP Class VI EPDM. Purified Water service shall be USP Class VI Viton and steam service shall be Tuf-Steel or equivalent. Gasket to be matched to fittings and clamps.
VALVES, Diaphragm
Diaphragm valves are the recommended type of valve for high- purity service with this piping class. Valve material, weld-end thickness, and surface finish are to be compatible with specified adjacent tubing. Valve body end-to-end dimensions shall comply with ASME BPE for buttweld bodies.
1/2" through 6” diaphragm valve 316L stainless steel body, forged, weir type, with butt weld or clamp ends to match adjacent piping.

VALVES, Diaphragm (Continued)
Diaphragm in contact with the Process shall be USP Class VI Viton. Diaphragms in contact with caustic solutions shall be USP Class VI EPDM. For Steam service the diaphragm shall be 2 pieces comprised of an EPDM elastomer backing cushion with USP Class VI PTFE diaphragm.
Topworks to include a user adjustable travel stop and stainless steel fasteners and sealed bonnets. Topworks material of construction to be Stainless Steel, PPS, PAS or PES and resistant to steam sterilization and typical washdown media. All unused ports in the Topworks must contain a plug to prevent contaminates from entering the bonnet area. Any vent ports/weep holes used for leak detection must contain a sintered/fettered vented plug.
VALVES, Ball
6" and smaller sizes shall be 316L cast stainless steel three piece body, stainless steel ball and stem, reinforced Teflon seats and seals, lever- operated with built in lockout feature, butt weld tube or clamped ends, as indicated on drawings, interior to be polished to the same smoothness as the adjacent tubing.
VALVES, Check
1/2" through 3" 316 stainless steel body, spring loaded, disk type, 316 stainless steel spider, spring and disc, 316L stainless steel body clamped ends. Wall thickness and surface finish to be the same as specified for adjacent tubing.
VALVES, Butterfly
1" through 6" butterfly valve 316 stainless steel body and disk, clamped ends.
DOCUMENTATION
All tubing, fittings, and valves to be welded and installed must be traceable to a mill heat number and be supplied with certifying documentation matching the markings on the piece. A chemical analysis is to be furnished for each mill heat number. Certificates of compliance are to be furnished for all equipment, components, and elastomers.
CLEANING & PACKAGING
Tubing, fittings, valves and accessories shall be cleaned of manufacturing oils and debris for use in sanitary/high purity service.
After cleaning, materials shall be sealed and packaged by an acceptable method to maintain the high-purity state until the item is ready for service.
NOTES:
A. All liquid lines of 3/4" diameter and greater shall have positive slope of at least 1/8" per foot. 1/2" diameter lines shall have a positive slope of at least 1/4" per foot. Short runs at valve manifolds can be horizontal.
B. All welded joints to be made with tungsten, inert gas, fusion welding (interior and exterior) machine or machine with equal weld controllability.
C. All piping, components, and fittings shall be passivated after installation.
D. All items that are assigned a tag number on the P&ID shall be permanently identified with stainless steel tags attached with stainless steel wire.

NOTES (Continued):
E. Each valve shall be identified per Section 400553 – Identification for Process Piping and Equipment.
F. All diaphragm, O-ring,and gasket material must be approved by the Owner's QA department prior to use.

2.3 SF0 SPECIFICATION

A. Service classes for SF0

1. Refer to Section 400610 – Schedules for Gas and Vapor Process Piping and Section 400620 – Schedules for Liquids Process Piping for Service List.

SYSTEM RATING
Tubing shall not exceed 150 psig @ 300°F
TUBING CHEMISTRY
Type 316L stainless steel tubing ASTM A269
Seamless or Welded
Allowable sulfur range 0.005 - 0.017%
TUBING DIMENSIONS
1/2" through 3" OD x 0.065" nominal wall thickness
4" OD x 0.083" wall thickness
6" OD x 0.109" wall thickness
Tubing dimensions shall conform to ASTM A269
Tubing used for compressed air, nitrogen, oxygen, and carbon dioxide must be cleaned for oxygen service.
TUBING FINISH
Standard manufacturer's finish for tubing interior and exterior.
FITTINGS
Tube fitting material, thickness, and finish are to be as specified for adjacent tubing. Long tangent type weld fittings are to be utilized for automatic machine welding.
All fittings shall comply with ASME BPE 2014 Part DT.
Custom made fittings are to be manufactured to the material grade and finish as adjacent tubing. Identical or similar heat lot numbers will be used whenever possible. Tolerances for fittings and ferrules fabricated from tubing are to conform to ASTM A269/A270 and ASME BPE 2014.
Bending of tubing of 1/2" and smaller is acceptable. Minimum bend radius shall be 3 times the normal tube diameter.
JOINTS
1/2" through 4" Ferrule, butt weld type 316 stainless steel the same as tubing.
1/2" through 6" 150 lb. stainless steel adapter flange. Drilling and OD to match ASA B 16.5. For use with lap joint stub end or flared nipple.

JOINTS (Continued)
1/2" through 1" compression type connections. Threaded adapters can be used to connect equipment or accessories.
CLAMPS
Tri-Clamp type joints are to be used when connecting to valves, equipment, and accessories with Tri-Clamp type ends.
High pressure Tri-Clamps are to be utilized in any clean steam systems where operators would not routinely disconnect Tri-Clamp fittings (ex, only disconnected for elastomer changeouts).
BOLTING
SA-193 Gr. B8 heavy hex head machine bolts with SA-194 Gr. 8 heavy Hex nuts in conjunction with anti-seize compound for installation within clean rooms.
ASTM A307 Gr. B heavy hex head machine bolts with ASTM A563 Gr. A heavy hex head nuts in conjunction with anti-seize compound for installation within non-clean rooms.
GASKETS AND ELASTOMERS
Material in contact with the Process shall be USP Class VI Viton. Material in contact with Caustic solutions shall be USP Class VI EPDM. Purified Water service shall be USP Class VI Viton and steam service shall be Tuf-Steel or equivalent. Gasket to be matched to fittings and clamps.
Flange gaskets shall be 1/16" thick, 150 lb. class, ring type, EPDM, except for steam service which shall be Flexitalic.
VALVES, General
Valves used for compressed air, nitrogen, oxygen, and carbon dioxide must be cleaned for oxygen service, and certified free of lubricants.
VALVES, Diaphragm
Valve material, weld-end thickness, and surface finish are to be compatible with specified adjacent tubing. Valve body end-to-end dimensions shall comply with ASME BPE for butt weld bodies.
1/2" through 4" 316L stainless steel body, investment cast or forged, weir type, with butt weld or clamp ends to match adjacent piping. Finish is to be exterior foundry finish and interior satin finish.
Diaphragm in contact with the Process shall be USP Class VI Viton. Diaphragms in contact with caustic solutions shall be USP Class VI EPDM. For Steam service the diaphragm shall be 2 pieces comprised of an EPDM elastomer backing cushion with USP Class VI PTFE diaphragm.
Top works to include a stainless steel indicating stem, bronze compressor, travel stop, stainless fasteners, and a V-notch vent plug (i.e. sealed bonnet). Top works material of construction to be a thermoplastic material. All unused ports in the Topworks must contain a plug to prevent contaminates from entering the bonnet area. Any vent ports/weep holes used for leak detection must contain a sintered/fettered vented plug. PPS, PAS, and PES are acceptable materials.

VALVES, Ball
Valve material, weld-end thickness, and surface finish are to be compatible with specified adjacent tubing.
1/2" through 1" butt weld or compression ends for OD tube, 3- piece design, 316L stainless steel body, ball, and trim, reinforced Teflon seats and seals, lever operated with built in lock-out feature.
1-1/2" through 2" butt weld ends for OD tube, 3-piece design, 316L stainless steel body, ball, and trim, reinforced Teflon seats and seals, lever operated with built in lockout feature.
2-1/2" through 6" 150 lb. R.F. ANSI flanged ball valve, 316L stainless steel body, ball, and trim, reinforced Teflon seats and seals, lever operated with built in lockout feature.
VALVES, Butterfly
1" through 6" butterfly valve 316L stainless steel body and disc.Clamped ends. Surface finish to be compatible with specified adjacent tubing.
VALVES, Check
Valve material, weld-end thickness, and surface finish are to be compatible with specified adjacent tubing.
1/4" through 3/4" shall be 316 stainless steel body, bonded poppet design, compression fitting.
1" through 3" 316 stainless steel body, spring loaded, disk type, 316 stainless steel spider, spring and disc, 316L stainless steel body clamp, Tri-clamp ends.
SPECIALTY ITEMS
Steam traps shall be Spirax Sarco BTM7 series, stainless steel thermostatic steam traps or approved equal. Steam traps shall have tri-clamp ends.
DOCUMENTATION
Manufacturer's Cut Sheet. Certificates of compliance are to be furnished for all equipment, components, and elastomers. Components used for compressed air, nitrogen, oxygen, and carbon dioxide must have documentation indicating the items have been cleaned for oxygen service and certified free of lubricants.
CLEANING & PACKAGING
Tubing, fittings, valves and accessories shall be cleaned of manufacturing oils and debris. Components used for compressed air, nitrogen, oxygen, and carbon dioxide must be cleaned and packaged for oxygen service and certified free of lubricants.
After cleaning, materials shall be packaged by acceptable method until the item is ready for installation.
NOTES:
A. All liquid lines of 3/4" diameter and greater shall have positive slope of at least 1/8" per foot. 1/2" diameter lines shall have a positive slope of at least 1/4" per foot. Short runs at valve manifolds can be horizontal.
B. All welded joints to be made with tungsten, inert gas, fusion welding (interior and exterior) machine or machine with equal weld controllability.

NOTES (Continued):
C. All items that are assigned a tag number on the P&ID shall be permanently identified with stainless steel tags attached with stainless steel wire.
D. Each valve shall be identified per Section 400553 – Identification for Process Piping and Equipment.
E. All diaphragm, O-ring, and gasket material must be approved by the Owner's QA department prior to use.

BRANCH OR LATERAL LINE SIZE FOR SF0 TUBING SPEC									
MAIN LINE SIZE	SIZE	1/2"	3/4"	1"	1 1/2"	2"	3"	4"	6"
	1/2"	T							
	3/4"	RT	T						
	1"	RT	RT	T					
	1 1/2"	RT	RT	RT	T				
	2"	SI/RT	SI/RT	SI/RT	RT	T			
	3"	SI/RT	SI/RT	SI/RT	SI/RT	RT	T		
	4"	SI/RT	SI/RT	SI/RT	SI/RT	SI/RT	RT	T	
	6"	SI/RT	SI/RT	SI/RT	SI/RT	SI/RT	RT	RT	T

T = EQUAL TEE
RT = REDUCING TEE
SI = STUB IN

2.4 SSP4 SPECIFICATION

A. Service classes for SSP4

1. Refer to Section 400610 – Schedules for Gas and Vapor Process Piping and Section 400620 – Schedules for Liquids Process Piping for Service List.

SYSTEM RATING
Piping shall not exceed 180 psig @ 350°F
TUBING CHEMISTRY
Type 304L stainless steel, seamless or welded, ASTM A312
TUBING DIMENSIONS
1/2" through 4", schedule 40S, plain ends
6" through 12", schedule 40S, beveled ends
TUBING FINISH
Standard manufacturer's finish.

FITTINGS
1/2" through 12", schedule 40S stainless steel, butt weld ASTM A-403, Gr. WP 304L.
1/2" and 3/4", 3000 lb. stainless steel, socket weld, ASTM A182 Gr. F304L, fittings schedule to match pipe (use for instrument or branch connections).
JOINTS
1/2" and 3/4", 3000 lb. stainless steel union, socket weld with ground joint, ASTM 182 Gr. F 304L.
1/2" through 12" shall be butt welded or flanged where required to match flanged valves or equipment.
1/2" through 12", lap joint flange, 150 lb. 304L stainless steel, ASTM A182/ANSI B16.5 with type A stub ends, schedule 40S, MSS length, ASTM A403, Gr. WP 304L/MSS SP-43.
SA-193 Gr. B8 heavy hex head machine bolts with SA-194 Gr. 8 heavy hex nuts in conjunction with anti-seize compound for installation within clean rooms.
ASTM A307 Gr. B heavy hex head machine bolts with ASTM A563 Gr. heavy hex head nuts in conjunction with anti-seize compound for installation within non-clean rooms.
GASKETS AND ELASTOMERS
Gaskets shall be 1/16" thick, 150 lb. class, ring type, EPDM, except for steam service which shall be Flexitallic style CGI.
VALVES, Ball
1/2" through 2" 304L or 316L stainless steel three piece body, schedule 40S, standard finish, socket weld ends, stainless steel ball and stem, reinforced Teflon seats and seals, lever operated with built in lockout feature.
2-1/2" through 6" 150 lb. raised face flanged, 304 or 316 stainless steel body, ball and trim, reinforced Teflon seats and seals, lever operated.
VALVES, Gate
1/2" through 2" class 150, 304L or 316L stainless steel body, schedule 40S, socket weld ends, solid wedge, rising stem, bolted bonnet, outside screw and yoke, integral seat, Teflon gasket and packing.
VALVES, Check
1/2" through 2" swing type, class 150, schedule 40S, type 304L or 316L stainless steel, integral seat, socket weld ends.
2-1/2" through 6" swing type, 150 lb. raised face flanged, type 304 or 316 stainless steel, integral seat.
2-1/2" through 12" single disc. Wafer check 150 lb. 304 or 316 stainless steel body with stainless steel disc.

VALVES, Globe
1/2" through 2" class 150, forged 304L or 316L stainless steel body, schedule 40S, socket weld ends, bolted bonnet, outside screw and yoke.
2-1/2" through 10” 150 lb. raised face flanged, 304 or 316 stainless steel body, plug type disc, bolted bonnet, outside screw and yoke, integral seats, Teflon stem packing and bonnet gasket.
VALVES, Butterfly
3" through 8" class 150, lug type, 304 or 316 stainless steel body, stainless steel disc and stem.
EQUAL TEE
Use socket weld on 2" and smaller, butt weld on 2-1/2" and larger.
REINFORCED STUB-IN
Branch pipe welded to header pipe per designated code. Fillet weld size per code satisfies pressure at temperature conditions only. Where external stresses are present reinforcing pads are required.
REDUCING TEE
Use socket weld on 2" and smaller, butt weld for 2-1/2" and larger.
STUB IN
When making a stub in on a piping main refer to designated code. Stub in may intersect main at either 45 degrees, 60 degrees or 90 degrees.
SOCK-O-LET
Sock-o-lets may be used for branch sizes listed above. The term sock-o-let also applies to the use laterial-o-lets (also latrolets). Socket-o-lets (socket weld elbolets) may be installed in the hill of 90 degree elbows as well as the back of tees.
THREAD-O-LET
Thread-o-lets may be used for thermal wells and analytical instruments. High point vents, low point drains, steam traps, pressure gauge valves and test points use Sch-80 nipple welded in socket-o-let.
WELD-O-LET
To be used where indicated on chart above. However, reducing tees may be used.
DOCUMENTATION
Manufacturer's cut sheets. Certificates of compliance are to be furnished for all equipment, components, and elastomers.
CLEANING & PACKAGING
All materials shall be cleaned of manufacturing oils and debris per manufacturing standards.
After cleaning, materials shall be packaged by acceptable method until the item is ready for installation.

