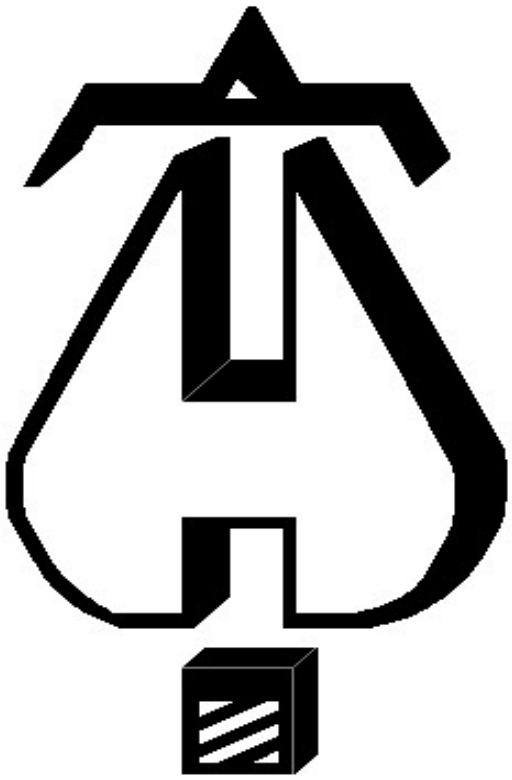


. . . Fire Protection by Computer Design

EASTERN FIRE
170 KITTYHAWK AVE. / P.O. BOX
AUBURN, ME , 04210
207-784-1507

Job Name	:	IMMUCELL
Building	:	1 OF 2
Location	:	PORTLAND
System	:	1
Contract	:	5568
Data File	:	Immucell system #2 interstitial space.WXF

HYDRAULIC CALCULATIONS
for

Project name: IMMUCELL
Location: PORTLAND
Drawing no: 1 OF 2
Date: 2/28/17

Design

Remote area number: 1
Remote area location: LEVEL 2 INTERSTITIAL SPACE
Occupancy classification: OH2
Density: .2 - Gpm/SqFt
Area of application: 1545 - SqFt
Coverage per sprinkler: 130 - SqFt
Type of sprinklers calculated: 5.6K BRASS UPRIGHTS
No. of sprinklers calculated: 13
In-rack demand: - GPM
Hose streams: 250 - GPM
Total water required (including hose streams): 564.08 - GPM @ 52.3 - Psi
Type of system: WET
Volume of dry or preaction system: - Gal

Water supply information

Date: 07-12-16
Location: FLOW HYDRANT LOCATED ON WELCH ST. & CADDIE ST.
Source: EASTERN FIRE PROTECTION

