

**City of Portland, Maine - Building or Use Permit Application 389 Congress Street, 04101, Tel: (207) 874-8703, FAX: 874-8716**

Location of Construction: 64 Blueberry Road  
 Owner: Regional Waste System  
 Phone: 776-6465  
 Permit No: 001203  
 Owner Address: 8MS 64 Blueberry Rd. Portland, ME 04101  
 Lessee/Buyer's Name: Business Name:  
 Contractor Name: Morit America, Inc.  
 Address: PO Box 790 Marshall, ME  
 Phone: 207-743-8956  
 Permit Issued: OCT 25 2000  
 Zone: CBL: 238-A-003

Proposed Use: Commercial  
 COST OF WORK: \$ 300,000.00  
 PERMIT FEE: \$ 1,824.00  
 FIRE DEPT.  Approved  Denied  
 INSPECTION: Use Group: Type:  
 Signature: Date:  
 PEDESTRIAN ACTIVITIES DISTRICT (P.A.D.)  
 Action:  Approved  Approved with Conditions  Denied

Proposed Project Description:  
 Foundation / Silo & Mechanical Control Room  
 Permit Taken By: Gayle  
 Date Applied For: October 12, 2000  
 Signature: Date:  
 Zoning Appeal  
 Variance  
 Miscellaneous  
 Conditional Use  
 Interpretation  
 Approved  
 Denied  
 Special Zone or Reviews:  
 Shoreland  
 Wetland  
 Flood Zone  
 Subdivision  
 Site Plan major  minor  Amm

1. This permit application does not preclude the Applicant(s) from meeting applicable State and Federal rules.  
 2. Building permits do not include plumbing, septic or electrical work.  
 3. Building permits are void if work is not started within six (6) months of the date of issuance. False information may invalidate a building permit and stop all work..

\*\*\*NEEDS TO GO THROUGH FIRE INSPECTION

**CERTIFICATION**  
 I hereby certify that I am the owner of record of the named property, or that the proposed work is authorized by the owner of record and that I have been authorized by the owner to make this application as his authorized agent and I agree to conform to all applicable laws of this jurisdiction. In addition, if a permit for work described in the application is issued, I certify that the code official's authorized representative shall have the authority to enter all areas covered by such permit at any reasonable hour to enforce the provisions of the code(s) applicable to such permit

**PERMIT ISSUED WITH REQUIREMENTS**

Action:  
 Approved  
 Approved with Conditions  
 Denied  
 Date: \_\_\_\_\_

Historic Preservation  
 Not in District or Landmark  
 Does Not Require Review  
 Requires Review

SIGNATURE OF APPLICANT: \_\_\_\_\_ DATE: October 12, 2000  
 ADDRESS: \_\_\_\_\_ PHONE: \_\_\_\_\_  
 RESPONSIBLE PERSON IN CHARGE OF WORK, TITLE: \_\_\_\_\_ PHONE: \_\_\_\_\_  
 White-Permit Desk Green-Assessor's Canary-D.P.W. Pink-Public File Ivory Inspector



## BUILDING PERMIT REPORT

DATE: 19 February 2000 ADDRESS: 64 Blueberry Rd CBL: 238-A-008  
 REASON FOR PERMIT: Install antennas to smoke stack add storage cabinet.  
 BUILDING OWNER: Regional Waste Systems  
 PERMIT APPLICANT: \_\_\_\_\_ CONTRACTOR Frey Morton Omnipe.  
 USE GROUP: U CONSTRUCTION TYPE: \_\_\_\_\_ CONSTRUCTION COST: 50,000 PERMIT FEES: \$ 324.00

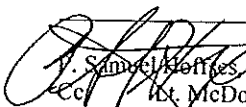
The City's Adopted Building Code (The BOCA National Building Code/1999 with City Amendments)  
 The City's Adopted Mechanical Code (The BOCA National Mechanical Code/1993)

### CONDITION(S) OF APPROVAL

This permit is being issued with the understanding that the following conditions are met: \*1 \*27 \*36