NOTES:
A. All welded joints to be made with tungsten, inert gas, fusion welding (interior and exterior) machine or machine with equal weld controllability.
B. All items that are assigned a tag number on the P&ID shall be permanently identified with stainless steel tags attached with stainless steel wire.
C. Use of a SO or WO in place of an RT where space is limited is permitted upon approval by the Owner or the Owner's Representative
D. Each valve shall be identified per Section 400553 – Identification for Process Piping and Equipment.
E. All diaphragm, O-ring,and gasket material must be approved by the Owner's QA department prior to use.

BRANCH OR LATERAL SIZE FOR SSP4 PIPING SPEC													
MAIN LINE SIZE	SIZE	1/2"	3/4"	1"	1 1/2"	2"	2 1/2"	3"	4"	6"	8"	10"	12"
	1/2"	T											
	3/4"	RT	T										
	1"	RT	RT	T									
	1 1/2"	RT	RT	RT	T								
	2"	SO	RT	RT	RT	T							
	2 1/2"	SO	SO	RT	RT	RT	T						
	3"	SO	SO	RT	RT	RT	RT	T					
	4"	SO	SO	SO	RT	RT	RT	RT	T				
	6"	SO	SO	SO	SO	RT	RT	RT	RT	T			
	8"	SO	SO	SO	SO	SO	WO	RT	RT	RT	T		
	10"	SO	SO	SO	SO	SO	WO	RT	RT	RT	RT	T	
	12"	SO	SO	SO	SO	SO	WO	WO	RT	RT	RT	RT	T

T = EQUAL TEE
RT = REDUCING TEE
SI = STUB IN
RS = REINFORCED STUB IN

SO = SOCK-O-LET
TO = THREAD-O-LET
WO = WELD-O-LET

PART 3 - EXECUTION

3.1 INSTALLATION OF MATERIALS

A. For installation, refer to specification Section 400513 – Common Work Results for Process Piping.

B. For pipe support hardware and materials, refer to 400529 – Hangers and Supports for Process Piping.

C. For insulating materials, refer to specification Section 404200 – Process Piping and Equipment Insulation.

D. Never use grinding wheels, sanding materials, or wire brushes made of iron, iron oxide, steel or zinc, or other undesirable materials that may cause contamination of the stainless steel surface.

E. Passivation may be applied to tubing, spool pieces, cut sections and weldments as specified to eliminate and remove potential iron containing contaminants from cutting tools and machinery affecting the surface finish of the stainless steel hygienic tubing.

END OF SECTION 400513.19

CONFIDENTIAL DOCUMENT

400529

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

HANGERS AND SUPPORTS FOR PROCESS PIPING

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

400529

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
400529	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 400529 – HANGERS AND SUPPORTS FOR PROCESS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Reference Specifications

1. 400513 - Common Work Results for Process Piping
2. 400610 - Schedules for Gas and Vapor Process Piping
3. 400620 - Schedules for Liquids Process Piping
4. 404200 - Process Piping and Equipment Insulation

C. Reference Codes and Standards

1. ASTM - Standards for Materials
2. ANSI - American National Standard Institute
3. ASME Code for Pressure Piping B31.3 - “Process Piping”
4. AWS D1.1 Structural Welding Code - Steel
5. ASME B&PV Code Section IX - Welding and Brazing Qualifications
6. MSS SP-58 Pipe Hangers and Supports - Materials, Design and Manufacturers, Selection
7. MSS SP-58 Pipe Hangers and Supports - Selection and Application
8. MSS SP-58 Pipe Hangers and Supports - Fabrication and Installation Practices
9. SMACNA Seismic Restraint Manual: Guidelines for Mechanical Systems
10. ASME BPE - Standard for Bioprocessing Equipment
11. FDA Guidelines & Current Good Manufacturing Practices (cGMP) compliance
12. International Mechanical Code 301.18 – Seismic Resistance and Section 305 – Piping Supports

1.2 SUMMARY

A. This Section includes the following:

1. In addition to general supporting of systems to address weight, span and thermal expansion, permanent supports shall be provided to avoid the need for temporary supports where regular maintenance necessitates removal of equipment, instruments or any other in-line components.
2. The design of all pipe-supporting elements shall be in accordance with the latest Standard Practices 58, developed by the Manufacturers Standardization Society (MSS).
3. In general, supports for process piping are only shown on the design drawings when special conditions are to be addressed. Such supports, including anchors, guides, and spring hangers, when indicated on the drawings, shall be installed as close as possible to the locations shown. MSS shall take precedence if a conflict exists between the drawings and the applicable standard.

1.3 SCOPE

A. Work Included:

1. This specification defines the pipe hangers and supports for all process piping and tubing.

1.4 SUBMITTALS

A. Submit manufacturer's catalog cut for selected support hardware, and fabrication sketches for any engineered supports.

B. Submittals shall be in accordance with the conditions of the contract.

1.5 QUALITY ASSURANCE

A. All work within the scope of this specification shall be performed in accordance with this specification and all applicable related documents. No deviations shall be made from this specification or any applicable related documents, without the prior written authorization. The application for each deviation shall completely and specifically define the location of, the nature of, and the reason for the proposed deviation.

B. Pipe supports design, fabrication, installation and testing shall be in accordance with ASME Code for Pressure Piping B31.3, using materials manufactured and tested in accordance with the applicable ASME/ANSI standards.

C. Supports, fabrication and attachment to building steel structure shall require welding procedures and welding operator qualifications in accordance with AWS D1.1 Structural Welding Code-Steel.

D. Seismic restraints, where required, shall be designed and installed to resist loads and limit displacement during an earthquake in accordance with applicable building codes and accepted design practices.

E. Welding of pressure piping and pressure retaining components shall be performed in accordance with ASME Boiler and Pressure Vessel Code - Section IX Welding and Brazing Qualifications.

1.6 TERMINOLOGY

A. GMP Area: Hygienic / clean processing areas and clean rooms (defined as any classified room), in which special items are required to assist all systems to comply with current FDA "Good Manufacturing Practice" (cGMP) guidelines for pharmaceutical /biotechnology plants.

B. Critical Piping Systems: Clean utility piping and/or hygienic tubing systems, product lines, and any piping carrying media that may come in contact with the product. Examples of typical systems are: WFI, DI, RO, USP, clean steam, clean steam condensate and bulk chemicals.

C. Supports: Attachments, hangers, rests, inserts, couplings, anchors, saddles, guides, channels, nuts, bolts, plates, rods, supplemental steel and other miscellaneous components required to support piping.

D. Cold: Content of pipeline below a temperature of 50°F.

E. Ambient: Content of pipeline which is not heated or cooled and will remain at temperature range between 51 to 79°F.

F. Hot: Heated content of pipeline at or above 80°F temperature.

G. Plastic Pipe: Thermoset or thermoplastic, rigid or semi-rigid PVC, CPVC, PVDF, PP, FRP and others.

H. Symbols for pipe supports shall be as follows:

1. PA "Pipe Anchor" – Rigid support, movement is restricted in all directions.
2. PG "Pipe Guide" – Movement permitted axially (along pipeline).
3. SH "Spring Hanger" – Required to maintaining weight support during thermal changes.
4. PS "Pipe Support" – Conventional support or hanger, with designated location.
5. LS “Line Stop” – Movement is restricted axially (along pipeline).

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Supports and Support Hardware

1. Anvil International (Grinnell)
2. Copper B-Line
3. Tolco, Inc.
4. PHD Manufacturing, Inc.
5. Pipe Shields, Inc.
6. Unistrut
7. Behringer
8. Empire Industries (SS Hangers)

B. Anchors and Guides

1. Anvil (Grinnell)
2. Metraflex
3. Pipe Shields, Inc.

C. Pre-insulated Support Systems

1. Pipe Shields, Inc.
2. Substitutions: Shall comply with the requirements of the Contract.

D. Supports and Support Hardware for cGMP Areas.

1. Behringer
2. Tri-Clover

E. Other manufacturers must be approved prior to installation.

2.2 MANUFACTURED UNITS

A. Hangers and support components shall be factory fabricated of materials, design and manufacturer complying with MSS SP-58, and shall be heavy industrial grade.

1. Components not installed in systems with field-applied finish shall have galvanized coatings.
2. Pipe attachments shall have copper or nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.
3. All components shall be supplied free of sharp edges or burrs. Sharp edges that are hazardous to installation personnel or maintenance personnel will be cause for rejection.
4. Channel-strut type supports shall be assembled with plastic end caps for personnel protection when installed at or below 7'-0" above floor, platform, or any walkway accessible to personnel.

B. Thermal Hanger Shield Inserts:

1. 100-psi average compressive strength; waterproofed calcium silicate, encased with a sheet metal shield.
2. Insert and shield shall cover entire pipe circumference and shall be of a length indicated by manufacturer for pipe size and thickness of insulation.

C. Pipe Anchors:

1. Insulated units are required for lines insulated for cold or anti-sweat conditions.
2. Anchors for hot lines may be designed and fabricated using common structural shapes in an approved arrangement, suitable for actual site conditions and loadings.
3. Anchors for clean steam lines shall be heavy-duty aluminum alloy split block type as manufactured by Behringer, or approved equal.
4. Concrete Anchors

a. Mounting plates or brackets shall be secured to concrete floor or walls using stud-type expansion anchors with tapered expansion cone for installation into drilled hole (Hilti Kwik-Bolt or approved). Loadings and spacing shall be in strict accordance with manufacturer's recommendations.
b. Sleeve-type drop in anchors (Hilti HDE or approved) may be used for light load situations (less than 500 lbs.). When used in conjunction with pipe hangers, prior approval must be obtained from the design engineer.
c. For equipment installation, adhesive type anchors shall be used.

D. Pipe Alignment Guides:

1. Factory fabricated units are required for lines insulated for cold or anti-sweat conditions. Guides shall have bolted two-section steel outer housing and guided spider clamped or welded to pipe, as well as provide a low coefficient of friction to allow axial movement of pipeline. Length of guide shall be as recommended by manufacturer to allow required travel.

2. Guides for hot lines may be designed and fabricated using structural steel shapes in an approved arrangement.
3. Guides for clean steam shall be same as anchors, except bore of clamp shall be 1/8 inch oversize of tube OD to allow free axial movement.

2.3 CONCRETE ANCHORS

A. Mounting plates or brackets shall be secured to concrete floor or walls using stud-type expansion anchors with tapered expansion cone for installation into drilled hole (Hilti Kwik-Bolt or approved). Loadings and spacing shall be in strict accordance with manufacturer's recommendations.

B. Sleeve-type drop in anchors (Hilti type HDE, or approved equal) may be used for light load situations (less than 500 lbs.). When used in conjunction with pipe hangers, prior approval must be obtained from the design engineer.

C. For equipment installation, adhesive type anchors shall be used.

2.4 HANGERS

A. Bare Pipe and Tubing:

1. Copper Tubing:

   a. 2-Inch and Smaller: Copper plated malleable iron split ring clamp, Grinnell Fig. CT-109 (MSS Type 11) or Fig. CT-138R (MSS Type 12). Plastic coated clevis is acceptable.
   b. 3 and 4-Inch: Copper plated adjustable clevis hanger, Grinnell Fig. CT-65 (MSS Type 1). Plastic coated clevis is acceptable.
   c. In locations designated requiring vibration isolation: Use split ring clamp with elastomer insert for mounting in Unistrut-type channel. B-Line Vibraclamp, -40 degrees F to 300 degrees F.

2. Hygienic Tubing in cGMP Area Supports:

   a. Thermoplastic split clamp block, type Behringer hygienic series; Santoprene (tan color) clamp halves with 304L stainless steel end plates and bolts. Note: temperature limitation is 302°F.
   b. Alternate, where spool pieces require supports: Tri-clover Model A24FCF with fluoroelastomer inserts.

3. Hygienic Tubing in Non-cGMP Area Supports:

   a. Thermoplastic split clamp block, type Behringer hygienic series, zinc-plated carbon steel end plates and bolts.
   b. Santoprene clamp halves (tan color) are acceptable for lines -40F to 302F.
   c. Polypropylene clamp halves (blue) are acceptable for lines -22F to 212F.

4. Stainless Steel Pipe:

    a. 2-Inch and Smaller: Galvanized adjustable wrought split ring (MSS Type 11) with elastomeric insulator between clamp and pipe ("Cush-A-Strip" or equal).
    b. Above 2-Inch: Galvanized adjustable clevis hanger (MSS Type 1) with stainless steel shield (22 gauge minimum) around pipe.

5. Nonmetallic Piping: Same as for carbon steel, with protection shields as specified below under "Pipe Shields".

6. Riser Clamp:

    a. General Purpose: Grinnell Fig. 261 (MSS Type 8).
    b. Copper Piping: Grinnell Fig. CT-121.

7. Floor Supports:

    a. 2-Inch and Smaller: U-bolt on structural steel channel or angle secured to floor with angle clips, Grinnell Fig. 137 (MSS Type 24).
    b. Above 2-Inch: Adjustable pipe saddle, Grinnell Fig. 264 (MSS Type 38) or Fig 259 (MSS Type 37) or fabrications from pipe and plate.
    c. Floor supports for hygienic tubing shall be supported through two sections of 7/8” 304L SS threaded rod, joined by a coupling nut to allow height and slope adjustment for spools. Refer to section 2.3 and 2.4.3 for anchoring and pipe support requirements.

8. Supports at Walls and Columns: Cast iron or steel brackets selected for weight supported.

    a. To 750 lbs. - Grinnell Fig. 194 (MSS Type 31).
    b. To 1500 lbs. - Grinnell Fig. 195 (MSS Type 32).
    c. To 3000 lbs. - Grinnell Fig. 199 (MSS Type 33).

9. Hanger Rod for Individual Pipes: Solid steel with threaded ends preferred. Exposed threads are not permitted in areas designated as "clean", “cGMP”, or "hygienic".

Table 1: Rod Diameters

Pipe Size	Rod Diameter
2-inch and under	3/8-inch
2-1/2 inch and 3-inch	1/2-inch
4-inch and 5-inch	5/8-inch
6-inch	3/4-inch
8-inch and above	per MSS SP-58 2009

10. Beam Clamps

    a. To 350 lbs. Loading: Universal "C" type with malleable iron jaw, square head bolt and nut, center loaded, with retainer clip, Grinnell Fig. 92 (FM listed) 93, 94 (MSS Type 19).
    b. To 1300 lbs. Loading: Malleable iron jaw, steel tie rod, center loaded. Grinnell Fig. 218 (FM listed) (MSS Type 30).
    c. To 11,000 lbs. Loading: Forged steel, observe manufacturer's stress limits. Grinnell Fig. 292 (MSS Type 29).

11. Spring Hangers: Recommended where vertical movement exceeds 0.25 inches.

    a. Variable spring type hanger for non-critical system and where movement is of small magnitude and force variation up to 25 percent.
    b. Constant spring type for large vertical movement or critical piping systems.

B. Insulated Pipe and Tubing

1. cGMP Area Support: For stainless steel tubing, use thermoplastic split clamp block type. Behringer Santoprene (tan color) clamp halves with 304 stainless steel end plates and bolts.
2. Non-cGMP Areas: Adjustable clevis hanger for insulated lines, Grinnell Fig. 300 (MSS Type 1), with galvanized insulation protection shield or cradle, Grinnell Fig. 167 (MSS Type 40). cGMP tubing lines passing through these areas will require plastic block clamps with zinc plated hardware as indicated.