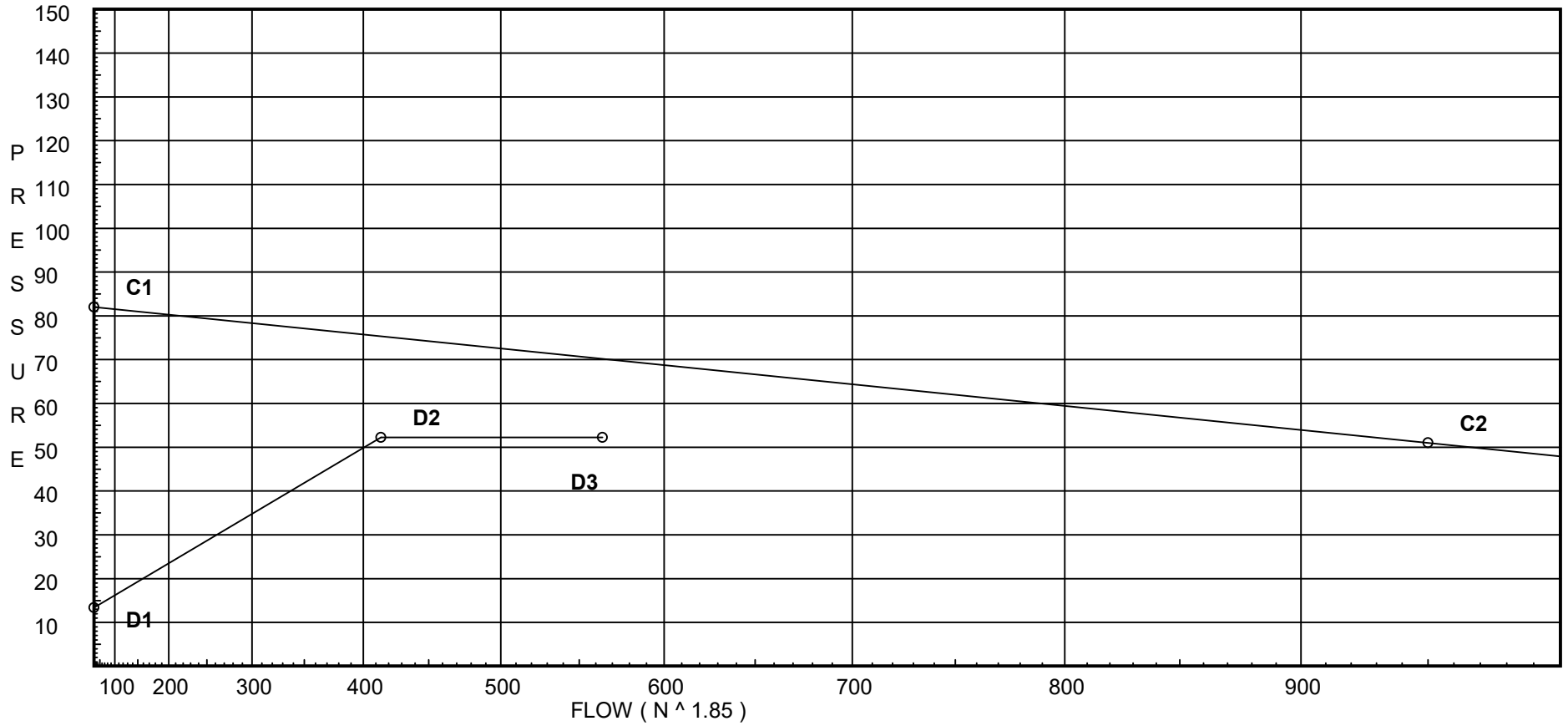
Name of contractor: EASTERN FIRE
Address: 170 KITTYHAWK AVE. / P.O. BOX / / AUBURN, ME , 04210
Phone number: 207-784-1507
Name of designer: RJP
Authority having jurisdiction: STATE FIRE MARSHAL
Notes: (Include peaking information or gridded systems here.)

Water Supply Curve C

EASTERN FIRE
IMMUCELL

City Water Supply:
- C1 - Static Pressure : 82
- C2 - Residual Pressure: 51
- C2 - Residual Flow : 950

Demand:
- D1 - Elevation : 13.365
- D2 - System Flow : 414.081
- D2 - System Pressure : 52.269
- Hose (Demand) : 150
- D3 - System Demand : 564.081
- Safety Margin : 17.912



Fittings Used Summary

Fitting Legend

Abbrev.	Name	½	¾	1	1¼	1½	2	2½	3	3½	4	5	6	8	10	12	14	16	18	20	24
B	NFPA 13 Butterfly Valve	0	0	0	0	0	6	7	10	0	12	9	10	12	19	21	0	0	0	0	0
E	NFPA 13 90' Standard Elbow	1	2	2	3	4	5	6	7	8	10	12	14	18	22	27	35	40	45	50	61
G	NFPA 13 Gate Valve	0	0	0	0	0	1	1	1	1	2	2	3	4	5	6	7	8	10	11	13
I	90' Grvd-Vic Elbow #10	0	0	2	3	4	3.5	6	5	8	7	8.5	10	13	17	20	23	25	33	36	40
J	90'Tee-Branch Grv Vic #20	0	0	4.5	6	8	8.5	10.8	13	17	16	21	25	33	41	50	65	78	88	98	120
S	NFPA 13 Swing Check	0	0	5	7	9	11	14	16	19	22	27	32	45	55	65					
T	NFPA 13 90' Flow thru Tee	3	4	5	6	8	10	12	15	17	20	25	30	35	50	60	71	81	91	101	121
Zma	Maxim M200 Horz Butt	Fitting generates a Fixed Loss Based on Flow																			

Unit Summary

Diameter Units	Inches
Length Units	Feet
Flow Units	US Gallons per Minute
Pressure Units	Pounds per Square Inch

Note: Fitting Legend provides equivalent pipe lengths for fittings types of various diameters. Equivalent lengths shown are standard for actual diameters of Sched 40 pipe and CFactors of 120 except as noted with *. The fittings marked with a * show equivalent lengths values supplied by manufacturers based on specific pipe diameters and CFactors and they require no adjustment. All values for fittings not marked with a * will be adjusted in the calculation for CFactors of other than 120 and diameters other than Sched 40 per NFPA.