- \*1. This permit does not excuse the applicant from meeting applicable State and Federal rules and laws.
- \*2. Before concrete for foundation is placed, approvals from the Development Review Coordinator and Inspection Services must be obtained. (A 24 hour notice is required prior to inspection) "**ALL LOT LINES SHALL BE CLEARLY MARKED BEFORE CALLING.**"
3. Foundation drain shall be placed around the perimeter of a foundation that consists of gravel or crushed stone containing not more than 10 percent material that passes through a No. 4 sieve. The drain shall extend a minimum of 12 inches beyond the outside edge of the footing. The thickness shall be such that the bottom of the drain is not higher than the bottom of the base under the floor, and that the top of the drain is not less than 6 inches above the top of the footing. The top of the drain shall be covered with an approved filter membrane material. Where a drain tile or perforated pipe is used, the invert of the pipe or tile shall not be higher than the floor elevation. The top of joints or top of perforations shall be protected with an approved filter membrane material. The pipe or tile shall be placed on not less than 2" of gravel or crushed stone, and shall be covered with not less than 6" of the same material. Section 1813.5.2
4. Foundations anchors shall be a minimum of 1/2" in diameter, 7" into the foundation wall, minimum of 12" from corners of foundation and a maximum 6' O.C. between bolts. Section 2305.17
5. Waterproofing and dampproofing shall be done in accordance with Section 1813.0 of the building code.
6. Precaution must be taken to protect concrete from freezing. Section 1908.0
7. It is strongly recommended that a registered land surveyor check all foundation forms before concrete is placed. This is done to verify that the proper setbacks are maintained.
8. Private garages located beneath habitable rooms in occupancies in Use Group R-1, R-2, R-3 or I-1 shall be separated from adjacent interior spaces by fire partitions and floor/ceiling assembly which are constructed with not less than 1-hour fire resisting rating. Private garages attached side-by-side to rooms in the above occupancies shall be completely separated from the interior spaces and the attic area by means of 1/2 inch gypsum board or the equivalent applied to the garage means of 1.2 inch gypsum board or the equivalent applied to the garage side. (Chapter 4, Section 407.0 of the BOCA/1999)
9. All chimneys and vents shall be installed and maintained as per Chapter 12 of the City's Mechanical Code. (The BOCA National Mechanical Code/1993). Chapter 12 & NFPA 211
10. Sound transmission control in residential building shall be done in accordance with Chapter 12, Section 1214.0 of the City's Building Code.
11. Guardrails & Handrails: A guardrail system is a system of building components located near the open sides of elevated walking surfaces for the purpose of minimizing the possibility of an accidental fall from the walking surface to the lower level. Minimum height all Use Groups 42", except Use Group R which is 36". In occupancies in Use Group A,B,H-4, I-1, I-2, M and R and public garages and open parking structures, open guards shall have balusters or be of solid material such that a sphere with a diameter of 4" cannot pass through any opening. Guards shall not have an ornamental pattern that would provide a ladder effect. (Handrails shall be a minimum of 34" but not more than 38". Use Group R-3 shall not be less than 30", but not more than 38"). Handrail grip size shall have a circular cross section with an outside diameter of at least 1 1/4" and not greater than 2". (Sections 1021 & 1022.0) Handrails shall be on both sides of stairway. (Section 1014.7)
12. Headroom in habitable space is a minimum of 7'6" (Section 1204.0)
13. Stair construction in Use Group R-3 & R-4 is a minimum of 10" tread and 7 1/4" maximum rise. All other Use Group minimum 11" tread, 7" maximum rise. (Section 1014.0)
14. The minimum headroom in all parts of a stairway shall not be less than 80 inches. (6'8") 1014.4
15. Every sleeping room below the fourth story in buildings of Use Groups R and I-1 shall have at least one operable window or exterior door approved for emergency egress or rescue. The units must be operable from the inside without the use of special knowledge or separate tools. Where windows are provided as means of egress or rescue they shall have a sill height not more than 44 inches (1118mm) above the floor. All egress or rescue windows from sleeping rooms shall have a minimum net clear opening height dimension of 24 inches (610mm). The minimum net clear opening width dimension shall be 20 inches (508mm), and a minimum net clear opening of 5.7 sq. ft. (Section 1010.4)
16. Each apartment shall have access to two (2) separate, remote and approved means of egress. A single exit is acceptable when it exits directly from the apartment to the building exterior with no communications to other apartment units. (Section 1010.1)
17. All vertical openings shall be enclosed with construction having a fire rating of at least one (1) hour, including fire doors with self closer's. (Over 3 stories in height requirements for fire rating is two (2) hours. (Section 710.0)
18. The boiler shall be protected by enclosing with (1) hour fire rated construction including fire doors and ceiling, or by providing automatic extinguishment. (Table 302.1.1)

19. All single and multiple station smoke detectors shall be of an approved type and shall be installed in accordance with the provisions of the City's Building Code Chapter 9, Section 920.3.2 (BOCA National Building Code/1999), and NFPA 101 Chapter 18 & 19. (Smoke detectors shall be installed and maintained at the following locations):
  - In the immediate vicinity of bedrooms
  - In all bedrooms
  - In each story within a dwelling unit, including basements
20. A portable fire extinguisher shall be located as per NFPA #10. They shall bear the label of an approved agency and be of an approved type. (Section 921.0)
21. The Fire Alarm System shall be installed and maintained to NFPA #72 Standard.
22. The Sprinkler System shall be installed and maintained to NFPA #13 Standard.
23. All exit signs, lights and means of egress lighting shall be done in accordance with Chapter 10 Section & Subsections 1023.0 & 1024.0 of the City's Building Code. (The BOCA National Building Code/1999)
24. Section 25 - 135 of the Municipal Code for the City of Portland states, "No person or utility shall be granted a permit to excavate or open any street or sidewalk from the time of November 15 of each year to April 15 of the following year".
25. The builder of a facility to which Section 4594-C of the Maine State Human Rights Act Title 5 MRSA refers, shall obtain a certification from a design professional that the plans commencing construction of the facility, the builder shall submit the certification the Division of Inspection Services.
26. Ventilation and access shall meet the requirements of Chapter 12 Sections 1210.0 and 1211.0 of the City's Building Code. (Crawl spaces & attics).
- X 27. All electrical, plumbing and HVAC permits must be obtained by a Master Licensed holders of their trade. No closing in of walls until all electrical (min. 72 hours notice) and plumbing inspections have been done.
28. All requirements must be met before a final Certificate of Occupancy is issued.
29. All building elements shall meet the fastening schedule as per Table 2305.2 of the City's Building Code (The BOCA National Building Code/1996).
30. Ventilation of spaces within a building shall be done in accordance with the City's Mechanical code (The BOCA National Mechanical Code/1993). (Chapter M-16)
31. Please read and implement the attached Land Use Zoning report requirements.
32. Boring, cutting and notching shall be done in accordance with Sections 2305.3, 2305.3.1, 2305.4.4 and 2305.5.1 of the City's Building Code.
33. Bridging shall comply with Section 2305.16.
34. Glass and glazing shall meet the requirements of Chapter 24 of the building code. (Safety Glazing Section 2406.0)
35. All signage, shall be done in accordance with Section 3102.0 signs of the City's Building Code, (The BOCA National Building Code/1999).
- X 36. *Antennas shall comply with Section 3109.0 of The bldg. Code*

  
 V. Samuel Heffles, Building Inspector  
 Lt. McDougall, PFD  
 Marge Schmuckal, Zoning Administrator

PSH 1/26/00

**\*\*On the basis of plans submitted and conditions placed on these plans any deviations shall require a separate approval.**

**\*\*\*THIS PERMIT HAS BEEN ISSUED WITH THE UNDERSTANDING THAT ALL THE CONDITIONS OF THE APPROVAL SHALL BE COMPLETED. THEREFORE, BEFORE THE WORK IS COMPLETED A REVISED PLAN OR STATEMENT FROM THE PERMIT HOLDER SHALL BE SUBMITTED TO THIS OFFICE SHOWING OR EXPLAINING THAT THE CONDITIONS HAVE BEEN MET. IF THIS REQUIREMENT IS NOT RECEIVED YOUR CERTIFICATE OF OCCUPANCY SHALL BE WITHHELD.**

**\*\*\*CERTIFICATE OF OCCUPANCY FEE \$50.00**



**CITY OF PORTLAND, MAINE**  
Department of Building Inspection

Oct. 12 2000

Received from Permit Contracting a fee

of one thousand eight hundred /100 Dollars \$ 1,774.00

for permit to install  
erect  
alter Building

at 64 Blueberry Rd move  
demolish Est. Cost \$ 300,000.