2.5 SLEEVES

A. General Areas: wall and floor penetrations.

1. Material: Schedule 40 steel pipe, burrs removed from all edges.
2. Sleeves to be sized to permit clearance around OD of piping. Minimum 1-inch nominal pipe size larger than line size plus insulation is recommended.
3. Sleeve Size Schedule:

Table 2: Sleeve Size Schedule

	Insulation Thickness				
Pipe Size	1/2"	1"	1-1/2"	2"	3"
1"	2"	4"	6"	6"	8"
1-1/2"	3"	4"	6"	8"	10"
2"	3"	6"	8"	8"	10"
3"	4"	6"	8"	10"	10"
4"	6"	8"	10"	10"	12"
6"	8"	10"	12"	12"	14"
8"	10"	12"	14"	14"	16"
10"	12"	14"	16"	16"	18"
12"	14"	16"	18"	18"	20"

B. Underground Wall Penetrations

1. Carbon steel sleeve with retainer ring and elastomeric compression seal. The sleeve and seal shall be from the same manufacturer.

2. Acceptable Units: Link Seal Type WS with Series 300, 400 or 500 seals or approved equal. Installation shall be in strict accordance with manufacturer's instructions.

2.6 PIPE SHIELDS (INSULATED PIPE)

A. Non-cGMP areas: For Semi-circular galvanized carbon steel (MSS Type 40) of thickness and length per Table A-3 of MSS SP-58 2009. Coordinate with Section 404200.

B. cGMP areas do not normally allow supports using external hangers and shields. Where shields are indicated, material must be Type 304L or 316L stainless steel.

2.7 PIPE SUPPORTS IN PIPE RACK

A. Insulated Pipes Non-cGMP Area – Hot and Ambient Service Piping

1. Unless otherwise indicated, insulated piping is designed to be supported using 4-inch tall structural tees (pipe shoe) welded or securely clamped to pipeline. Welds to be 3/16 inch fillet.
2. Steam and condensate piping shall be installed using low-friction slide bearing pads, unless otherwise directed.
3. cGMP tubing other than clean steam service, when supported within rack shall use the same thermoplastic clamp blocks as indicated.
4. For clean steam service on rack, use block clamps, Behringer aluminum clamp halves with zinc plated hardware or approved equal.
5. For all services except clean steam, use Behringer aluminum guides with oversized bores allowing axial movement of the pipe. The Contractor is responsible for manufacturing the oversized bore.

B. Insulated Pipes Non-cGMP Area – Cold Service Piping

1. Unless otherwise indicated, insulated piping shall be supported using galvanized steel shield, extending a minimum of 6 inches each side of hanger (MSS Type 40).
2. Approved high-density insulation inserts shall be used where piping rests on support. Coordinate materials and installation with insulation Contractor per Specification for Piping and Equipment Insulation.

C. Bare Utility Piping

1. Unless otherwise indicated, uninsulated lines for utilities such as water, air, and other gases may be supported directly on rack steel.
2. Copper lines require a stainless steel sheet metal shield between pipeline and rack steel.

2.8 MISCELLANEOUS MATERIALS

A. Steel Plates, Shapes and Bars: ASTM A36.

B. Pipe Stanchions: ASTM A53 carbon steel, schedule 40 standard weight, unless design calls for thicker wall or other material. Use appropriate stainless steel pipe for corrosion resistance or exposed clean/ GMP areas.

C. Cement Grout: Portland cement (ASTM C150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C404, Size No. 2). Mix ratio shall be 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration

PART 3 - EXECUTION

3.1 PIPE HANGERS AND SUPPORTS

A. All pipe supports are to be located, designed and installed by the Contractor unless noted otherwise.

B. Suspend the following pipe services from individual hangers, unless shown otherwise on drawings:

1. Steam
2. Condensate
3. Hygienic tubing

C. Pipe for other services may be suspended by individual pipe hangers, unless otherwise indicated, or, where 2 or more pipes are parallel at the same elevation, common trapeze bars may be used. Construct trapeze bars of structural steel angles or channels, with rods of sufficient strength to support the load. Secure individual pipes to the trapeze with U-bolts. Groups of small-bore pipes or tubes may be trapeze supported with Unistrut channel. Ends of channels must be free of burrs or sharp edges. Submit design in accordance with Contract Documents for approval.

D. Risers:

1. Provide floor supports at the bottom of risers using structural steel supports unless otherwise indicated.
2. At every floor or roof penetration, support risers at the penetration sleeve or steel framing if framed opening is provided.
3. Welded pipe attachments (trunnions or lugs) shall be used in conjunction with riser clamps to support vertical load, where necessary. Welding is prohibited on any lined piping.
4. Vertical piping 2 inches and smaller shall be guided at every floor. Larger pipe shall be guided at every other floor.
5. Spring hangers shall be used to adequately compensate for thermal expansion in the vertical direction.
6. Rest riser clamps on the floor or on the pipe sleeve. If possible, install under flanges, fittings, or couplings.

E. Spacing of hangers

1. Locate trapeze hangers to comply with the hanger spacing requirement for the smallest size pipe on the trapeze.
2. Distance between supports for water service piping shall not exceed the maximum recommended spacing listed below. Spacing indicated below may differ from that listed in MSS SP-58.

Table 3: Hanger Spacing		
Pipe Material	Tubing Size OD in inches	Maximum Horizontal Spacing in feet
Steel Pipe	1/2 and 3/4	7
	1 and 1-1/4	7
	1-1/2	9
	2	10
	3	12
	4	14
	Above 4	Refer to MSS SP-58
Copper Tubing and Schedule 10 Pipe	1/4 and 1/2	5
	3/4	5
	1	6
	1-1/14	7
	1-1/2 to 2	8
	3	10
	Above 3	Refer to MSS SP-58
Stainless Steel Tubing	1/4 and 1/2	3.25
	3/4	4
	1 and 1-1/4	5
	1-1/2 to 3	6
	4 to 6	12

a. Cast Iron Pipe: Maximum 5 ft spacing. Place hangers close to joints.
b. Plastic piping: Support in accordance with manufacturer's recommendations.
c. For spacing supports incorporating Type 40 shields, see MSS SP-58 Table A.3

3. Closer spacing may be required to accommodate valves, changes in direction, etc. The anchor supports shall be constructed with rigid supports (unistrut or tube steel) attached to building or wall structure, and Behringer (or approved equal) hanger clamps, such that the piping is prevented from moving laterally. For Laboratory Furniture, furnish and install fasteners to secure service piping to the channel or Unistrut®-type upright pipe rack assemblies furnished with the equipment. All supports shall be concealed within the furniture if possible.

F. Do not support piping from vessels or equipment, unless otherwise indicated.

G. Do not weld piping to floor supports, unless floor support is used as an anchor. Base elbow supports at pumps may be exempted from this requirement.

H. Do not weld supports to stainless steel pipe or tubing. Use appropriate clamps, U-bolts, and protective metal shields.

I. Furnish insulation support shields to the insulation Contractor, based on required hanger size as indicated. For actual sizes for insulation support shields, Refer to Section 404200.

J. Pre-insulated Hangers:

1. Install band in accordance with orientation markers on shielding.
2. Do not exceed manufacturer's maximum recommended torque when tightening support band.

K. In general, cGMP tubing should not be rigidly anchored, but should be supported to allow freedom of movement due to thermal expansion or contraction. Rods or trapezes shall be utilized as pendant supports from overhead support steel. Short rods may be utilized as stanchions above pipe rack steel, in conjunction with the appropriate attachments.

L. Supports for hygienic / cGMP tubing shall be fabricated and installed in accordance with the design drawings and the pipe support details provided, unless otherwise directed.

M. For non-cGMP piping systems supported on rod hangers, provide roller hangers where thermal movement will cause the hanger rod to deviate more than 4 degrees from the vertical, or where longitudinal expansion will cause a movement of more than ½ inch in the piping, or as shown.

N. All supports in cGMP areas shall be 304L or 316L stainless steel with a No. 4 (satin) finish. Special support bracket design may be required in some areas.

O. Exposed supports shall be fabricated of plate and enclosed shapes in such a way to eliminate debris collection crevices and provide for easy surface cleaning.

P. Where tubing passes through walls, ceilings, and floors, clearance is required around the tube to allow it to move during expansion and contraction. Escutcheons are required to seal the openings.

Q. cGMP tubing shall be supported in such a manner as to allow the line to slope as required for complete drainage. Unless otherwise directed, tubing shall slope a minimum of 1/8 inch per linear foot. Slopes shall be verified prior to acceptance.

R. Supports are required at any point of use branch connection.

S. Anchor type supports shall be constructed with rigid support members (Unistrut or tube steel) attached to building or wall structure, and Behringer or approved equal hanger clamps, such that the piping is prevented from moving laterally.

3.2 SECURING PIPING SUPPORTS AT BUILDING CONSTRUCTION

A. Provide steel or malleable iron inserts in poured concrete construction, with maximum load of 100 pounds per foot of continuous insert.

B. Use expansion shields to support piping from existing concrete or masonry, bolt diameter shall be equal to hanger rod diameter.

C. If existing masonry is not suitable for attachment, or if other means are preferable, submit alternate method for approval. Caution: Some floor slabs may not be suitable for concentrated loads.

D. Attach piping supports to structural steel framing or supporting members using either welded beam attachments or beam clamps securely fastened. Welded attachment for large piping is preferred. However, if new piping is to be installed into an existing facility, no drilling, cutting or welding shall be performed on steel structural members unless prior approval is obtained from the Owner. Coordinate work with fireproofing contractor, such that connections to building steel are in place prior to placement of fireproofing. Refer to Specification for Firestopping.

E. Do not suspend hangers from roof deck, conduit, or ductwork.

F. Unless otherwise indicated, walls or closures shall not be considered for supporting piping.

G. Temporary construction supports shall not be welded to the pipe, except with approval by the Owner or his Representative, and shall be attached in a manner that will not damage the pipe. Where approved, any weld metal for temporary supports shall be completely removed upon completion of construction.

3.3 ANCHORS AND GUIDES

A. Support and anchor design shall be based on thermal-expansion and pressure-thrust forces and the greater of the test weight or operating weight.

B. Install anchors at proper locations to prevent stresses from exceeding those permitted by ASME B31.3 (or B31.9 for building mechanical piping) and to prevent transfer of loading forces and stresses to connected equipment.

C. Factory-built or fabricated components must comply with ASME B31.3 (B31.9) and with AWS Standards D1.1.

D. Where expansion compensators are indicated, install anchors and guides in accordance with expansion joint manufacturer’s written instructions to control movement to compensators.

E. Anchor Location:

1. Where pipe anchors (PA) or pipe guides (PG) are located on design drawings, the location is critical and should not be modified without prior approval of the Owner or his Representative.

2. Where not otherwise indicated, install anchors on principal pipe runs in conjunction with expansion loops.
3. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.
4. Locate anchors at points of use and branch connections on piping indicated.

F. Guide plastic piping at each support point. Provide a wear plate (of larger sized plastic pipe material) under each support point. Anchors shall be installed in approved locations.

G. Install pipe alignment guides (PG) on piping that adjoins expansion joints and elsewhere as indicated.

H. Anchor to building substrate, i.e. structural concrete or structural steel for safe transfer of forces.

I. Provide at least two guides in piping on each side of expansion loops or expansion joints indicated, unless otherwise directed. Install in accordance with manufacturer's recommendations.

3.4 HANGER ADJUSTMENT

A. Adjust hangers to distribute loads equally on attachments and to achieve required slope of pipe. Some re-adjustment may be necessary at system operating temperature. Slopes shall be verified on cGMP tubing systems.

B. Spring hangers shall be adjusted to their required hot load at system operating temperature.

3.5 PENETRATION SLEEVES

A. Install sleeves where piping passes through floors, walls, and other concrete or masonry structures, except where tunnels, chases, or shafts are provided.

B. Install sleeves on roof decking and decks for floors and platforms. Cut openings as required, and tack weld sleeves in place.

C. Install sleeves prior to masonry or concrete placement. Coordinate with General Contractor.

D. Wall sleeve shall be flush with finished wall. Floor sleeve shall extend four inches above finished floor or platform except where indicated.

E. Seal pipe penetrations through fire rated walls, partitions and floors so that fire-rating integrity is maintained. Refer to Specification for Firestopping for special sealants and materials.

F. Seal pipe penetrations through mechanical area floors and other wet area floors to ensure water-tightness.

G. Install underground sleeves and seals in accordance with manufacturer's recommendations.

3.6 TOUCH-UP PAINTING

A. After erection of hangers, clean field welds of anchors and supports. Touch-up marred surfaces with same paint and finish to match shop painting to comply with SSPC-PA-1 requirements for touch-up of field-painted surfaces.

1. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.
2. For Galvanized Surfaces: Clean welds of any slag, spatter or rust, clean bolted connections and abraded areas, then apply galvanizing repair paint to comply with ASTM A780. Application of approved coating is to be in strict accordance with manufacturer's instructions.

3.7 SEISMIC RESTRAINTS

A. Piping shall be installed and restrained to meet the seismic requirements of the International Building Code (IBC) and in accordance with the SMACNA Seismic Restraint Manual.

1. As per Chapter 13 of IBC, Seismic Design Category B, nonstructural mechanical and electrical components are exempt.

3.8 FABRICATION OF ENGINEERED SUPPORTS

A. Engineered supports are normally fabricated at an off-site facility specializing in such work.

B. When approved, certain engineered pipe support details can be assigned to the Jobsite for fabrication when the details are limited to the following:

1. Simply cut structural steel sections, such as column angle, channel brackets, guide angles, and pipe stanchions.
2. Hangers, when rod diameter does not exceed 1 inch (25 mm).

3.9 SPECIAL REQUIREMENTS

A. cGMP Tubing: Clean Steam, WFI, and CIP distribution systems.

1. Due to anticipated dynamic loads resulting from widely varying fluid usage (on-off pulsations), additional anti-sway type restraints or anchors may be necessary where pipelines change direction, in excess of the basic supports to allow for thermal expansion and resulting pipe movement.
2. Piping shall be supported in such a manner to allow for gradual thermal expansion/contraction, but prevent large excursions due to dynamic loadings.
3. Excessive lateral movement or sway is not acceptable.
4. It is the Contractor's responsibility to provide permanent restraint type supports where excessive free movement is determined during operational checkout.

END OF SECTION 400529

CONFIDENTIAL DOCUMENT

400553

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

IDENTIFICATION FOR PROCESS PIPING

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

400553

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
400553	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 400553 – IDENTIFICATON FOR PROCESS PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Reference Specifications

1. 400513 - Common Work Results for Process Piping
2. 400610 - Schedules for Gas and Vapor Process Piping
3. 400620 - Schedules for Liquids Process Piping
4. 404200 - Process Piping and Equipment Insulation

C. Reference Codes and Standards

1. ASME/ANSI A13.1-1996 – Standard for Identification of Piping Systems

1.2 SUMMARY

A. This section covers the minimum requirements for permanent labeling of process piping systems, valves, and installed process equipment. Piping for fire protection systems or mechanical systems not considered process equipment, is not included.

B. The purpose is to provide a system of easy identification of process systems and components by operating and maintenance personnel, consistent with the Owner’s requirements.

C. Identification requirements described in this section are in addition to any nameplates for individual devices or equipment that may be required as described in the equipment specifications or purchase order documents for such equipment.

1.3 SUBMITTALS

A. Submit a schedule of label types, corresponding to the intended areas of use. Submittals require approval prior to purchase and application of subject materials.