Pressure / Flow Summary - STANDARD

Node No.	Elevation	K-Fact	Pt Actual	Pn	Flow Actual	Density	Area	Press Req.
SP03	0.0	5.6	15.43	na	22.0	0.2	110	7.0
EQ03	0.0		16.36	na				
SP02	0.0	5.6	15.43	na	22.0	0.2	110	7.0
EQ02	0.0		15.9	na				
SP01	0.0	5.6	15.43	na	22.0	0.2	110	7.0
EQ01	0.0		15.9	na				
SP04	0.0	5.6	15.43	na	22.0	0.2	110	7.0
EQ04	0.0		15.9	na				
SP05	0.0	5.6	15.43	na	22.0	0.2	110	7.0
EQ05	0.0		16.36	na				
42	130.86	K = K @ EQ05	16.36	na	22.0			
43	130.86		16.69	na				
44	129.7		19.44	na				
45	129.7	K = K @ EQ03	19.71	na	24.15			
46	129.7	K = K @ EQ03	21.74	na	25.35			
47	129.7		24.89	na				
48	129.7		25.12	na				
69	129.7		28.81	na	50.0			
TOR2	129.7		31.63	na				
HDR1	107.0		43.42	na	50.0			
BFP	102.0		46.12	na				
BASE	100.0		50.91	na				
TEST	100.0		52.27	na	150.0			
49	130.86	K = K @ EQ04	16.31	na	22.28			
50	130.86	K = K @ EQ04	16.43	na	22.36			
51	130.86	K = K @ EQ05	16.48	na	22.08			
52	129.7	K = K @ EQ01	19.2	na	24.18			
53	129.7	K = K @ EQ03	19.26	na	23.87			
54	127.53	K = K @ EQ02	19.43	na	24.32			
55	129.7		21.86	na				
56	129.7	K = K @ EQ03	22.06	na	25.55			
57	129.7	K = K @ EQ03	22.57	na	25.83			
58	129.7	K = K @ EQ03	23.43	na	26.32			
59	129.7		25.0	na				
60	129.7	K = K @ EQ01	21.85	na	25.79			

The maximum velocity is 16.35 and it occurs in the pipe between nodes 46 and 47

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	******* Notes ******
SP03	22.00	1.049	T	5.0	1.000	15.434		K Factor = 5.60
to		120.0		0.0	5.000	0.0		
EQ03	22.0	0.1552		0.0	6.000	0.931		Vel = 8.17
	0.0							
	22.00					16.365		K Factor = 5.44
SP02	22.00	1.049	E	2.0	1.000	15.434		K Factor = 5.60
to		120.0		0.0	2.000	0.0		
EQ02	22.0	0.1550		0.0	3.000	0.465		Vel = 8.17
	0.0							
	22.00					15.899		K Factor = 5.52
SP01	22.00	1.049	E	2.0	1.000	15.434		K Factor = 5.60
to		120.0		0.0	2.000	0.0		
EQ01	22.0	0.1550		0.0	3.000	0.465		Vel = 8.17
	0.0							
	22.00					15.899		K Factor = 5.52
SP04	22.00	1.049	E	2.0	1.000	15.434		K Factor = 5.60
to		120.0		0.0	2.000	0.0		
EQ04	22.0	0.1550		0.0	3.000	0.465		Vel = 8.17
	0.0							
	22.00					15.899		K Factor = 5.52
SP05	22.00	1.049	T	5.0	1.000	15.434		K Factor = 5.60
to		120.0		0.0	5.000	0.0		
EQ05	22.0	0.1552		0.0	6.000	0.931		Vel = 8.17
	0.0							
	22.00					16.365		K Factor = 5.44
42	44.28	2.157	J	10.461	9.000	16.365		K Factor @ node EQ05
to		120.0		0.0	10.461	0.0		
43	44.28	0.0169		0.0	19.461	0.329		Vel = 3.89
43	44.45	2.157	2J	20.921	11.420	16.694		
to		120.0	I	4.307	25.228	0.502		
44	88.73	0.0612		0.0	36.648	2.243		Vel = 7.79
44	48.04	2.157		0.0	2.000	19.439		
to		120.0		0.0	0.0	0.0		
45	136.77	0.1365		0.0	2.000	0.273		Vel = 12.01
45	24.15	2.157		0.0	11.000	19.712		K Factor @ node EQ03
to		120.0		0.0	0.0	0.0		
46	160.92	0.1841		0.0	11.000	2.025		Vel = 14.13
46	25.35	2.157	J	10.461	2.610	21.737		K Factor @ node EQ03
to		120.0		0.0	10.461	0.0		
47	186.27	0.2413		0.0	13.071	3.154		Vel = 16.35
47	0.0	4.26	J	21.067	4.640	24.891		
to		120.0		0.0	21.067	0.0		
48	186.27	0.0088		0.0	25.707	0.225		Vel = 4.19
48	127.81	4.26	8I	73.736	86.250	25.116		
to		120.0		0.0	73.736	0.0		
69	314.08	0.0231		0.0	159.986	3.690		Vel = 7.07
69	50.00	4.26	2I	18.434	53.583	28.806		Qa = 50.00
to		120.0	J	21.067	39.501	0.0		
TOR2	364.08	0.0303		0.0	93.084	2.822		Vel = 8.20