Check #  
002570  
CBI- 238 A008

Inspector of buildings  
Per [Signature]

**THIS IS NOT A PERMIT**

No work is to be started until PERMIT CARD is actually posted upon the premises. Acceptance of fee is no guarantee that permit will be granted. PRESERVE THIS RECEIPT. In case permit cannot be granted the amount of the fee will be refunded upon return of the receipt less \$5.00 or 10% whichever is greater.

WHITE - Applicant's Copy  
YELLOW - Office Copy  
PINK - Auditors Copy

**BUILDING PERMIT REPORT**

DATE: 16 OCT 2008  
 ADDRESS: 64 Quaberry Rd. Foundation/Silo & Mechanical Control Room  
 BUILDING OWNER: Regional Waste Systems  
 PERMIT APPLICANT: CONTRACTOR North America, Inc.  
 USE GROUP: N CONSTRUCTION TYPE: 1B CONSTRUCTION COST: 300,000 PERMIT FEES: 7,804.00  
 The City's Adopted Building Code (The BOCA National Building Code/1999 with City Amendments)  
 The City's Adopted Mechanical Code (The BOCA National Mechanical Code/1993)

**CONDITION(S) OF APPROVAL**

This permit is being issued with the understanding that the following conditions shall be met: \*1) \*2) \*22) \*27) \*28) \*29) \*30) \*31) \*32) \*33) \*34) \*35) \*36) \*37) \*38) \*39) \*40) \*41) \*42) \*43) \*44) \*45) \*46) \*47) \*48) \*49) \*50) \*51) \*52) \*53) \*54) \*55) \*56) \*57) \*58) \*59) \*60) \*61) \*62) \*63) \*64) \*65) \*66) \*67) \*68) \*69) \*70) \*71) \*72) \*73) \*74) \*75) \*76) \*77) \*78) \*79) \*80) \*81) \*82) \*83) \*84) \*85) \*86) \*87) \*88) \*89) \*90) \*91) \*92) \*93) \*94) \*95) \*96) \*97) \*98) \*99) \*100)

1. Foundations anchors shall be a minimum of 1/2" in diameter, 7" into the foundation wall, minimum of 12" from corners of foundation and a maximum of 6" O.C. between bolts. Section 2305.17
2. Foundations shall be covered with not less than 6" of the same material. Section 1813.5.2
3. Foundations shall be protected with an approved filter membrane material. The pipe or tile shall be placed on not less than 2" of gravel or crushed stone, and tile or perforated pipe is used, the invert of the pipe or tile shall not be higher than the floor elevation. The top of joints or top of perforations shall be 6 inches above the top of the footing. The top of the drain shall be covered with an approved filter membrane material. Where a drain thickness shall be such that the bottom of the drain is not higher than the bottom of the base under the floor, and that the top of the drain is not less than 6 inches above the top of the footing. The top of the drain shall be covered with an approved filter membrane material. Where a drain percent material that passes through a No. 4 sieve. The drain shall extend a minimum of 12 inches beyond the outside edge of the footing. The foundation drain shall be placed around the perimeter of a foundation that consists of gravel or crushed stone containing not more than 10 percent material that passes through a No. 4 sieve. The drain shall extend a minimum of 12 inches beyond the outside edge of the footing. The thickness shall be such that the bottom of the drain is not higher than the bottom of the base under the floor, and that the top of the drain is not less than 6 inches above the top of the footing. The top of the drain shall be covered with an approved filter membrane material. Where a drain shall be protected with an approved filter membrane material. The pipe or tile shall be placed on not less than 2" of gravel or crushed stone, and shall be covered with not less than 6" of the same material. Section 1813.5.2
4. Foundations anchors shall be a minimum of 1/2" in diameter, 7" into the foundation wall, minimum of 12" from corners of foundation and a maximum of 6" O.C. between bolts. Section 2305.17
5. Waterproofing and dampproofing shall be done in accordance with Section 1813.0 of the building code.
6. Precast concrete must be taken to protect concrete from freezing. Section 1908.0
7. It is strongly recommended that a registered land surveyor check all foundation forms before concrete is placed. This is done to verify that the proper setbacks are maintained.
8. Private garages located beneath habitable rooms in occupancies in Use Group R-1, R-2, R-3 or I-1 shall be separated from adjacent interior spaces by fire partitions and floor/ceiling assemblies which are constructed with not less than 1-hour fire resisting rating. Private garages attached side-by-side to rooms in the above occupancies shall be completely separated from the interior spaces and the attic area by means of 1/2 inch gypsum board or the equivalent applied to the garage side. (Chapter 4, Section 407.0 of the BOCA/1999)
9. All chimneys and vents shall be installed and maintained as per Chapter 12 of the City's Mechanical Code. (The BOCA National Mechanical Code/1993). Chapter 12 & NFPA 211
10. Sound transmission control in residential building shall be done in accordance with Chapter 12, Section 1214.0 of the City's Building Code.
11. Guards & Handrails: A guardrail system is a system of building components located near the open sides of elevated walking surfaces for the purpose of minimizing the possibility of an accidental fall from the walking surface to the lower level. Minimum height all Use Groups 42". In occupancies in Use Group A, B, H-4, I-1, I-2, M, R, public garages and open parking structures, open guards shall have balusters or be of solid material such that a sphere with a diameter of 4" cannot pass through any opening. Guards shall not have an ornamental pattern that would provide a ladder effect. Handrails shall be a minimum of 34" but not more than 38". Exception: Handrails that form part of a guard shall have a height not less than 36 inches (914 mm) and not more than 42 inches (1067 mm). Handrail grip size shall have a circular cross section with an outside diameter of at least 1 1/4" and not greater than 2". (Sections 1021 & 1022.0). Handrails shall be on both sides of stairway. (Section 1014.7)
12. Headroom in habitable space is a minimum of 7'6". (Section 1204.0)
13. Stair construction in Use Group R-3 & R-4 is a minimum of 10" tread and 7 1/2" maximum rise. All other Use Group minimum 11" tread.
14. The minimum headroom in all parts of a stairway shall not be less than 80 inches. (6'8") 1014.4
15. Every sleeping room below the fourth story in buildings of Use Groups R and I-1 shall have at least one operable window or exterior door approved for emergency egress or rescue. The units must be operable from the inside without the use of special knowledge or separate tools. Where windows are provided as means of egress or rescue they shall have a sill height not more than 44 inches (1118mm) above the floor. All egress or rescue windows from sleeping rooms shall have a minimum net clear opening height dimension of 24 inches (610mm). The minimum net clear opening width dimension shall be 20 inches (508mm), and a minimum net clear opening of 5.7 sq. ft. (Section 1010.4)
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17. All vertical openings shall be enclosed with construction having a fire rating of at least one (1) hour, including fire doors with self closures. (Over 3 stories in height requirements for fire rating is two (2) hours. (Section 710.0)
18. The boiler shall be protected by enclosing with (1) hour fire rated construction including fire doors and ceiling, or by providing automatic extinguishment. (Table 302.1.1)