B. Submit manufacturer’s technical product data, installation instructions, and samples for each identification material and device required.

1.4 DEFINITIONS

A. Valves are considered to mean all pipeline valves, excluding engineered control valves and plumbing fixtures. Valves in process systems shall be numbered in accordance with assigned valve numbers indicated on the design drawings.

B. Pressure-sensitive pipe markers: Vinyl plastic with an adhesive backing and peel-off liner.

C. Wrap-around or Snap-on pipe markers: Mechanically applied pre-formed plastic with built-in tension designed to grip the pipe surface without banding tape when installed. The markers shall cover 360 degrees of pipe.

D. Equipment shall mean all stationary machinery in process systems, including items such as pumps, compressors, chillers, heat exchangers, and storage vessels. Process equipment residing in clean areas is not included.

1.5 QUALITY ASSURANCE

A. Manufacturer’s Qualifications: Firms regularly engaged in manufacture of identification devices of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Seton Identification Products

B. W.H. Brady Co., Signmark Division

C. Industrial Safety Supply Co.

D. Substitutions require owner approval.

2.2 PIPE MARKERS

A. General

1. Pipe marker shall be sized to fit insulation diameter where applicable.
2. Pipe markers shall indicate fluid service and direction of flow.
3. Flow arrows shall be applied to all piping as part of the marking system. For lines carrying flow in both directions, flow arrow labels shall indicate both directions.

B. Snap-On Type: Provide manufacturer's standard pre-printed, semi-rigid snap-on, color-coded pipe markers, complying with ANSI A13.1.

C. Pressure-Sensitive Type: Provide manufacturer's standard pre-printed, permanent adhesive, color-coded, pressure-sensitive vinyl pipe markers, complying with ANSI A13.1.

D. Small Pipes: For external diameters less than 6" (including insulation if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:

1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
2. Adhesive lap joint in pipe marker overlap.
3. Taped to pipe (or insulation) with matching color-coded plastic adhesive tape, not less than 3/4 inch wide, full circle at both ends of pipe marker, tape lapped 1-1/2 inches.

E. Large Pipes: For external diameters of 6" and larger (including insulation if any), provide either full-band or strip-type pipe markers, but not narrower than 3 times letter height (and of required length), fastened by one of the following methods:

1. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-1/2 inch wide, full circle at both ends of pipe marker, tape lapped 3 inches.
2. Strapped-to-pipe (or insulation) application of semi-rigid type, with manufacturer's standard stainless steel or nylon wire tie bands.

F. Lettering: Comply with piping system nomenclature as specified, scheduled or shown, and abbreviate only as necessary for each application length.

1. Size: Lettering size shall meet or exceed those recommended in ANSI A13.1.
2. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic.

G. Plastic Tape

1. General: Provide manufacturer's standard color-coded pressure-sensitive (self-adhesive) vinyl tape, not less than 3 mils thick.
2. Width: Provide 1-1/2 inch wide tape markers on pipes with outside diameters (including insulation, if any) of less than 6 inches, 2- 1/2 inches wide tape for larger pipes.
3. Color: Comply with ANSI A13.1, except where another color selection is indicated.

2.3 VALVE TAGS

A. General

1. Material: Tags are commonly available in stainless steel and plastic. Materials chosen shall be compatible with the application, environment, and any existing plant requirements. All valve tag materials shall be approved by the Owner.
2. Process Valves: Tags for process valves shall indicate the assigned valve number. Tag numbers may include abbreviated fluid service designation lettering and sequential process numbering. See design drawings. Stainless steel with stamped lettering or laminated plastic material with engraved lettering is usually chosen for this application.

B. Stainless Steel Valve Tags

1. Provide 24-gauge thickness (.025”/ .63mm) series 300 stainless steel with stamp-engraved piping system abbreviation in 1/4" high letters and sequenced valve numbers 1/2 inch high and with 5/32 inch hole for fastener.
2. Provide 1-1/2” diameter tags unless otherwise directed.

3. Fasteners: Provide manufacturer's standard stainless steel chain with permanent fastening system in sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.

2.4 PLASTIC EQUIPMENT MARKERS

A. Provide manufacturer's standard laminated plastic equipment markers with engraved lettering, with pre-drilled mounting screw holes, or plain with contact type permanent adhesive where screws cannot or should not penetrate the substrate. Plates may be black with white lettering, or color coded in accordance with ANSI standard, per the Owner's preference.

1. Nomenclature: Include equipment name and number, and equipment service, consistent with terminology shown on schedules or design drawings as closely as possible.
2. Size: Provide approximate 2-1/2" x 4" markers for control devices, dampers, and control valves; and 4-1/2" x 6" with 0.5" high lettering for equipment.
3. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

2.5 LETTERING AND GRAPHICS

A. General: Coordinate names, abbreviations and other designations used in mechanical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated, or if not indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of mechanical systems and equipment.

1. Refer to Table 1 for recommended legend letter sizes for pipe markers.
2. Legend on steam piping, condensate return, compressed air and gas, and vacuum shall include working pressure or vacuum level.
3. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification that indicates individual system number as well as service. (As examples: Boiler No.3, Air Supply No.1H, Standpipe F12).
4. Refer to Table 3 for recommended legend letter sizes for valve tags.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Coordination: Where identification is to be applied to surfaces that require insulation, painting, or other covering or finishing, including permanent valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.2 PIPING SYSTEM IDENTIFICATION

A. Install plastic pipe markers to those finished systems that require fluid service and flow direction identification.

1. Clean surfaces prior to applying adhesives.
2. Pressure sensitive markers shall be secured with pressure sensitive strapping tape for surfaces in which the marker is difficult to adhere. The strapping tape color shall match the marking color.
3. For uninsulated pipe in which temperatures will exceed the marker temperature limitation, insulate the portion of the pipe where the marker is intended to be placed, prior to placing the marker. Pressure sensitive and snap-around marker temperature limitations are typically 248°F and 180°F, respectively. These values are supplied as guidelines only. The contractor is responsible for verifying the temperature limitation of the selected markers and insulating pipe accordingly.
4. Locate pipe markers and color bands as follows wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations. Install pipe markers for easy viewing at or near the following locations:

    a. Spaced intermediately at a maximum spacing of 50 feet per straight run of pipe, except reduce spacing to 20 feet in congested areas of piping and equipment.
    b. Near each valve and control device.
    c. Changes in flow direction.
    d. Branch Connections: Near each branch, excluding short take-offs for fixtures and terminal units. Mark each pipe at branch, where there could be question of flow pattern.
    e. Points of entry or exit where pipes pass through walls, floors, ceilings, partitions, or enter non-accessible enclosures.
    f. At access doors, manholes, and similar access points which permit view of concealed piping.
    g. Near major equipment items and other points of origin or termination.
    h. On piping above removable acoustic ceilings, except omit intermediately spaced markers.

3.3 VALVE TAGS

A. All valves, as defined in 1.4, shall be tagged. The tag location shall provide for easy viewing where possible.

B. Tags shall be affixed to the valve using appropriate permanent fastening chain, to a place on the valve that does not interfere with the operation of hand wheel or actuating lever, or restricts valve stem travel.

C. For concealed valves, a second tag shall be generated and mounted in a visible location indicating a concealed valve. Manufacturer's standard engraved plastic laminate access panel/door markers are recommended for this application.

3.4 PROCESS EQUIPMENT IDENTIFICATION

A. Install engraved plastic equipment markers on or near each major item of process equipment and each operational device, unless otherwise directed. The marker location shall provide for easy viewing.

B. Provide signs for the following general categories of equipment and operational devices:

1. Main control and operating valves, including safety devices and hazardous units such as gas outlets
2. Meters, gages, thermometers and similar units
3. Pumps, compressors, chillers, condensers and similar motor-driven units
4. Heat exchangers, evaporators, and similar equipment
5. Tanks and pressure vessels
6. Strainers, filters, water treatment systems and similar equipment

C. Lettering Size: Minimum 1/4" high lettering for name of unit where viewing distance is less than 2'-0", 1/2" high for distances up to 6'-0", and proportionately larger lettering for greater distances. Provide secondary lettering 2/3 to 3/4 of size of principal lettering.

D. Text of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

3.5 ADJUSTING AND CLEANING

A. Relocate any identification device that has become visually blocked by work of this division or other divisions.

B. Clean the face of identification devices, tags and nameplates, and glass of framed valve charts.

3.6 EXTRA STOCK

A. Furnish minimum of 5 percent extra stock of each identification material required, including: additional numbered valve tags (not less than 3) for each piping system, additional piping system identification markers, and additional plastic laminate engraving blanks of assorted sizes.

Appendix A – ASME/ANSI A13.1 Pipe Marking Standard

Table 1: Color Recommendations		
Material Classification	**Material Sub-Classification**	**Color Scheme-Background/Text**
Materials Inherently Hazardous	Flammable or Explosive	Yellow / Black
	Chemically Active or Toxic	
	Extreme Temperature/Pressure	
	Radioactive	
Materials of Inherently Low Hazard	Liquid or Liquid Admixture	Green / White
	Gas or Gaseous Mixture	Blue / White
Fire Quenching Materials	Water, Foam, CO_2, Halon, etc.	Red / White

Table 2: Suggested Lettering Size		
Pipe Size	**Color Field Length**	**Letter Height**
¾” to 1 ¼”	8”	½”
1 ½” to 2”	8”	¾”
2 ½” to 6”	12”	1 ¼”
8” to 10”	24”	1 ½”
12” and larger	32”	3 ½”

Appendix B – Pipe Marking and Valve Tagging Requirements

Table 3: Piping Marking Methods				
	Above-Ground Piping		Underground Piping	
Pipe Size	**Clean Area**	**Non-Clean Area**	**Metallic Piping**	**Non-Metallic Piping**
6” and Smaller	1.5” wide pressure sensitive	1.5” wide pressure sensitive, or snap-around	6” wide X .004” thick PE tape	4” wide electronically detectable tape with a .035” thick metal core strip covered by .004” PE
8” and Larger	2.5” wide pressure sensitive	2.5” wide pressure sensitive		

Table 4: Valve Tagging		
	Clean Area	**Non-Clean Area**
Tag Diameter	1 ½”	
Hole Size	Manufacturer’s Standard	
Tag Material	Stainless Steel (1)	Brass (2)
Attachment Method	Chain and S-hook	
Attachment Material	Stainless Steel	Brass (2)
Service Designation	Position: First Line Size: ¼” High	
Sequence Number	Position: Second Line Size: ½” High	
1) Engraved plastic if required. 2) Stainless steel is acceptable.		

END OF SECTION 400553

CONFIDENTIAL DOCUMENT

400610

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

SCHEDULES FOR GAS AND VAPOR PROCESS PIPING

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

400610

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
400610	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 400610 – SCHEDULES FOR GAS AND VAPOR PROCESS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Reference Specifications

1. 400513 - Common Work Results for Process Piping
2. 400529 - Hangers and Supports for Process Piping
3. 400553 - Identification for Process Piping and Equipment
4. 402400 - Process Piping and Equipment Insulation

C. Reference Codes and Standards

1. ASME Code for Pressure Piping B31.3 - “Process Piping”
2. ASME Bioprocessing Equipment (BPE) (2014)

1.2 SUMMARY

A. This specification provides the “Service Listing” which identifies process gas and vapor services and their corresponding operating pressures, operating temperatures, materials and specification codes. This specification does not identify non-process gas and vapor services and their requirements.

1.3 SUBMITTALS

A. The Seller shall submit a list of operating pressures for all fluid services and equipment supplied by him, and any design parameters specified by him. The Seller shall also submit items as described in the Related Documents.

1.4 SPECIFICATIONS

A. All specifications, standards, codes, etc., referred to and designated herein, together with all addenda, revisions, and supplements, shall be considered part of this specification. Specifications, standards, codes, etc., referred to shall be of the latest edition at the time of design.

B. Conflicts between the requirements of this specification, related specifications, standards, purchase orders or design drawings shall be referred to the Owner or his Representative for clarification before proceeding with work on the affected parts.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Piping materials for each line class are specified in another document. Refer to Section 400513.13 – Steel Process Piping, Section 400513.19 – Stainless Steel Process Piping and Tubing.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Section 400513 – Common Work Results for Process Piping for installation of gas and vapor piping systems.

Table 1: Service List

Service	Code	Rated Temp.	Rated Press.	Material	Plant Spec (Note 3)	Process Spec (Note 2)
STEAM						
CLEAN STEAM (## - STEAM PRESSURE)	CS##	300 ºF	150 psig	316L S.S. Tubing, 25 µin Ra MP	SF2	SF2
VENT						
RELIEF VENT	RV	300 ºF	150 psig	316L S.S. Tubing, Mill Finish / 316L S.S. Tubing, 25 µin Ra MP	SF0	SF0/SF2
GENERAL VENT	V	300 ºF	150 psig	Carbon Steel Pipe, Mill Finish / 316L S.S. Tubing, Mill Finish	CSP2/SF0	SF0
PROCESS VENT	PV	300 ºF	150 psig	316L S.S. Tubing, Mill Finish / 316L S.S. Tubing, 25 µin Ra MP	SF0/SF2	SF0/SF2

Notes:

1. Maximum operating pressure and temperature listed are to be considered as design conditions, per ASME B31.3, for the purpose of calculating system test pressures and thermal growth.
2. Material line class listed in “Process” column is for piping inside clean process and clean manufacturing areas.
3. Material line class listed in “Plant” column is for piping in balance of plant, outside clean areas.

END OF SECTION 400610

CONFIDENTIAL DOCUMENT

400620

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

SCHEDULES FOR LIQUIDS PROCESS PIPING

ImmuCell

Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

400620

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
400620	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 400620 – SCHEDULES FOR LIQUIDS PROCESS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Reference Specifications

1. 400513 Common Work Results for Process Piping
2. 400529 Hangers and Supports for Process Piping
3. 400553 Identification for Process Piping and Equipment
4. 402400 Process Piping and Equipment Insulation

C. Reference Codes and Standards

1. ASME Code for Pressure Piping B31.3 - “Process Piping”
2. ASME Bioprocessing Equipment (BPE) (2014)

1.2 SUMMARY

A. This specification provides the “Service Listing” which identifies process liquids services and their corresponding operating pressures, operating temperatures, materials and specification codes. This specification does not identify non-process liquid services and their requirements.

1.3 SUBMITTALS

A. The Seller shall submit a list of operating pressures for all fluid services and equipment supplied by him, and any design parameters specified by him. The Seller shall also submit items as described in the Related Documents.

1.4 SPECIFICATIONS

A. All specifications, standards, codes, etc., referred to and designated herein, together with all addenda, revisions, and supplements, shall be considered part of this specification. Specifications, standards, codes, etc., referred to shall be of the latest edition at the time of design.

B. Conflicts between the requirements of this specification, related specifications, standards, purchase orders or design drawings shall be referred to the Owner or his Representative for clarification before proceeding with work on the affected parts.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Piping materials for each line class are specified in another document. Refer to Section 400513.19 – Stainless Steel Process Piping and Tubing.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Section 400513 – Common Work Results for Process Piping for installation of liquid piping systems.