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	******* Notes ******
TOR2	0.0	4.26	B	15.8	20.000	31.628		
to		120.0	S	28.968	44.768	9.831		
HDR1	364.08	0.0303		0.0	64.768	1.964		Vel = 8.20
HDR1	50.00	4.26	I	9.217	2.000	43.423		Qa = 50.00
to		120.0	G	2.633	11.850	2.166		
BFP	414.08	0.0384		0.0	13.850	0.532		Vel = 9.32
BFP	0.0	4.26	Zma	0.0	2.000	46.121		
to		120.0	I	9.217	9.217	4.357		* Fixed Loss = 3.491
BASE	414.08	0.0385		0.0	11.217	0.432		Vel = 9.32
BASE	0.0	6.16	3I	43.037	200.000	50.910		
to		140.0	J	35.864	83.205	0.0		
TEST	414.08	0.0048	G	4.304	283.205	1.359		Vel = 4.46
	150.00							Qa = 150.00
	564.08					52.269		K Factor = 78.02
49	22.28	2.157		0.0	11.000	16.313		K Factor @ node EQ04
to		120.0		0.0	0.0	0.0		
42	22.28	0.0047		0.0	11.000	0.052		Vel = 1.96
	0.0							
	22.28					16.365		K Factor = 5.51
50	22.36	2.157		0.0	11.000	16.430		K Factor @ node EQ04
to		120.0		0.0	0.0	0.0		
51	22.36	0.0047		0.0	11.000	0.052		Vel = 1.96
51	22.08	2.157	J	10.461	2.000	16.482		K Factor @ node EQ05
to		120.0		0.0	10.461	0.0		
43	44.44	0.0170		0.0	12.461	0.212		Vel = 3.90
	0.0							
	44.44					16.694		K Factor = 10.88
52	24.18	2.157		0.0	11.000	19.202		K Factor @ node EQ01
to		120.0		0.0	0.0	0.0		
53	24.18	0.0055		0.0	11.000	0.060		Vel = 2.12
53	23.86	2.157		0.0	9.000	19.262		K Factor @ node EQ03
to		120.0		0.0	0.0	0.0		
44	48.04	0.0197		0.0	9.000	0.177		Vel = 4.22
	0.0							
	48.04					19.439		K Factor = 10.90
54	24.32	1.049	E	2.0	11.040	19.427		K Factor @ node EQ02
to		120.0	T	5.0	7.000	-0.940		
55	24.32	0.1869		0.0	18.040	3.371		Vel = 9.03
55	25.79	2.157		0.0	9.700	21.858		
to		120.0		0.0	0.0	0.0		
56	50.11	0.0212		0.0	9.700	0.206		Vel = 4.40
56	25.54	2.157		0.0	11.000	22.064		K Factor @ node EQ03
to		120.0		0.0	0.0	0.0		
57	75.65	0.0455		0.0	11.000	0.501		Vel = 6.64
57	25.84	2.157		0.0	11.000	22.565		K Factor @ node EQ03
to		120.0		0.0	0.0	0.0		
58	101.49	0.0785		0.0	11.000	0.863		Vel = 8.91

Final Calculations - Hazen-Williams

EASTERN FIRE
IMMUCELL

Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	******* Notes ******
58	26.32	2.157	J	10.461	2.610	23.428		K Factor @ node EQ03
to		120.0		0.0	10.461	0.0		
59	127.81	0.1203		0.0	13.071	1.572		Vel = 11.22
59	0.0	4.26	J	21.067	5.610	25.000		
to		120.0		0.0	21.067	0.0		
48	127.81	0.0043		0.0	26.677	0.116		Vel = 2.88
	0.0							
	127.81					25.116		K Factor = 25.50
60	25.79	2.067		0.0	1.300	21.848		K Factor @ node EQ01
to		120.0		0.0	0.0	0.0		
55	25.79	0.0077		0.0	1.300	0.010		Vel = 2.47
	0.0							
	25.79					21.858		K Factor = 5.52