11/2

\*\*\*CERTIFICATE OF OCCUPANCY FEE \$50.00

\*\*\*ALL PLANS THAT REQUIRE A PROFESSIONAL DESIGNER'S SEAL, (AS PER SECTION 114.0 OF THE BUILDING CODE) SHALL ALSO BE PRESENTED TO THIS DIVISION ON AUTO CAD LT. 2000, DXF FORMAT OR EQUIVALENT.

\*\*\*THIS PERMIT HAS BEEN ISSUED WITH THE UNDERSTANDING THAT ALL THE CONDITIONS OF THE APPROVAL SHALL BE COMPLETED. THEREFORE, BEFORE THE WORK IS COMPLETED A REVISED PLAN OR STATEMENT FROM THE PERMIT HOLDER SHALL BE SUBMITTED TO THIS OFFICE SHOWING OR EXPLAINING THAT THE CONDITIONS HAVE BEEN MET. IF THIS REQUIREMENT IS NOT RECEIVED YOUR CERTIFICATE OF OCCUPANCY SHALL BE WITHHELD.

\*\*This permit is herewith issued, on the basis of plans submitted and conditions placed on these plans, any deviations shall require a separate approval.

PSH 10/00  
Marge Schumack, Zoning Administrator  
Lt. McDougall, PFD  
Building Inspector

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

- 19. All single and multiple station smoke detectors shall be of an approved type and shall be installed in accordance with the provisions of the City's Building Code Chapter 9, Section 920.3.2 (BOCA National Building Code/1999), and NFPA 101 Chapter 18 & 19. (Smoke detectors shall be installed and maintained at the following locations):
  - In the immediate vicinity of bedrooms
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- 20. A portable fire extinguisher shall be located as per NFPA #10. They shall bear the label of an approved agency and be of an approved type. (Section 921.0)
- 21. The Fire Alarm System shall be installed and maintained to NFPA #72 Standard.
- 22. The Sprinkler System shall be installed and maintained to NFPA #13 Standard.
- 23. All exit signs, lights and means of egress lighting shall be done in accordance with Chapter 10 Section & Subsections 1023.0 & 1024.0 of the City's Building Code. (The BOCA National Building Code/1999)
- 24. City's Building Code for the City of Portland states, "No person or utility shall be granted a permit to excavate or open any street or sidewalk from the time of November 15 of each year to April 15 of the following year".
- 25. The builder of a facility to which Section 4594-C of the Maine State Human Rights Act Title 5 MRSA refers, shall obtain a certification from a design professional that the plans commencing construction of the facility, the builder shall submit the certification the Division of Inspection Services.
- 26. Ventilation and access shall meet the requirements of Chapter 12 Sections 1210.0 and 1211.0 of the City's Building Code. (Crawl spaces & attics).
- 27. All electrical, plumbing and HVAC permits must be obtained by Master Licensed holders of their trade. No closing in of walls until all electrical (min. 72 hours notice) and plumbing inspections have been done.
- 28. All requirements must be met before a final Certificate of Occupancy is issued.
- 29. All building elements shall meet the fastening schedule as per Table 2305.2 of the City's Building Code (The BOCA National Building Code/1996).
- 30. Ventilation of spaces within a building shall be done in accordance with the City's Mechanical code (The BOCA National Mechanical Code/1993). (Chapter M-16)
- 31. Please read and implement the attached Land Use Zoning report requirements.
- 32. Boring, cutting and notching shall be done in accordance with Sections 2305.3, 2305.3.1, 2305.4.4 and 2305.5.1 of the City's Building Code.
- 33. Bridging shall comply with Section 2305.16.
- 34. Glass and glazing shall meet the requirements of Chapter 24 of the building code. (Safety Glazing Section 2406.0)
- 35. All signage, shall be done in accordance with Section 3102.0 signs of the City's Building Code, (The BOCA National Building Code/1999).
- 36. All flashing shall comply with Section 1406.3.10.

# FAX MESSAGE



Date : October 17, 2000 Our Ref: NAI-8035

Company : City of Portland Maine

City : Portland, Maine

Attention : Mr. Sam Hoffsesf

Fax : 207-874-8716

Total number of pages, including this cover page: 4

Re : Regional Waste Systems, Inc.  
Carbon Silo Dosing System

NORIT Americas Inc.  
3200 W. University Ave.  
P.O. Box 790  
Marshall, Texas 75671  
Tel. 903-938-9211  
Fax 903-938-9701

Dear Mr. Hoffsesf,

Attached please find letter concerning design basis for subject project.

A handwritten signature in black ink, appearing to read 'John Dittmar', written in a cursive style.