Table 1: SERVICE LIST

Service	Code	Rated Temp.	Rated Press.	Material	Plant Spec (Note 3)	Process Spec (Note 2)
WATER						
RO WATER	RO	300°F	150 psig	316L S.S. Tubing, 25 µin Ra MP	SF2	SF2
PURIFIED WATER	USP	300°F	150 psig	316L S.S. Tubing 25 µin Ra MP	SF2	SF2
PROCESS						
PROCESS	P	300°F	150 psig	316L S.S. Tubing, 25 µin Ra MP /316L S.S. Tubing, 25 µin Ra EP	SF2/SF6	SF2/SF6
CLEAN-IN-PLACE – SUPPLY	CIPS	300°F	150 psig	316L S.S. Tubing, 25 µin Ra MP	SF2	SF2
CLEAN-IN-PLACE – RETURN	CIPR	300°F	150 psig	316L S.S. Tubing, 25 µin Ra MP	SF2	SF2
CONCENTRATED ACID (50%)	A	300°F	150 psig	316L S.S. Tubing, Mill Finish, Compression Fittings	SF2	SF2
CONCENTRATED CAUSTIC (50%)	OHC	300°F	150 psig	316L S.S. Tubing, Mill Finish, Compression Fittings	SF2	SF2
DILUTED CAUSTIC (0-10%)	OHD	300°F	150 psig	316L S.S. Tubing, Mill Finish, Compression Fittings	SF2	SF2
CONDENSATE						
CLEAN STEAM CONDENSATE	CSC	300°F	150 psig	316L S.S. Tubing, 25 µin Ra MP /316L S.S. Tubing, Mill Finish	SF2/SF0	SF2/SF0
MISCELLANEOUS						
PROCESS DRAIN	PD	300°F	150 psig	316L S.S. Tubing, Mill Finish	SF0	SF0

Notes:

1. Maximum operating pressure and temperature listed are to be considered as design conditions, per ASME B31.3, for the purpose of calculating system test pressures and thermal growth.
2. Material line class listed in “Process” column is for piping inside clean process and clean manufacturing areas.
3. Material line class listed in “Plant” column is for piping in balance of plant, outside clean areas.

END OF SECTION 400620

CONFIDENTIAL DOCUMENT

404200

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

PROCESS PIPING AND EQUIPMENT INSULATION

ImmuCell
Portland, ME

Reviews / Approvals

Title	Name	Signature	Date
Project Manager Stantec	Kevin Merrikin		
ImmuCell Project Manager ImmuCell	Elizabeth Williams		
Design Manager Stantec	Robby Cosgriff		

The completion of this page indicates review of the contents by the relevant disciplines and approval by responsible individuals.

CONFIDENTIAL DOCUMENT

404200

ImmuCell

ImmuCell Interior Fit-Out Package

Design Specification

Specification Package Revisions

Revision Level	Revision Date	Revision Description
0	8/19/2016	Interior Fit-Out - Issued for Construction

Specification Package Documents

Specification Number	Revision Level	Revision Date	Revision Description
404200	0	8/19/2016	Interior Fit-Out - Issued for Construction

SECTION 402400 – PROCESS PIPING AND EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Reference Specifications:

1. Section 400513 - Common Work Results for Process Piping
2. Section 400529 - Hangers and Supports for Process Piping
3. Section 400553 - Identification for Process Piping and Equipment

C. Referenced Codes and Standards:

1. ANSI - American National Standards Institute.
2. ASTM C450 - Recommended Practice for Fabrication of Thermal Insulating Fitting Covers
3. ASTM C534 - Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
4. ASTM C547 - Specification for Mineral Fiber/Fiberglass Preformed Pipe Insulation
5. ASTM C585 - Recommended Practice for Inner and Outer of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing
6. ASTM C592 - Specification for Mineral Fiber/Fiberglass Blanket Insulation (Metal Mesh Covered)
7. ASTM C612 - Specification for Mineral Fiber Block and Board Thermal Insulation
8. ASTM C795 - Specification for Wicking-type Thermal Insulation for Use Over Austenitic Stainless Steel
9. ASTM C1094 - Specification for Removable Covers
10. ASTM E84 - Surface Burning Characteristics of Building Materials
11. ASTM E96 - Water Vapor Transmission of Materials in Sheet Form
12. cGMP/FDA - Current Good Manufacturing Practices of the Food and Drug Administration, U.S. Department of Health and Human Services.
13. FM - Factory Mutual Association
14. IAMFES/USPHS/DIC - International Association of Milk, Food and Environmental Sanitarians/US Public Health Service/The Dairy Industry Committee - 3A Sanitary Standards
15. NFPA - National Fire Protection Association
16. NIAC/ MICA - National Insulation and Abatement Contractors Association/ Midwest Insulation Contractors Association
17. OSHA - Occupational Safety and Health Act
18. TIMA - Thermal Insulation Manufacturers Association
19. UBC - Uniform Building Code, latest edition (Building Code is NYS, or other applicable building code)
20. UL - Underwriters Laboratories
21. Applicable state, city and county codes

1.2 SUMMARY

A. Work included

1. This specification details the selection and installation of field applied thermal insulation and weatherproofing to process piping, vessels and equipment.
2. Objectives:

    a. Maintain process or fluid temperature and conserve energy.
    b. Maintain surface temperature less than 100°F (38°C) for hot services.
    c. Prevent condensation on the external surface for cold services.
    d. Prevent miscellaneous external fluid impingement (drips, spills, rainwater, etc.) from entering and wetting the insulating layer.

B. Work not included

1. Ductwork insulation.
2. Factory-applied equipment insulation.

1.3 SUBMITTALS

A. The insulator shall provide the following in accordance with the conditions of the contract:

1. Material samples and Materials Safety Data Sheets (MSDS) per OSHA for proposed alternative materials.
2. Design details of valve, fitting, flange, clamp, and transition to piping insulation per MICA standards.
3. Details of insulated valve operating handles.
4. Samples of removable flange and clamp covers.
5. Certification, of material insulating quality and conformance to ASTM C-795 - Specification for Thermal Insulation For Use In Contact with Austenitic Stainless Steel, and C-177 - Test Method for Steady State Heat Flux Measurement and Thermal Transmission Properties by Means of the Guarded-Hot Plate Apparatus.
6. Proposed alternate design details.
7. Installation Procedures.
8. Installation details and standards for insulation supports, sheathing, and/or jacket for pipe.
9. R or k-values of each material and thickness supplied.
10. Materials, insulation details, or intended practices of insulation application are not covered in these specifications. Omission of details from these specifications shall not relieve the Contractor from the obligation to supply a properly designed installation in accordance with current acceptable construction practices at no additional cost or schedule impact to the Owner.

1.4 QUALITY ASSURANCE

A. Buyer reserves the right to inspect insulation materials and insulation installation at any time. Buyer reserves the right to dictate removal of unsatisfactory work or materials. Cost of removal of unsatisfactory work or materials shall be borne by the insulator.

1. All materials must be inspected for conformance to this Specification prior to start of installation.
2. Buyer inspection of insulation installation activity will occur during the actual work, assuring conformance with Buyer approved procedures.
3. All materials used (insulation, cements, mastics, adhesives, tapes, etc.) or their shipping cartons shall have the Underwriters label, which indicates the smoke/flame ratings for the product.

1.5 TERMINIOLOGY

A. GMP Areas: Areas in which special items are required in order to assist mechanical systems in meeting the cGMP guidelines of the FDA for pharmaceutical/ biotechnology facilities.

B. Indoors: An area in which insulation is completely surrounded by a building structure.

C. Outdoors: An area in which insulation is not completely surrounded by a building structure.

D. Insulation Codes: A two-letter code is used to indicate the functional category or type of insulation, but does not define the actual insulating materials. Piping and equipment shall be insulated according to insulation category codes shown on the drawings, or described in equipment specifications. Piping insulation codes normally appear at the end of a pipeline number, following the material line spec designation. The insulation category codes are as follows:

Table 1: Insulation Categories

Code	Definition / Category
AS	Anti-sweat
CC	Cold Conservation
HC	Heat Conservation
PP	Personnel Protection
C/H	Dual-Temperature

E. Temperature Range Definitions:

1. Cold: Content of pipeline below a temperature of 50°F (10°C).
2. Ambient: Content of pipeline which is not heated or cooled and will remain at temperature range between 51 - 79°F (11 - 26°C).
3. Hot: Heated content of pipeline at or above 80°F (26°C) temperature.
4. Block or Board: Rigid insulation having compressive strength of at least 100 psi at 5 percent deformation

PART 2 - PRODUCTS

2.1 GENERAL

A. Material shall be new, the best quality of the respective types and suitable for the intended service.

B. In order to maintain safe practices, insulation materials, where tested, shall indicate a flame-spread and smoke-density index in accordance with ASTM E 84-91a and any State, City and Local Codes.

C. All covering or insulation used on heating and cooling systems shall be of materials suitable for the operating temperature of the system. The insulation, jackets, and lip-seal adhesives shall be tested as a complete product and shall have a flame spread rating of not more than 25 and smoke developed rating of not more than 50 when tested in accordance with ASTM E84.

D. Storage and Protection:

1. Insulation materials must be kept dry, clean and protected at all times.
2. Water-soluble cements and finishes must be protected from freezing or damage until set.
3. Unfinished and finished work must be protected against damage during construction.
4. Exposed insulation must be protected from the weather.
5. Insulation materials must be new and undamaged.
6. The manufacturer's name and brand marking must be clearly displayed on all containers.

E. Asbestos and asbestos bearing materials are prohibited.

F. Insulating materials shall be non-corrosive.

G. Insulation shall be certified upon manufacture and testing to be free of chloride ions sufficient to meet ASTM Specification C-795. Material shall be so certified by documentation from the manufacturer.

2.2 ACCEPTABLE MANUFACTURERS

A. Insulation

1. Fibrous Glass

a. Owens-Corning Corp.- "One-piece Insulation", A.S.J.-SSL II
b. Schuller- "Mikro-Lok"
c. CTM "Alley K Snap-on"
d. Hamfab by ICA, Inc. - Type 650
e. Certainteed
f. Knauf
g. Johns-Manville

2. Preformed Mineral Wool

a. Owens-Corning Corp. – Paroc 1200 PC
b. Rockwool International – "Roxul 1200"

3. Closed Cell Elastomeric Foam

a. Armstrong World Industries, Inc.- Armaflex
b. Rubatex Corp. – Armacell LLC

4. Cellular Glass (Fire Wall Service)

    a. Melamine Pittsburgh Corning Corporation-“Foamglas”
    b. ACS Industries – “Cell-U-Foam Foam

5. Melamine Foam

    a. Acessible Products Co. - TechLite

6. Polyisocyanurate Foam

    a. Dow Chemical- Trymer
    b. HiTherm – HT-300

7. Polystyrene Foam

    a. Dow Chemical- Styrofoam

8. Ceramic Fiber Blanket

    a. Unifrax Corp. – Fiberfrax: Durablanket, Duraback
    b. Premier Refractory – Cerwool
    c. HWR Products/ A.P.Green – Inswool

9. Rigid Closed-Cell PVDF Foam

    a. UFP Technologies, Inc. – T-Tubes

B. PVC Valve and Fitting Covers

1. Speedline Mfg. Co. SLW
2. Great Lakes Textiles Inc. Polyco VP
3. Schuller - Zeston 2000

C. PVC Pipe Covers

1. Speedline Mfg. Co. SLW
2. Great Lakes Textiles Inc. Polyco VP
3. IMC Insulation - Sani Jac.
4. Proto Corp.-Lo Smoke Jacket
5. Schuller - Zeston 2000

D. Encapsulating reinforcing Cloth, White glass fiber, 10x20 mesh (nylon reinforced)

1. Insul-Coustic "Glass Cloth”
2. Childers "Chil-Glass" (hot) or "Vapor barrier" (cold)
3. CCX Fiberglas Products – Style 1658 or 1659

E. Jacket Sealing Mastic

1. Childers CP-76 (white)(-100 to +300°F)
2. Epolux #745 (white)

F. Jacket Adhesive

1. Polyco VP Welding Adhesive
2. VP Welding Adhesive (not permitted with Fibrous Glass Insulation)
3. IMC PVC Weld Adhesive (not permitted with Fibrous Glass Insulation)

G. Pipe, Fitting and Valve Mastic

1. GMP / Sanitary Areas: Childers Encacel CP-30 or 50 (white)
2. Non-Sanitary Areas: Sealing Mastic: Childers CP-10

H. Brand or trade names indicated are for the purpose of identifying general types of acceptable materials and a level of quality. Substitutions shall comply with the requirements of the contract documents.

2.3 FIBROUS GLASS PIPING INSULATION

A. Fibrous glass, molded one-piece insulation with an attached vapor barrier (all service jacket - ASJ) and joint sealing strips (self-sealing lap-SSL).

B. Material to have a nominal density of 5 lb/ft^3 and a maximum thermal conductivity value of 0.23 BTU-in/hr-ft^2-°F or less at 75°F mean temperature (ASTM C-177).

C. Fittings shall be insulated with molded fitting covers or mitered sections of pipe insulation, equal in thickness to the insulation on adjacent pipe and securely fastened in place.

2.4 PREFORMED MINERAL WOOL PIPING INSULATION

A. Pre-formed Mineral Wool shall have a density of not more than 8 lb/ft^3 and a thermal conductivity less than 0.23 BTU-in/hr-ft^2-°F at 75°F mean temperature.

B. Owens-Corning Corp. - premolded pipe insulation, Paroc 1200 PC, stainless steel wired in place with all service jacket.

C. For fittings and valves, and where tubular material cannot be used, insulator shall use Hamfab by ICA, Inc. fabricated covers, stainless steel wired in place with all service jacket.

2.5 CLOSED CELL ELASTOMER PIPING INSULATION

A. Armaflex AP premolded pipe insulation, closed cell structure elastomeric. Thermal conductivity, K, shall be 0.27 in/hr-ft^2-°F, at 75°F mean temperature using ASTM C177-85.

B. For fittings and valves, and where tubular material cannot be used, insulator shall use Armaflex II sheet and roll insulation.

1. Armstrong World Industries, Inc. “AP Armaflex”.
2. Seams and butt joints shall be completely sealed with Armstrong 520 adhesive.

2.6 CELLULAR GLASS PIPING INSULATION

A. Foamglas Insulation, as manufactured by Pittsburgh Corning Corporation, in accordance with ASTM(C-552-88) - Standard Specification for Cellular Glass Thermal Insulation.

1. Thermal conductivity, K, shall be 0.35 btu-in/hr-ft^2-°F or less at 75°F.
2. Thickness shall be 1-1/2 inch or 3 inch. Insulator shall choose the thickness closest to the adjacent pipe insulation thickness.

2.7 MELAMINE FOAM PIPING INSULATION

A. TechLite Series 879 melamine foam insulation with .020" pvc film jacket; Accessible Products Co.

1. Thermal conductivity, K, shall be 0.26 BTU-in/hr-ft^2-°F or less at 75°F.

2.8 POLYISOCYANURATE FOAM IINSULATION

A. Trymer 2000 rigid foam insulation with Saran vapor retarder jacket; Dow Chemical Co.

1. Thermal conductivity, K, shall be 0.19 BTU-in/ hr-ft^2-°F or less at 75°F after 180 days.
2. Use Trymer 4000 or 6000 high compressive strength foam at saddle pipe supports.
3. Use Saran vapor retarder tape for jacket joining.

2.9 STYRENE FOAM INSULATION

A. Styrofoam brand rigid polystyrene foam insulation; Dow Chemical Co.

1. Thermal conductivity, K, shall be 0.25 BTU-in/ hr-ft^2-°F or less at 75°F.
2. Use Saran film vapor retarder and Saran joint sealing tape.