John Dittmar



October 17, 2000

By Fax: 10/17/00

Mr. Sam Hoffsesf  
Building Inspector  
City Of Portland  
389 Congress Street  
Portland, Maine 04101

NORIT AMERICAS INC  
P.O. Box 790  
Marshall, TX 75671  
Fax 903-938-9701  
Tel. 903-938-9211

RE: Regional Waste Systems, Inc  
Carbon Silo Dosing System

Dear Mr. Hoffsesf

NORIT Americas Inc. is a company that primarily manufactures Activated Carbon and has more than 75 years of experience handling this material. NORIT has been contracted by Regional Waste Systems, Inc. to furnish and install a Carbon Silo Dosing System to remove Mercury from flue gas at their facility in Portland, Maine. We, in turn, have contracted Bancroft Contracting Company to install the foundations for this project and to assist in obtaining a Building Permit.

Relating to the forms you transmitted to Bancroft Contracting Company concerning the basis of design, we offer the following:

1. The Storage Silo is designed to the BOCA Code, 1999 Edition by A.O. Smith Engineered Storage Products Company in Parsons, Kansas. Their design calculations and drawings have been reviewed and stamped by a Registered Professional Engineer in the State of Maine. Their design calculations and drawings were part of the submittal package for a Building Permit.
2. The Precast Concrete Building was designed to the BOCA Code, 1996 Edition by Lonestar Prestress Mfg., Inc. in Houston, Texas. Their design calculations have been prepared and stamped by a Registered Professional Engineer in the State of Texas. Their design is very conservative and is based on a 60 psf Roof Live Load, a 250 psf Floor Live Load, Wind Loading base on 130 mph and a Seismic Performance Category 'E'. Their design calculations and drawings were also a part of the submittal package for a Building Permit.
3. The foundation design for this project was prepared by Mohlin & Company in Saco, Maine. Their drawings were prepared by and have been stamped by a Registered Professional Engineer in the State of Maine. These drawings were also a part of the submittal package for a Building Permit.
4. The Mechanical and Electrical aspects of the Project were designed by NORIT Americas Inc. in accordance with ASME, ANSI, NEMA, NEC and other applicable Codes. The NORIT Mechanical and Electrical drawings were also part of the submittal package for a Building Permit. We are in the process of obtaining a copy of the 1999 BOCA National Building Code and the 2000 International Mechanical Code to verify compliance. (These documents have been ordered and should be delivered by FedEx today.) After we have



Certificate No. FM 36335



Mr. Sam Hoffsesf  
Building Inspector  
City Of Portland

-2-

October 17, 2000



reviewed our drawings for compliance, we will have the drawings stamped by a Registered Professional Engineer in the State of Maine.

Please review the above design basis and advise NORIT Americas as to the corrective actions required to secure a Building Permit.

Relating to the "Accessibility Certificate" faxed to Bancroft Contracting, we submit that this is a small 80 square foot equipment area that is non-occupied space. The primary function of the building is to house the power and control equipment for the system. As such, it is NORIT's belief that "Handicap Accessibility" is not required.

Regional Waste Systems requires the installation of this system to maintain compliance with new environmental regulations effective mid December. We at NORIT are trying to expedite the installation of this equipment and are asking that the Building Permit be issued so the foundation or foundation only work can progress. We will make every effort to fulfill your permitting requirements.

If you have any questions or need to discuss any of this with me by phone, I can be reached at 903-926-2991.

Sincerely,

NORIT Americas Inc.

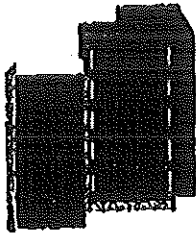
A handwritten signature in black ink, appearing to read 'John Dittmar', written over the typed name.

John Dittmar  
Project Manager

JAD:Bldg Permit

Cc: Dick McKnight  
Kevin Trytek  
Brad Moll  
NAI-8035

NORIT Americas  
Regional Waste Systems, Inc.  
Bancroft Contracting Company



CITY OF PORTLAND  
BUILDING CODE CERTIFICATE  
389 Congress St., Rm. 315  
Portland, ME 04101

TO: Inspector of Buildings City of Portland, Maine  
Department of Planning & Urban Development  
Division of Housing & Community Service

FROM: NORIT AMERICAS, INC.

RE: Certificate of Design

DATE: OCT. 17, 2000

These plans and/or specifications covering construction work on:

REGIONAL WASTE SYSTEMS, INC.  
CARBON SLO DOSING SYSTEM

Have been designed and drawn up by the undersigned, a Maine registered architect/engineer according to the BOCA National Building Code/1999 Fourteenth Edition, and local amendments.  
\* BOCA NATIONAL BUILDING CODE / 1996

(SEAL)

Signature John Williams

Title PROJECT MGR

Firm NORIT AMERICAS, INC

Address MARSHALL, TEXAS

As per Maine State Law:

\$50,000.00 or more in new construction, repair, expansion, addition, or modification for Building or Structures, shall be prepared by a registered design Professional.

PSM 10/99

SEE ATTACHED LETTER  
FOR CLARIFICATION.

October 17, 2000

By Fax: 10/17/00



Mr. Sam Hoffsesf  
Building Inspector  
City Of Portland  
389 Congress Street  
Portland, Maine 04101

NORIT AMERICAS INC.  
P.O. Box 790  
Marshall, TX 75671  
Fax 903-938-9701  
Tel. 903-938-9211

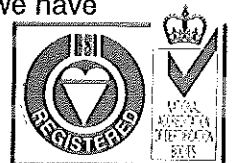
RE: Regional Waste Systems, Inc  
Carbon Silo Dosing System

Dear Mr. Hoffsesf

NORIT Americas Inc. is a company that primarily manufactures Activated Carbon and has more than 75 years of experience handling this material. NORIT has been contracted by Regional Waste Systems, Inc. to furnish and install a Carbon Silo Dosing System to remove Mercury from flue gas at their facility in Portland, Maine. We, in turn, have contracted Bancroft Contracting Company to install the foundations for this project and to assist in obtaining a Building Permit.

Relating to the forms you transmitted to Bancroft Contracting Company concerning the basis of design, we offer the following:

1. The Storage Silo is designed to the BOCA Code, 1999 Edition by A.O. Smith Engineered Storage Products Company in Parsons, Kansas. Their design calculations and drawings have been reviewed and stamped by a Registered Professional Engineer in the State of Maine. Their design calculations and drawings were part of the submittal package for a Building Permit.
2. The Precast Concrete Building was designed to the BOCA Code, 1996 Edition by Lonestar Prestress Mfg., Inc. in Houston, Texas. Their design calculations have been prepared and stamped by a Registered Professional Engineer in the State of Texas. Their design is very conservative and is based on a 60 psf Roof Live Load, a 250 psf Floor Live Load, Wind Loading base on 130 mph and a Seismic Performance Category 'E'. Their design calculations and drawings were also a part of the submittal package for a Building Permit.
3. The foundation design for this project was prepared by Mohlin & Company in Saco, Maine. Their drawings were prepared by and have been stamped by a Registered Professional Engineer in the State of Maine. These drawings were also a part of the submittal package for a Building Permit.
4. The Mechanical and Electrical aspects of the Project were designed by NORIT Americas Inc. in accordance with ASME, ANSI, NEMA, NEC and other applicable Codes. The NORIT Mechanical and Electrical drawings were also part of the submittal package for a Building Permit. We are in the process of obtaining a copy of the 1999 BOCA National Building Code and the 2000 International Mechanical Code to verify compliance. (These documents have been ordered and should be delivered by FedEx today.) After we have



Certificate No. FM 36335

Mr. Sam Hoffsesf  
Building Inspector  
City Of Portland

-2-

October 17, 2000



reviewed our drawings for compliance, we will have the drawings stamped by a Registered Professional Engineer in the State of Maine.

Please review the above design basis and advise NORIT Americas as to the corrective actions required to secure a Building Permit.

Relating to the "Accessibility Certificate" faxed to Bancroft Contracting, we submit that this is a small 80 square foot equipment area that is non-occupied space. The primary function of the building is to house the power and control equipment for the system. As such, it is NORIT's belief that "Handicap Accessibility" is not required.

Regional Waste Systems requires the installation of this system to maintain compliance with new environmental regulations effective mid December. We at NORIT are trying to expedite the installation of this equipment and are asking that the Building Permit be issued so the foundation or foundation only work can progress. We will make every effort to fulfill your permitting requirements.

If you have any questions or need to discuss any of this with me by phone, I can be reached at 903-926-2991.

Sincerely,

NORIT Americas Inc.

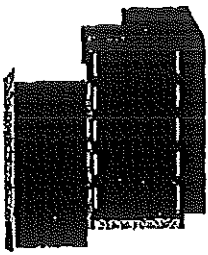
A handwritten signature in cursive script that reads "John Dittmar".

John Dittmar  
Project Manager

JAD:Bldg Permit

Cc: Dick McKnight  
Kevin Trytek  
Brad Moll  
NAI-8035

NORIT Americas  
Regional Waste Systems, Inc.  
Bancroft Contracting Company



CITY OF PORTLAND  
BUILDING CODE CERTIFICATE  
389 Congress St., Rm. 315  
Portland, ME 04101

TO: Inspector of Buildings City of Portland, Maine  
Department of Planning & Urban Development  
Division of Housing & Community Service

FROM: NORT AMERICAS, INC.

RE: Certificate of Design

DATE: OCT. 17, 2000

These plans and/or specifications covering construction work on:  
REGIONAL WASTE SYSTEMS, INC.  
CARBON SILO DOSING SYSTEM

Have been designed and drawn up by the undersigned, a Maine registered architect/engineer according to the BOCA National Building Code/1999 Fourteenth Edition, and local amendments.  
# BOCA NATIONAL BUILDING CODE / 1999

(SEAL) Signature John Williams  
Title PROJECT MGR  
Firm NORT AMERICAS INC  
Address MARSHALL, TEXAS

As per Maine State Law:  
\$50,000.00 or more in new construction, repair, expansion, addition, or modification for Building or Structures, shall be prepared by a registered design Professional.

PSH 10/9/00

SEE ATTACHED LETTER  
FOR CLARIFICATION.

**MAIL TO: BANCROFT CONTRACTING CORP.**  
 23 PHILLIPS RD., S. PARIS ME 04881

**THIS IS NOT A PERMIT/CONSTRUCTION CANNOT COMMENCE UNTIL THE PERMIT IS ISSUED**

ATTN: BRAD MO

**Building or Use Permit Pre-Application**

Attached Single Family Dwellings/Two-Family Dwelling

Multi-Family or Commercial Structures and Additions Thereto

In the interest of processing your application in the quickest possible manner, please complete the Information below for a Building or Use Permit.

**NOTE\*\*** If you or the property owner owes real estate or personal property taxes or user charges on ANY PROPERTY within the City, payment arrangements must be made before permits of any kind are accepted.

Location/Address of Construction (include Portion of Building):		64 BLUEBERRY ROAD, PORTLAND	
Total Square Footage of Proposed Structure	350 SF	Square Footage of Lot	
Tax Assessor's Chart, Block & Lot Number	Chart# 238 Block# A Lot# 008	Owner:	REGIONAL WASTE SYSTEM Telephone: 776-6465
Owner's Address:	64 BLUEBERRY RD PORTLAND, ME 04101	Lessee/Buyer's Name (If Applicable)	N/A
Proposed Project Description: (Please be as specific as possible)	FOUNDATION/SILO AND MECHANICAL CONTROL ROOM		
Contractor's Name, Address & Telephone	NORTH AMERICA, INC. PO BOX 790 MARSHALL, TX 75753 207-743-8946		Rec'd By: BRAD MO
Current Use:	INDUSTRIAL	Proposed Use:	INDUSTRIAL

Gayle 10/12

- All construction must be conducted in compliance with the 1996 B.O.C.A. Building Code as amended by Section 6-Art II.
- All plumbing must be conducted in compliance with the State of Maine Plumbing Code.
- All Electrical Installation must comply with the 1996 National Electrical Code as amended by Section 6-Art III.
- HVAC (Heating, Ventillation and Air Conditioning) Installation must comply with the 1993 BOCA Mechanical Code.

You must include the following with you application:

- 1) A Copy of Your Deed or Purchase and Sale Agreement
- 2) A Copy of your Construction Contract, if available
- 3) A Plot Plan/Site Plan

**\* IF Available also Submit Plans on ADOBE OR CAD FORMS**

Minor or Major site plan review will be required for the above proposed projects. The attached checklist outlines the minimum standards for a site plan.