2.10 JOINT SEALANT

A. Use products recommended for each type of insulation, in accordance with the insulation manufacturer's recommendations. Apply to longitudinal and transverse joints.

B. For Foamglas insulation, joint sealant shall be Pittsburgh Corning Pittseal 444N.

2.11 JOINT SEALANT

A. Fire stop caulking: 3M #CP-25 WB+. 1-Hour (3M, Inc.)

B. Firemaster Bulk and Mastic: UL-1479/ASTM E-814, 3-Hour. (Thermal Ceramics)

C. Flame Stop V, 1-hour. (Flame Stop Inc.)

2.12 PIPE, FITTING AND VALVE JACKETS / COVERS

A. Premolded or routed fitting covers, two piece metal or PVC covers, shall be used to the largest commercially available size. For larger sizes fabricate suitable covers. Use routed or molded two piece insulation fittings to the largest commercially available size unless the insulation schedule indicates otherwise. The larger ells shall be insulated in mitered segments. The proper number of miters and rasping of each miter is required to accommodate complete closure of the fitting covers.

B. PVC Jackets/Covers

1. Jacket shall be washable, 20 mil thickness PVC.
2. In GMP / sanitary areas, jackets must endure daily water wash down exposing jackets to temperatures not exceeding 165°F.

C. Aluminum jacket incorporating a moisture barrier.

1. 0.016" thick as minimum and manufactured of Type 3003 (“3s”), 5005 (“5s”) or 5010 aluminum with a mill finish.

2.13 SEALING COMPOUNDS

A. Sealing compounds shall be water-based and of fire resistant materials.

B. Water vapor permeance shall be 0.08 perm, maximum

C. The service temperature range for sealing compounds shall be at least -20°F to 180°F.

2.14 H-BLOCK PIPE SUPPORT INSULATION

A. Insulation pipe support inserts shall be high-density 20 lb/ft^3 molded fiberglass, Hamfab by ICA, Inc., rated for use in cold and hot systems (-120 to +450°F).

2.15 EQUIPMENT ISULATION

A. GMP / Sanitary Areas

1. Equipment and vessels residing in clean areas shall be insulated with melamine foam. Techlite is suitable for operating temperatures between -150°F and +400°F.

B. Non-Sanitary Areas

1. Hot equipment, pumps, and vessels – Fiberglass, Foamglas, or Ceramic fiber.
2. Cooling equipment, pumps, and vessels – Armaflex closed cell foam.
3. Dual-temperature service equipment – Fiberglass or Foamglas.

C. Outdoor Equipment

1. Hot equipment – Fiberglass, Foamglas, or Ceramic fiber.

2. Cold equipment – Armaflex or Fiberglass.

D. Cryogenic Equipment

1. Material selection based on service temperature and heat loss – Melamine foam, Trymer, or Styrofoam.
2. Vacuum Jacketed Piping.

E. Jacketed Vessels

1. For jacketed vessels assembled with welded-on sheathing, insulation between heat transfer jacket and sheathing shall be ceramic fiber blanket.

2.16 REMOVABLE AND REUSABLE PADS

A. Equipment with irregular or complex surfaces such as pump casings and piping items, such as valves and flanges that are to be insulated and require regular inspection and maintenance, shall be insulated with removable and reusable covers or pads.

1. Removable covers should be designed to provide for the following qualities:

a. Suitable insulation integrity
b. Accuracy of fit
c. Ease in removing and replacing
d. Adaptability to field conditions and interferences
e. Appearance consistent with adjacent insulation and general neatness of insulation systems

2. Insulation material shall be a nominal 2 inches thick, 10 to 12 lbs./ft^3 density needled glass fiber mat, meeting the requirements of military specification MIL-1-16411E, Type II, J. P. Stevens, Burlington Industries, or approved equal.
3. The weather barrier for the outer surface shall be silicone rubber impregnated glass cloth; Alpa-Maritex 3259-2-SS or Teflon coated cloth; Alpha-Maritex Style TC-114, or an approved equal.
4. For equipment surface temperatures below 500°F, the liner material for the cover inner surface shall be silicone rubber impregnated glass cloth, Alpha-Maritex #3259-2-SS or approved equal. For surface temperatures 500°F and above, the liner material shall be 3 mil (0.003 of an inch) thick stainless steel foil, Type 304.
5. All cloth cover surfaces shall be covered with a layer of Maritex Type 304 stainless steel wire 0.011 inches in diameter with a density of 60.
6. Hog ring constructed covers shall be secured with 16 gauge, Type 304 stainless steel hog ring staples on 1-1/4 inch centers (plus or minus 1/4 inch).
7. Sewn covers shall be double stitched 8 to 10 stitches per inch. Fabric seams shall be inside wherever possible.
8. Lacing hooks, speed clips and quilting fasteners shall be Type 304 stainless steel.
9. Covers designed with Velcro attachment straps shall have a secondary attachment included in the design.

PART 3 - EXECUTION

3.1 GENERAL

A. Insulation shall be installed by experienced craftsmen regularly engaged in the insulation industry. Finished work shall be uniform and neat in appearance.

B. Buyer reserves the right to reduce thickness stated in the attached tables.

C. Omission of the details from these Specifications shall not relieve the Insulator of the obligation to supply a properly designed installation in accordance with this Specification.

3.2 PROHIBITED PRACTICES

A. Field welding of studs, nuts, rings, clips, etc., for insulation installation.

B. Insulation cements shall not be used as a substitute for insulation. Where voids or openings exist, the insulation shall be replaced.

C. Jackets shall not be secured with materials that can puncture vapor barrier finishes or coatings. Bands shall be used to secure the jacket.

D. “Group” insulation is prohibited. Each pipe shall be insulated separately.

E. Insulation of fire protection piping is prohibited.

F. Insulation and protective jacketing shall not extend over sanitary ferrules and clamps, except as noted under 3.3.B. The protective jacket shall be terminated 1 inch on each side of the ferrule, and shall be sealed to it with a bead of FDA-approved clear silicone caulking at least 1/4 inch wide.

3.3 INSTALLATION – PIPING INSULATION

A. Sequencing

1. GMP systems requiring slope shall have slopes verified and documented by the piping installation contractor prior to the application of insulation.
2. All piping shall have been tested by the piping installation contractor and approved by the owner’s representative prior to application of insulation.
3. All surfaces to be insulated shall be clean and dry. Any necessary cleaning shall be done by the Insulator. Special solvents are not required for use in cleaning, but any oil, grease, dirt, or foreign material shall be wiped or scraped from the pipe surface.
4. Where critical services require corrosion protection under insulation, the coatings shall be properly completed prior to installing the insulation.

B. Valves and Fittings:

1. Valves, flanges and fittings in steam supply service shall be insulated.

2. Valves, flanges and fittings in hot service lines above 100°F shall be insulated.
3. All valves, flanges and flanged fittings in cold service lines shall be insulated.
4. Ball, plug and butterfly valves entire valve body shall be insulated.
5. Valve insulation:

    a. Valve bodies shall be insulated up to the packing gland.
    b. Insulation shall not interfere with adjustment or removal of packing gland, or interfere with operation of actuator.
    c. Insulation shall be sealed to valve body with suitable mastic.
    d. On 3" and larger globe valves and control valves, insulation shall permit valve removal and replacement with minimal damage to the insulation.

6. Steam trap bodies shall be left uninsulated unless otherwise directed.
7. Flange insulation shall be premolded, temporarily removable and replaceable by breaking seals to permit flange bolt tightening or removal. Jacketed insulation on flanges shall extend at least 2 inches over adjacent jacketed pipe insulation.
8. Insulation shall be sealed off at all flanges, valves and fittings by applying mastic on the ends of the insulation and on the pipe.
9. Cold sanitary clamps shall be covered with premolded PVC.
10. Insulation shall terminate at bolted flanges 1", plus a bolt length for ease of bolt removal wherever possible. Seal all terminated insulation on cold systems with reinforced vapor barrier mastic or a coat of silicone caulking sealant on small applications. On hot systems, use metal end caps.

C. Piping:

1. Equipment nozzles, fittings, instruments, and piping engineered items, when insulated, shall be considered a part of the piping and shall have the same insulation requirements as the attached piping.
2. In general, personal protection (PP) insulation shall be provided on piping not normally insulated, whose surface temperature may exceed 140°F, within a vertical distance of 7 feet, and a horizontal distance of 3 feet from the edge of any normal working or walking platform level, or to any hot surfaces that are in such a position where accidental contact may be possible.
3. Personal protection (PP) insulation shall be provided up to the ceiling for all piping in GMP areas. All continuously steamed lines and all lines that will be steamed-in-place (SIP) require insulation. In non-GMP areas, personal protection (PP) insulation shall be provided up to a height of 7 feet. Use same insulation thickness as for heat conservation.
4. Insulation shall be sealed off at intervals of not more than 21 feet on continuous runs of pipe by applying mastic on the ends of the insulation and on the pipe.
5. Insulation joints shall be staggered on single and multiple layers.
6. Insulation ends shall be tightly butted together.
7. Insulation ending at equipment shall be beveled to the radius of the equipment.
8. Insulation joints on cold systems shall be sealed against entering water vapor. Provide tape as required.
9. Insulation on hot systems shall be completely sealed against moisture intrusion and conduction by using a weather proofing mastic.
10. Outdoor insulation shall be continued for a minimum distance of 3'-0" inside the building.

D. Stainless Steel Piping

1. Protective Coating: Coat all outside surfaces of stainless steel piping that are to be covered with insulating materials with (Dampney Co.) Thurmalox 70 silicone coating, prior to applying insulating layers. GMP / Sanitary tubing systems are excluded from this coating requirement, unless otherwise specified.

E. GMP / Sanitary Areas:

1. Insulation shall be double encapsulated.

    a. The glass cloth cover must be completely sealed, inspected and approved by the Owner prior to the application of the PVC cover.
    b. The PVC cover must be completely sealed, inspected and approved by the Owner.

2. No insulation particles, fibers or flakes are permitted within a clean or GMP validated area.
3. No water is permitted within the seals, between the seals, or in the insulation.
4. No organic matter is permitted in the insulating system, i.e. wood inserts or shims, within a clean or GMP validated area.
5. Slip joints are not permitted in GMP / sanitary areas. Piping and insulation design shall be such that pipe expansion resulting from temperature changes shall be absorbed outside the sanitary area, wherever possible.

F. Pipe Hangers and Supports

1. All pipelines with supports shall be set in their permanent location before insulation is applied.
2. If it is necessary to block or shore up pipe, or to displace or remove hangers to install insulation, the pipe and hangers shall be restored to their original locations and aligned when the insulation is complete. Coordinate with the piping installer.
3. Indoor Pipe Hangers (clamped directly to pipes) shall be insulated as follows:

    a. For services with “HC” or “PP” insulation codes, the insulation shall be carefully fitted around the hanger clamp and sealed at openings in the jackets.
    b. For services with “CC” insulation codes, the insulation shall completely cover the hanger clamp and extend up the hanger rod approximately four (4) times the specified thickness. The insulation shall be vapor sealed, extending at least 6" beyond insulation.

4. Outdoor Pipe Hangers (and indoor pipe hangers installed outside the insulation and finish) shall be insulated as follows:

    a. Provide a galvanized steel or stainless steel half-round shield at every support point. For roller supports, provide a 10 gauge shield. For stationary supports and hangers, provide a shield with thickness adequate to support the pipe size and weight.
    b. The shields shall have an inside diameter equal to the outside diameter of the finished insulation. The shields shall have a minimum length equal to 1.5 times the outside diameter of the insulation.

c. Refer to Section 400529 – Hangers and Supports for Process Piping for support hardware specifications.

5. H-Block Pipe Support Insulation

a. High compressive strength insulation inserts shall be installed from the inside radius of the insulation in blocks so that the insulation envelope is not breached, and so that the vapor barrier remains intact.
b. The support blocks shall provide solid support to the pipe and avoid compression of the surrounding insulation.
c. Insulation shall be inserted at pipe supports per manufacturer's recommended method, preserving vapor barrier.

G. Weather Protected Application

1. All insulation applications shall have the basic insulation jacketed. Insulated fittings and valves shall be jacketed with prefabricated fitting covers with weatherproof seams.
2. Insulated pipe cover shall be high impact type smooth indoor-outdoor (UV resistant) jacket with positive seal against contamination and moisture. Jacket shall be continuously welded as specified by the manufacturer, lapped, with the lap pointing downward to shed water.
3. Apply jacketing with a minimum 2" overlap for pipe. Orient the longitudinal seams downward (on horizontal lines) at 9 or 3 o'clock, to shed water. Provide a continuous bead of caulking sealant under the circumferential overlap.
4. There shall be no gap greater than 3/16" between the weather barrier and nozzles, brackets, hangers, etc., projecting through insulation; otherwise, additional flashing will be required.
5. Openings for protrusions, such as valve stems, shall be as small as possible and sealed with mastic.
6. Caulk insulation jacket interfaces with a 3/8" bead to fill potential leak paths. Do not feather edge the bead of caulking. The joints shall be caulked the same day the jacketing is installed.
7. Aluminum jacket shall be installed so that rainwater from above cannot seep into the jacket.
8. Aluminum jacket shall be attached using 1/2 inch x 0.015 stainless straps and winged seals and # 7x 3/8-inch self-tapping screws made from stainless steel. All exposed edges shall be broken to remove sharp edges.
9. Insulation shields shall be installed on the outside of the outer jacket to spread the load imposed by pipe hangers and to protect the underlying insulation.
10. Slip joints must be installed in long runs of the protective jacket (over 25 feet in length or as otherwise indicated). Slip joints shall overlap not less than 4 inches with the lap of the upper jacket conforming to that of the lower jacket.
11. Troweling, rolling or applying of mastics, adhesives, caulking compounds, tape or exterior finishes shall not be performed below 40°F, or in wet weather.

H. Heat Traced Lines

1. All electric or steam heat tracing shall be completed after the application of any specified corrosion resistive coatings and prior to the installation of insulation and sheathing.
2. Heat tracing shall be located on pipe so as not to be located between the pipe and the support load.

3. Do not use screws to secure jacketing on electrically traced lines.
4. Steam tracer connections or couplings shall be located outside the pipe insulation. The tracer jumpers shall be sealed with high temperature caulking compound where it protrudes from the weather barrier. Overwrap the jumper with fiberglass listing tape and finish with acrylic type mastic.
5. Install oversize diameter insulation on heat traced lines. Do not groove insulation to accommodate tracing. To prevent movement of the insulation, on piping larger than 2" (nominal) stabilize the insulation to the pipe exterior with spacer blocks or shims fabricated from the insulation material as required.
6. Pre-formed coverings shall be used to cover tees, elbows and crosses. Fitting covers shall overlap jacketing material a minimum of 1". PVC covers shall be circumferentially stapled and tape sealed.
7. Two piece metal covers shall be secured with metal bands and screws. Do not use staples or screws that can puncture the vapor barrier finishes or coating on cold or dual temperature insulation.
8. Install visible warning signs on the insulation finish indicating “Heat Traced Line”.

I. Steam Traps and Strainers

1. Steam traps will normally not be insulated, in order to allow for proper operation of those devices. The short length (usually 2-3 feet) of connecting piping from the drip point to the trap inlet, which usually includes a strainer, should be left uninsulated to function as a condensate cooling leg. However, bucket type steam traps, strainers, and steam trap piping shall be insulated for personnel protection in areas where PP insulation is required. Guards or barriers are preferred to insulation of steam trap piping.