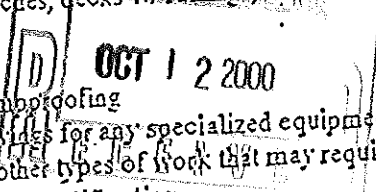
Unless exempted by State Law, construction documents must be designed by a registered design professional.

- A complete set of construction drawings showing all of the following elements of construction:
- Cross Sections w/ Framing details (including porches, decks, walkways, and accessory structures)
  - Floor Plans & Elevations
  - Window and door schedules
  - Foundation plans with required drainage and dampproofing
  - Electrical and plumbing layout. Mechanical drawings for any specialized equipment such as furnaces, chimneys, gas equipment, HVAC equipment (air handling) or other types of work that may require special review must be included.

**Approved Exemption in Plan**

**Certification**

I hereby certify that I am the Owner of record of the named property, or that the proposed work is authorized by the owner of record and that I have been authorized by the owner to make this application as his/her authorized agent. I agree to conform to all applicable laws of this jurisdiction. In addition, if a permit for work described in this application is issued, I certify that the Code Officer's authorized representative shall have the authority to enter all areas covered by this permit at any reasonable hour to enforce the provisions of the codes applicable to this permit.



Signature of applicant: Brad Moll Date: 10/10/00

Building Permit Fee: \$30.00 for the 1st \$1000 cost plus \$6.00 per \$1,000.00 construction cost thereafter.  
 Additional Site review and related fees are attached on a separate addendum

# ELECTRICAL PERMIT

## City of Portland, Me.



To the Chief Electrical Inspector, Portland Maine:  
 The undersigned hereby applies for a permit to make electrical installations  
 in accordance with the laws of Maine, the City of Portland Electrical Ordinance,  
 National Electrical Code and the following specifications:

Date 2-14-01  
 Permit # 1235  
 CBL# 230-A000

LOCATION: 114 Blueberry Rd METER MAKE & # \_\_\_\_\_  
 CMP ACCOUNT # \_\_\_\_\_ OWNER Regional Waste Systems  
 TENANT \_\_\_\_\_ PHONE # 773-1738

					TOTAL EACH FEE		
OUTLETS	Receptacles		Switches		Smoke Detector	.20	
FIXTURES	Incandescent		Fluorescent		Strips	.20	
SERVICES	Overhead		Underground		TTL AMPS <800	15.00	
	Overhead		Underground		>800	25.00	
Temporary Service	Overhead		Underground		TTL AMPS	25.00	
						25.00	
METERS	(number of)					1.00	
MOTORS	(number of)					2.00	
RESID/COM	Electric units					1.00	
HEATING	oil/gas units		Interior		Exterior	5.00	
			5.00		5.00		
APPLIANCES	Ranges		Cook Tops		Wall Ovens	2.00	
	Insta-Hot		Water heaters		Fans	2.00	
	Dryers		Disposals		Dishwasher	2.00	
	Compactors		Spa		Washing Machine	2.00	
	Others (denote)					2.00	
	MISC. (number of)	Air Cond/win					3.00
		Air Cond/cent				Pools	10.00
		HVAC		EMS		Thermostat	5.00
		Signs					10.00
		Alarms/res					5.00
	Alarms/com					15.00	
	Heavy Duty(CRKT)					2.00	
	Circus/Carnv					25.00	
	Alterations					5.00	
	Fire Repairs					15.00	
	E Lights					1.00	
	E Generators					20.00	
PANELS	Service	/	Remote	/	Main	4.00	
TRANSFORMER	0-25 Kva					5.00	
	25-200 Kva	/				8.00	
	Over 200 Kva					10.00	
					TOTAL AMOUNT DUE		
					MINIMUM FEE/COMMERCIAL 45.00	35.00	
					MINIMUM FEE	35.00	

INSPECTION: Will be ready 2-16-01 or will call \_\_\_\_\_

CONTRACTORS NAME Carl Russell MASTER LIC. # 14963  
 ADDRESS 109 Grant Rd Saco Me LIMITED LIC. # \_\_\_\_\_  
 TELEPHONE 207-284-1720