3.4 FIRE WALL PENETRATIONS

A. Fire Wall Penetrations, to pass ANSI / UL 1479 test (ASTM E814) - Penetrations through fire rated walls or fire barrier floors shall be sealed to preserve the fire rating of the wall or floor as described in the applicable Building Code. Refer to Division 7 specifications. Penetrations into GMP/ sanitary areas must be completely sealed yet allow for thermal expansion of the piping.

3.5 PIPING INSULATION - SERVICE LIST

A. For piping service and operating temperature requirements, refer to Section 400610 – Schedules for Gas and Vapor Process Piping and Section 400620 – Schedules for Liquids Process Piping.

3.6 PIPING INSULATION - MATERIALS BY AREA

A. See Appendix A.

3.7 PIPING INSULATION THICKNESS TABLES

A. See tables in Appendix B.

3.8 PIPING INSULATION SELECTION GUIDE

A. To aid in determining the appropriate insulating system and insulation thickness from information presented on the project design drawings, refer to the outline in Appendix C.

3.9 HOT VESSELS AND EQUIPMENT INSULATION

A. General

1. Vessels and equipment shall be insulated as identified in 2.15.
2. Manhole covers, flanges on exchangers, channels and channel covers shall be insulated with removable covers according to Section 3.6 when insulation is specified. Insulation shall be stopped short of flanges in sufficient distance to allow bolt removal without damage to insulation.
3. Vessels and tubular equipment 24 inches in diameter and smaller shall be insulated with preformed pipe insulation in accordance with 3.2.
4. Rigid block insulation shall be used on the heads of vertical vessels and for walkways on storage tank roofs.
5. Pumps, if insulated, shall be insulated with removable insulation covers as specified in Section 3.10.

B. Insulation Application

1. Code inspection plates or stamping, nameplate, dataplates, test plugs, nozzles, flanges, weephole nipples and system components on equipment shall be left permanently visible unless otherwise specified by cutting back the insulation where necessary, and property sealing it against moisture penetration.
2. Above 24 inch OD, blankets shall be used on the shells except when attachment welding is prohibited, then insulation shall be block.
3. Block insulation on vessels and equipment shall be applied with staggered joint arrangement. Top and bottom edges shall be securely tied over support rings with wire on 12 inch centers. Vertical and horizontal seams shall be laced together by interlocking the wire mesh and with wire ties where necessary. The insulation shall then be secured in place with bands spaced on 12 inch centers. When using block insulation it shall be secured with bands on 12 inch centers.
4. Heads shall have the insulation shaped so that all sections closely fit the contour of the head and are laced together with wire or are secured with bands on 12 inch centers at tangent line. Insulation for exposed heads shall be secured with bands attached to a 1/4 inch round steel rod, with a floating ring on the top and a circumferential band at the tangent line of the vessel head. Unexposed heads shall have the insulation secured with wire to insulation supports provided by the vessel manufacturer.
5. Transactions shall have the insulation applied with all edges securely laced together with wire for blanket insulation and with bands on 12 inch centers for block insulation.
6. Stiffener rings shall have the insulation applied with all edges securely laced together with wire or bands. The insulation shall also be secured in place with a band in the center of each stiffener ring.

7. Stiffener rings on vessels and equipment shall be insulated with the same thickness of insulation as the adjacent surfaces. The stiffener rings shall be boxed with insulation and the areas between the outer flange and the vessel shall be left void.
8. Install insulation materials with smooth, even surface. Rework poorly fitted joints. Do not use joint sealer or mastic as filler for joint gaps and excessive voids resulting from poor workmanship. Apply using staggered joint method.

C. Supports

1. Supports for insulation shall be supplied and installed by the Insulation Contractor. Field welding of supports to vessels, equipment and piping is not allowed without prior written authorization. Contractor shall not remove or modify owner supplied insulation supports without prior notification and approval of the Construction Manager.

D. Expansion Joints (For Hot Insulation)

1. All insulation expansion joints shall be provided by Insulation Contractor. No insulation expansion joints shall be located inside sanitary rooms.

    a. Insulation expansion joints shall be provided below vessel insulation support rings and piping as required per this specification.
    b. Expansion joints shall be constructed as follows:

        1) A 1-1/2 inch space shall be provided at designated locations. Space shall be packed with loose insulation, which shall be retained by the jacketing.

E. Weatherproofing Application (For Hot Insulation)

1. On metal-jacketed vertical vessels and equipment, jacketing shall be supported on S-clips spaced on 4 foot centers. Metal jacketing shall be secured with bands spaced on 12 inch centers with one band at each circumferential lap. On vessels over 36 inches in diameter, screws shall be installed on vertical seams on 12 inch centers in addition to bands. Band loops shall be installed on each band to prevent vertical movement. Loop shall be placed on 15 foot centers with no fewer than two loops per band. All screws shall be installed on ridges of corrugated metal weatherproofing sheets.
2. Breather springs shall be installed in each band on metal-jacketed vessel and tubular equipment shells as follows:

Table 2: Equipment Jacket Springs

Diameter	Operating Temp.	No. of Springs
8'-0" through 14'-11"	130°F through 875°F	1
15'-0" through 30'-0"	All temperatures	2 (180°F apart)

3. Metal jackets on horizontal vessels and tubular equipment shall be secured with bands spaced on 12 inch centers.
4. Weatherproofing on exposed vessel heads shall be with flat sheets cut into "pie" pieces. Metal sheets shall be secured with screws on 3 inch centers.

5. Irregularly shaped surfaces and block insulation that cannot be suitably weatherproofed with jacketing shall be finished with a 3/8 inch thick layer of insulating and finishing cement. A 1/16 inch thick tack coat of mastic shall then be applied over the dry cement, followed by a layer of reinforcing fabric installed wrinkle-free. Over the reinforcing fabric, a 1/8 inch thick dry coat of mastic weathercoat shall be applied with a smooth finish. This finish shall extend approximately 2 inches under the adjacent pipe jacketing. No porosity shall exist in mastic weathercoating when dry.
6. PVC jacketing shall have adjacent sheets overlapped 3 inches and seams arranged in order to shed water. All PVC jacketing shall be thoroughly checked to ensure positive sealing. Jacket shall be tight fitting and shall endure daily washdowns. All jacket seams and overall finish appeal shall meet with the approval of the owner. Any rework due to improper installation shall be at the cost of the subcontractor.

3.10 COLD VESSELS AND EQUIPMENT INSULATION

A. General

1. Vessels and equipment shall be insulated with materials as identified in 2.15.
2. Insulate manhole covers, flanges, and all other appurtenances. Where periodic maintenance or inspection is required, such as at manholes and nameplates, design provision for removability and replacement without damage to the insulation.
3. Insulate attachments secured to the vessel or equipment that project through the insulation. Insulate projections externally from the point where they project through the insulation for a distance of four times the thickness of the base insulation.
4. Insulate stiffener rings on vessels and equipment with the same thickness of insulation as the adjacent surfaces. Box the stiffener rings with insulation and leave void the areas between the outer flange and the vessel.
5. Vessels and tubular equipment 24 inches in diameter and smaller shall be insulated with preformed pipe insulation in accordance with Section 3.03.
6. Rigid block insulation shall be used on the heads of vertical vessels and for walkways on storage tank roofs.
7. Pumps shall be insulated, including the pump casing and any seal water piping, to prevent atmospheric condensation.

B. Insulation Application

1. Block insulation on vessels and equipment shall be applied with stagger joint arrangement. Coat the butt edges with a 1/16 inch thick layer of joint sealer. In cases of double layer insulation, apply the inner layer without joint sealer. Secure each layer of insulation with bands on 12 inch centers. When applying double layer insulation, stagger or offset outer layer joints from the inner layer joints. Only the outer layer of double layer insulation shall be a vapor barrier. Seal joints with a foil-to-mylar 3 inch wide strip applied over the vapor barrier jacketing.
2. Shape blockheads so that sections closely fit the contour of the head. Coat butt edges with a 1/16 inch thick layer of joint sealer. In cases of multiple layers, seal only the outermost layer. Secure insulation for exposed heads with bands attached to a floating ring on the top and to a circumferential band at the tangent line of the vessel head. Band spacing shall be on 12 inch maximum centers at the tangent line. For unexposed heads, fasten bands to attachments provided by vessel manufacturer.

3. Shape vessel transitions block insulation so that sections closely fit the contour of the shell. Coat butted edges with a 1/16 inch thick layer of joint sealer. Secure insulation in place with bands.
4. Enclose stiffener ring in block insulation. Coat butted edges of insulation with a 1/16 inch thick layer of joint sealer. Secure insulation in place with a band in the center of each stiffener ring.
5. Enclose pump and compressor casings in block insulation. Coat butted edges of insulation with a 1/16 inch thick layer of joint sealer. Secure the insulation in place with bands.
6. Stiffener rings on vessels and equipment shall be insulated with the same thickness of insulation as the adjacent surfaces. The stiffener rings shall be boxed with insulation, and the areas between the outer flange and the vessel shall be left void.
7. Apply vapor barrier coating at 1/16 inch dry film thickness to seal protrusions, joints, or other discontinuities in the vapor barrier jacketing.

C. Supports

1. Supports for insulation shall be supplied and installed by the Insulation Contractor. Field welding of supports to vessels, equipment and piping is not allowed without prior written authorization. Contractor shall not remove or modify owner supplied insulation supports without prior notification and approval of the Construction Manager.

D. Contraction Joints (For Cold Insulation)

1. All insulation contraction joints shall be provided by Insulation Contractor. No insulation contraction joints shall be located inside sanitary rooms.
2. Insulation expansion joints shall be provided below vessel insulation support rings and piping as required per this specification.
3. Joints shall be 1-1/2 inches wide, packed with 2 inches of flexible insulation. Seal joints with a foil-to-mylar strip to serve as a vapor barrier.

E. Weatherproofing Application (For Cold Insulation)

1. On vertical vessels and equipment, support metal jacketing on S-clips. Secure metal jacketing with bands spaced on 12 inch centers with one band at each circumferential overlap. Equip each band with one breather spring.
2. On horizontal vessels and tubular equipment, secure the metal jacketing with bands spaced on 12 inch centers with one band at each circumferential overlay. Equip each band with one breather spring.
3. Make longitudinal laps on 1-1/4 inch corrugated metal jacketing 1-1/2 corrugations. Make longitudinal laps on 3/16 inch corrugated metal jacketing a minimum of 2 inches. Make circumferential laps a minimum of 3 inches.
4. Jacket heads on vertical vessels and tubular equipment with a minimum of 6 inches turned down on the straight side of the vessel as an overlap. Secure metal head cover in places at the circumferential overlap with a band equipped with a breather spring. Make all joints weatherproof seams.
5. Finish transitions and stiffener rings with jacketing with weatherproof seams. Extend jacketing under the upper shell jacketing a minimum of 6 inches and down over the lower shell jacketing a minimum of 6 inches. Secure metal covers in place at the circumferential overlaps with a band equipped with a breather spring.

6. Finish pumps and irregularly shaped surfaces, that cannot be suitably weatherproofed with metal jacketing, with a tack coat of mastic applied over the vapor barrier, followed by a layer of reinforcing fabric installed wrinkle-free. Over the reinforcing fabric, apply a 1/8 inch thick dry coat of mastic weathercoat with a smooth finish. Extend finish approximately 6 inches beyond the insulation at all metal projections to assure a good seal.
7. Apply heavy fillets of flashing compound on metal jackets as flashing at all possible sources of moisture penetration, such as nozzles and other protrusions.
8. PVC jacketing shall have adjacent sheets overlapped 3 inches and seams arranged in order to shed water. All PVC jacketing shall be thoroughly checked to ensure positive sealing. Jacket shall be tight fitting and shall endure daily washdowns. All jacket seams and overall finish appeal shall meet with the approval of the owner. Any rework due to improper installation shall be at the cost of the subcontractor.

3.11 REMOVABLE AND REUSABLE INSULATION COVERS

A. Covers shall be designed with a minimum number of pieces with joints located to provide flashing against weather. Covers shall overlap adjacent insulation by 2 inches and must be designed to prevent air movement behind the insulating covers.

B. Where a joint cannot be located at the 6 o'clock position, NPS 1/2 inch nipples must be installed in the downward position to detect flange leakage.

C. Covers shall be designed either from drawings or actual field measurements to ensure proper fit and design.

D. Insulation adjacent to the cover shall be finished and weatherproofed the same as if the part were uninsulated.

E. Valves shall be insulated unless otherwise indicated. Covers for valves shall be designed and applied so that the packing and stem remain exposed (uninsulated). Valves requiring insulation shall have operating shaft extensions.

3.12 EQUIPMENT INSULATION THICKNESS

A. See tables in Appendix D.

APPENDIX A

Table A 1: Piping Insulation Materials by Area

Piping	GMP-Sanitary Areas	Non-Sanitary Areas	
	Indoor	Indoor	Outdoor
Hot	Melamine / PVC	FG / ASJ / ssl / PVC	FG / ASJ / ssl / AL
Dual- Hot and Cold	Melamine / PVC	MW / ASJ / ssl / PVC	MW / ASJ / ssl / AL
Cold	Melamine / PVC -or- CCE / PVC	CCE / PVC -or- MW / ASJ / ssl / PVC	CCE / AL -or- MW / ASJ / ssl / AL
Cryogenic	Dow Styrofoam® or Trymer® w/ PVC jacket[1]	Dow Styrofoam® -or- Trymer® w/ PVC jacket[1]	Dow Styrofoam® -or- Trymer® w/ UV-resistant PVC jacket*
Refrigerant Piping	Melamine / PVC -or- CCE / PVC	CCE / PVC	CCE / AL -or- MW / ASJ / ssl / AL
Pipe Support	N/A	H-Block 20# high density fibrous glass[2]	
Fire Wall Penetrations	Foamglas and fire stop caulking	Foamglas and fire stop caulking	

1. Installation shall be per Dow Chemical Installation Guidelines
2. Insert in insulation at pipe supports per manufacturer's recommendation and per the pipe support drawings. Purpose is to prevent bottoming out of the pipe supports and to prevent metal-to-metal contact between pipe and pipe supports. Use Dow Trymer insulation in lieu of Armaflex at pipe supports.

Definitions: Sanitary Areas – Clean areas including GMP/ Sanitary/ Hygienic process areas, clean manufacturing areas, and are only those areas visible within a clean room or clean corridor and not within walls, above ceilings, or in service chases.

Non-Sanitary Areas – all other areas not defined as "sanitary areas".

FG – fibrous glass insulation

ASJ – all-service jacket

ssl – self-sealing lap

GC – glass cloth cover

PVC – polyvinyl chloride

MW – preformed mineral wool

AL – aluminum

CCE – Armaflex closed cell elastomer

Trymer – Dow polyisocyanurate foam

Melamine – TechLite melamine foam

Syrofoam – Dow polystyrene foam

APPENDIX B

Table B 1: Insulation Thickness for Heat Conservation / Personnel Protection, Piping
FIBROUS GLASS— for steam, steam condensate, and hot water

	Temperature Range				
Fluid Design Operating Temperature °F	105°F to 150°F	151°F to 250°F	251°F to 350°F	351°F to 450°F	451°F to 550°F
Insulation Conductivity Range Btu-in/hr/ft^2-°F	0.24-0.28	0.25-0.29	0.27-0.30	0.29-0.31	0.32-0.34
Conductivity Mean Rating Temperature °F	100	125	150	200	250
Pipe Size	**Thickness (in)**				
½	1	1	2	2-1/2	3
¾	1	1	2	2-1/2	3
1	1	1	2	2-1/2	3
1-1/2	1	2	2-1/2	3	4
2	1-1/2	2	3	3-1/2	4
2-1/2	1-1/2	2	3	3-1/2	4
3	1-1/2	2-1/2	3-1/2	4	4
4	1-1/2	3	4	4	4
6	2	3	4	4	4-1/2
8	2	3-1/2	4	4	5
10	2	3-1/2	4	4	5
12	2	3-1/2	4	4	5
14	2	3-1/2	4	4	5
16	2-1/2	3-1/2	4	4	5-1/2
18	2-1/2	3-1/2	4	4	5-1/2

Table B 2: Insulation Thickness for Heat Conservation, Piping					
	Temperature Range				
Fluid Design Operating Temperature °F	105°F to 150°F	151°F to 250°F	251°F to 350 °F	351 °F to 450 °F	451 °F to 550 °F
Insulation Conductivity Range Btu-in/hr/ft^2-°F	0.24 / 0.28	0.25 / 0.29	0.27 / 0.30	0.29 / 0.31	0.32 / 0.34
Conductivity Mean Rating Temperature °F	100	125	150	200	250
Pipe Size	**Thickness (in)**				
½	1	1-1/2	2	2-1/2	3
¾	1	1-1/2	2	2-1/2	3
1	1	1-1/2	2	2-1/2	3-1/2
1-1/2	1	2	2-1/2	3	4
2	1-1/2	2	3	3-1/2	4
2-1/2	1-1/2	2	3	3-1/2	4
3	1-1/2	2-1/2	3-1/2	4	4
4	1-1/2	3	4	4	4
6	2	3	4	4	4-1/2
8	2	3-1/2	4	4	5
10	2	3-1/2	4	4	5
12	2	3-1/2	4	4	5
14	2	3-1/2	4	4	5
16	2-1/2	3-1/2	4	4	5-1/2
18	2-1/2	3-1/2	4	4	5-1/2

Table B 3: Insulation Thickness, Cold Conservation / Anti-Sweat, Piping Mineral Wool— for chilled water and refrigerant service		
	Temperature Range	
Fluid Design Operating Temperature °F	40°F to 55°F	Below 40°F
Insulation Conductivity Range Btu-in/hr/ft^2-°F	0.23-0.27	0.23-0.27
Conductivity Mean Rating Temperature °F	75	75
Pipe Size	**Thickness (in)**	
½	1/2	1
1/2	1/2	1
1	1/2	1
1-1/2	3/4	1-1/2
2	3/4	1-1/2
2-1/2	1	1-1/2
3	1	1-1/2
4	1	1-1/2
6	1	1-1/2
8	1	1-1/2
10	1	1-1/2
12	1	1-1/2
14	1	1-1/2
16	1	1-1/2
18	1	1-1/2
Note: The required min. thickness does not consider water Vapor transmission & condensation. Additional insulation, Vapor retarders, or both may be required to limit vapor transmission & condensation.		

Table B 4: Insulation Thickness, Cold Conservation / Anti-sweat AP Armaflex— for chilled water		
	Temperature Range	
Fluid Design Operating Temperature °F	0°F to 34°F	35°F to 50°F
Insulation Conductivity Range Btu-in/hr/ft^2-°F	0.27	0.27
Conductivity Mean Rating Temperature °F	75	75
Pipe Size	**Thickness (in)**	
3/8	1	3/4
1/2	1	3/4
3/4	1	3/4
1	1	3/4
1-1/2	1	3/4
2	1	3/4
2-1/2	1	1
3	1	1
4	1	1
6	1-1/4	1
8	1-1/4	1
10	1-1/4	1
12	1-1/4	1
14	1-1/4	1
16	1-1/4	1
18	1-1/4	1

Table B 5: Insulation Thickness, Cold Conservation / Heat Conservation, Piping MELAMINE FOAM— K = 0.26, Jacket Emissivity = 0.9									
	Temperature Range								
	1°F to 34°F	35°F to 60°F	61°F to 95°F	96°F to 120°F	121°F to 150°F	151°F to 220°F	221°F to 250°F	251°F to 300°F	301°F to 350°F
Pipe Size	**Thickness (in)**								
1/2	1.5	1	1	1	1	1.5	1.5	2	2
3/4	1.5	1	1	1	1	1.5	1.5	2	2
1	1.5	1	1	1	1	1.5	1.5	2	2
1.25	1.5	1	1	1	1	1.5	1.5	2	2
1.5	2	1.5	1	1	1.5	1.5	2	2	2
2	2	1.5	1	1	1.5	1.5	2	2	2
2.5	2	1.5	1	1	1.5	1.5	2	2	2
3	2	1.5	1	1	1.5	1.5	2	2	2.5
3.5	2	1.5	1	1	1.5	1.5	2	2	2.5
4	2	1.5	1	1	1.5	1.5	2	2	2.5
6	2	2	1.5	1.5	2	2	2	2	2.5
8	2.5	2	1.5	1.5	2	2	2	2.5	2.5
10	2.5	2	1.5	1.5	2	2	2	2.5	2.5
12	2.5	2	1.5	1.5	2	2	2	2.5	3
Note: The above chart considers normal ambient conditions approximately 70% relative humidity and 80°F. If ambient RH and temperature conditions are more severe, consult the manufacturer for guidance.									

Table B 6: Insulation Thickness, Cold Conservation, Piping Polyisocyanurate (Trymer) Insulation Dow Plastics (minimum thickness) Cryogenic Service (Indoor, 80% RH)										
Insulation Thickness (inches)	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5
Conductivity Mean Rating Temperature °F	80	80	80	80	80	80	80	80	80	80
Pipe Size	**Temperature Range °F**									
½	-15	-80	-140	-300						
¾	0	-60	-115	-235						
1	-15	-65	-120	-175						
1-1/2	-5	-50	-125	-175						
2	0	-45	-90	-140						
2-1/2	5	-65	-105	-150	-215					
3	5	-35	-75	-115	-155	-230				
4	10	-30	-65	-105	-150	-200	-280			
6	15	-15	-55	-90	-125	-175	-235			
8	15	-15	-50	-90	-125	-160	-210	-275		
10	15	-15	-50	-80	-115	-145	-180	-240		
12	15	-15	-50	-80	-110	-140	-170	-225	-290	
14	15	-10	-40	-70	-100	-130	-170	-205	-260	
16	15	-10	-40	-65	-95	-125	-165	-195	-245	
18	20	-10	-35	-65	-95	-125	-160	-190	-235	
Note: The required minimum thickness does not include any safety factor.										

Table B 7: Insulation Thickness, Cold Conservation, Piping STYROFOAM Dow Plastics (minimum thickness) Cryogenic Service (Indoor, 70% RH)					
Insulation Thickness (inches)	1	1.5	2	2.5	3
Conductivity Mean Rating Temperature °F	80	80	80	80	80
Pipe Size	**Temperature Range °F**				
1/2	-75	-200			
3/4	-45	-160			
1	-70	-165			
1-1/2	-50	-130	-295		
2	-40	-125	-215		
2-1/2	-35	-160	-245		
3	-25	-100	-175	-295	
4	-20	-90	-155	-270	
6	-5	-65	-135	-270	
8	-5	-65	-125	-200	
10	-5	-65	-120	-180	-295
12	0	-65	-115	-170	230
14	0	-45	-100	-155	-210
Note: The required minimum thickness does not include any safety factor					

Table B8: Insulation NPS Schedule
(oversize for heat traced piping)

	3/8” OD Tubing and All Electric Cable		1/2" OD Tubing		3/4" OD Tubing and 1/2" Pipe		1” OD Tubing and 3/4” Pipe		1” Pipe	
Pipe or Tube Size	**One Tracer**	**Two Tracer**	**One Tracer**	**Two Tracer**	**One Tracer**	**Two Tracer**	**One Tracer**	**Two Tracer**	**One Tracer**	**Two Tracer**
Without Heat Transfer Cement										
1/2”	1”	1-1/4”	1-1/4”	1-1/4”	2”	2”				
3/4”	1-1/4”	1-1/4”	1-1/4”	1-1/2”	2”	2”				
1”	1-1/2”	1-1/2”	1-1/2”	2”	2”	2-1/2”:				
1-1/2”	2”	2”	2-1/2”	2-1/2”	2-1/2”	3"				
2”	2-1/2”	2-1/2”	3”	3”	3”	3”	3”	3-1/2”	3-1/2”	4”
2-1/2”	3”	3”	3”	3-1/2”	3-1/2”	3-1/2”	3-1/2”	4”	4”	5”
3”	3-1/2”	3-1/2”	3-1/2”	4’	4”	4”	4”	5”	5”	5”
4”	5”	5”	5”	5”	5”	5”	5”	6”	6”	6”
6”	7”	7”	7”	7”	7”	7”	8”	8”	8”	8”
8”	9”	9”	9”	9”	9”	9”	10”	10”	10”	10”
10”	11”	11”	11”	11”	11”	11”	12”	12”	14”	14”
12”	14”	14”	14”	14”	14”	14”	14”	14”	15”	15”
14”	15”	15”	15”	15”	15”	15”	15”	16”	16”	16”
16”	17”	17”	17”	17”	17”	17”	17”	18”	18”	18”
18”	19”	19”	19”	19”	19”	19”	19”	20”	20”	20”
20”	21”	21”	21”	21”	21”	21”	21”	22”	22”	22”
22”	23”	23”	23”	23”	23”	23”	23”	24”	24”	24”
24”	25”	25”	25”	25”	25”	25”	25”	26”	26”	26”
With Heat Transfer Cement										
1-1/2	2-1/2		2-1/2							
2”	3”		3”							
3”	4”	4”	4”	4”	5”	5”				
4”	5”	5”	5”	5”	6”	6”				
6”	8”	8”	8”	8”	8”	8”				
8”	10”	10”	10”	10”	10”	10”				
10”	12”	12”	12”	12”	12”	12”				
12”	14”	14”	14”	14”	14”	14”				
14”	16”	16”	16”	16”	16”	16”				
16”	18”	18”	18”	18”	18”	18”				
18”	20”	20”	20”	20”	20”	20”				
20”	22”	22”	22”	22”	22”	22”				
24”	26”	26”	26”	26”	26”	26”				

1) Double traced lines are calculated on 90° spacing.
2) When using heat transfer cement of a type that covers the entire tracer tube, make allowance for the cement.

APPENDIX C

PIPING INSULATION SELECTION GUIDE

Purpose

A. This document serves to define the recommended procedure to be followed to determine required insulation thickness on process piping.

B. The following information documents are required to accurately determine insulation thickness and material type for the various piping systems.

1. 400513 – Common Work Results for Process Piping
2. 400513.13 – Steel Process Piping
3. 400513.19 – Stainless Steel Process piping and Tubing
4. P&ID drawings – Indicate pipeline sizes, insulation category, and insulation boundaries.
5. When available, contractors shall also refer to all piping layout drawings, isometric, and fabrication spool drawings to determine the physical lengths of pipe to be insulated.

Procedure

A. Beginning with the P&ID drawings, identify all lines where insulation is indicated. Using the line number designation, identify the type of insulation indicated, the service of the pipe, and the pipe specification for that line.

1. Example: line number ¾" –CS60 - 70101 – SF0 - HC indicates a 3/4" Clean Steam @ 60 psig (CS60) in 316L stainless steel hygienic tubing (SF0) with heat conservation type insulation (HC).

B. Refer to specifications to obtain maximum / minimum service temperatures (Section 400610 and 400620) and piping materials for each line classification (Section 400513).

C. Appendix A describes the insulation material classes by areas, i.e., sanitary area and non-sanitary areas. The line example given is in a GMP /sanitary area. The table defines the general insulation material class for sanitary areas and the insulation and sheathing or service jacket materials to be used.

D. Once the insulating material has been determined and the area into which the line will be installed, refer to the appropriate Table in Appendix B to determine the required piping insulation thickness. The example pipeline is 3/4 inch operating at a maximum temperature of 307°F and located within a clean area. Therefore the required insulation thickness is 2 inches of melamine foam insulation, with a 20 mil PVC jacket.

APPENDIX D

Table D 1: Insulation Thickness, Equipment Heat Conservation / Personnel Protection Fiberglass Board	
Surface Operating Temperature	**Minimum Thickness (in)**
150°F	½
200°F	½
250°F	½
300°F	1
350°F	1
400°F	1
450°F	1.5
500°F	1.5
550°F	2
600°F	2

2. Minimum thickness required to keep external surface temperature below 140°F.
3. Thickness based on ASTM C585 tables.

Table D 2: Insulation Thickness, Equipment Heat Conservation / Cold Conservation Melamine Foam, K = 0.26	
Surface Operating Temperature	**Minimum Thickness (in)**
-150°F to -65°F	3
-64°F to 0°F	3
+1°F to +34°F	2.5
35°F to 60°F	2
61°F to 95°F	1.5
96°F to 120°F	1.5
121°F to 150°F	2
151°F to 220°F	2
221°F to 250°F	2
251°F to 300°F	2
301°F to 350°F	2
351°F to 400°F	2.5

1. The above chart considers normal ambient conditions approximately 70% relative humidity and 80°F.
2. If ambient RH and temperature conditions are more severe, consult the manufacturer for guidance.

Table D 3: Insulation Thickness, Equipment Cold Conservation / Anti-Sweat Armaflex Closed Cell Elastomer, K = 0.27 @ 75 °F	
Surface Operating Temperature	**Minimum Thickness (in)**
Above 25°F	3/4
+10°F to 25°F	1
-10°F to +10°F	1.25
Below -10°F	1.5
1. Based on indoor ambient temperature 85°F, and 80% RH.	

Table D 4: Insulation Thickness, Equipment Cold Conservation / Anti-Sweat Cellular Glass								
	Operating Temperature Range °F							
	-131 to -161	-101 to -130	-61 to -129	-31 to -60	-21 to -30	-20 to -1	0 to +35	+36 to +70
Pipe / Tube Size	**Thickness (in)**							
½	3.5	3.5	3	2.5	2	2	1.5	1.5
¾	4	3.5	3	2.5	2	2	2	1.5
1	4	3.5	3	2.5	2.5	2.5	2	1.5
1.5	4.5	4	3.5	3	2.5	2.5	2	1.5
2	4.5	4.5	3.5	3	2.5	2.5	2	1.5
3	5	4.5	4	3.5	3	3	2	1.5
4	5	5	4	3.5	3	3	2.5	1.5
6	5.5	5	4.5	3.5	3	3	2.5	2
8	6	5.5	5	4	3	3	2.5	2
10	6	5.5	5	4	3.5	3.5	2.5	2
12	6.5	6	5.5	4	3.5	3.5	2.5	2
14	6.5	6	5.5	4.5	4	4	3	3
16	6.5	6	5.5	4.5	4	4	3	3
18	7	6	6	4.5	4	4	3	3
20	7	6.5	6	4.5	4	4	3	3
24	7	6.5	6	4.5	4	4	3	3
Flat Surface	8.5	7.5	6.5	4.5	4	4	3	3

1. Insulation thickness is based on condensation prevention at ambient conditions of 90°F still air, and 80% relative humidity.

END OF SECTION 402400