SIGNATURE OF CONTRACTOR Carl Russell





**A.O. SMITH**  
**ENGINEERED STORAGE**  
**PRODUCTS COMPANY**

2101 S. 21st Street, P.O. Box 996  
 Parsons, KS 67357-0996 U.S.A.  
 316-421-0200 Phone, 316-421-9122 Fax



APPROVED FOR  
 CONSTRUCTION  
  
 SEP 20 2000  
  
 ESPC  
 Parsons

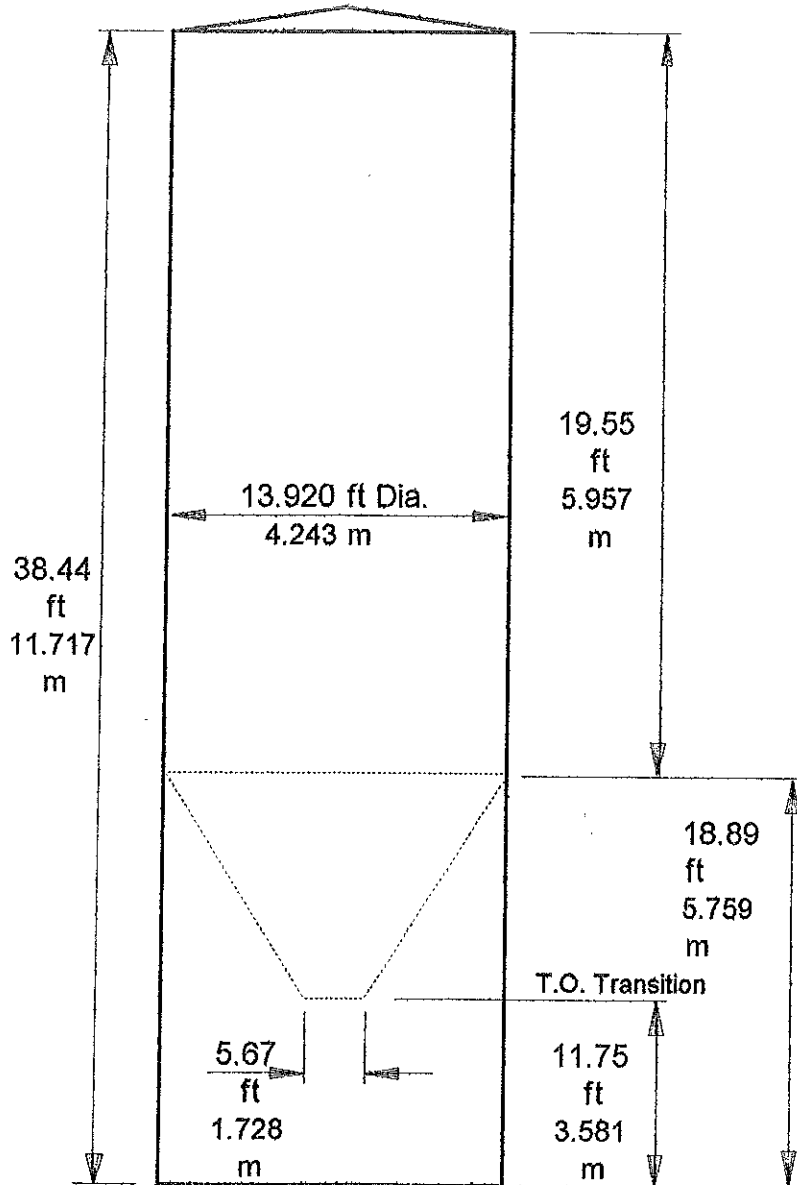
**CALCULATIONS**

Mass Flow Welded Tank

Customer: Norit Americas  
 Sales Order Number: 00-1793  
 Date: 08/16/00  
 Engineer: Shedd  
 Checker:

Tank Diameter =	13.920 ft	4.243 m
Tank Height =	38.44 ft	11.717 m
Hopper Angle =	60.00 deg	
Hopper Opening (Top Of Transition) =	5.67 ft	1.728 m
Hopper Clearance (Top Of Transition) =	11.75 ft	3.581 m
Tank Volume =	3545 cf	100 m <sup>3</sup>
Bulk Density =	35 pcf	561 kg/m <sup>3</sup>
Product:	Activated Carbon	
BOCA 1999 Wind Velocity =	90 mph	40.2 m/s
BOCA 1999 Seismic Zone =	0.10 = Aa, V =	0.056 W
Deck Live Load =	100 psf	488.2 kg/m <sup>2</sup>
Equipment Weight =	1000 lbs	4.448 kN
Angle Of Repose =	0.0 deg	
Shell Friction Angle =	25.0 deg	K = 0.6
Hopper Friction Angle =	15.0 deg	K = 0.4
Internal Friction Angle =	50.0 deg	
Sigma/Gamma B :	0.52	
Design Pressure =	8.00 oz/in <sup>2</sup>	34.5 mBar
Design Vacuum =	0.50 oz/in <sup>2</sup>	2.2 mBar

*Handwritten notes:*  
 8-22-2000  
 9-22-2000



Material Specifications:

- Sheet Steel: ASTM A570  
40 Ksi Min. Yield
- Plate Steel: ASTM A36
- Struct Steel: ASTM A36
- Anchor Bolts: A 307

Stress Increases For Wind/Seismic:  
AISC Spec. A5, Allowable Stresses  
May Be Increased By 1/3 When  
Produced By Wind Or Seismic Loads.

(Not To Scale)

*Handwritten signature and date: 9-22-2000*

**WIND LOAD (At Tank Base)**  
**Ref. BOCA 1999 (Ref. ASCE 7-93)**

Tank Dia. (D) =	13.92 Ft	
Tank Ht. (h) =	38.44 Ft	$F = (qz G Cf) Af = F' Af$
Velocity =	90 Mph	$F' = qz G Cf$
I =	1.15	$qz = 0.00256 Kz Kzt (V^2) I = Pv Kz$
Exposure	C	$Pv = 0.00256 Kzt (V^2) I$
Structure Ht. =	0.00 Ft	$F' = (Pv Kz) G Cf$
Gh =	1.23	$Af = \text{Ring Ht} \times D$
Pv =	27.42 Psf	$F = F' Af$
h/D =	2.76	$OTM = F h$
Cf =	0.73	

---

	Ring Ht. (Ft)	Ht. From Grade (Ft)	Kz	F' (Psf)	Af (Sq.Ft)	F (Lbs)	h (Ft)	OTM (Ft-Lbs)
1	15.00	15.00	0.80	19.76	209	4125	7.50	30938
2	5.00	20.00	0.87	21.48	70	1495	17.50	26169
3	5.00	25.00	0.93	22.97	70	1598	22.50	35966
4	5.00	30.00	0.98	24.20	70	1684	27.50	46322
5	8.44	38.44	1.05	25.87	117	3039	34.22	104002

---

Total Base Shear = Sum of the Forces (F) = 11943 Lbs  
 Total Overturning Moment At Tank Base = Sum of the OTMs = 243396 Ft-Lbs

**SEISMIC LOAD**  
 Ref. BOCA 1999

$V_s = \text{Seismic Force} = \text{Base Shear} = 2.5 A_a / R$

$A_a = 0.10$

$R = 4.5$

$V_s = 0.056 W$

W = Weight Of Tank/Equip./Contents/Snow (If > 30 psf)

h = Height To Centroid From Base Of Tank

OTMs = Overturning Moment =  $V_s h$

	W lbs	Vs lbs	h ft	OTMs ft-lbs
Equipment:	1000	56	38.44	2136
Deck:	1738	97	38.85	3751
Shell:	20166	1120	20.50	22965
Hopper:	3096	172	16.27	2798
Product In Repose:	0	0		0
Product In Shell:	104107	5784	28.67	165803
Product In Hopper:	19957	1109	16.27	18038
Deck Live Load:	15218	845	38.85	32846
Totals:	165282	9182		248337

## EQUIVALENT VERTICAL LOADS

Tank Diameter = 13.920 ft

M = OTM, Overturning Moment Due To Wind Or Seismic

EVL = Equivalent Vertical Load

Fb = Bending Stress

S = Section Modulus Of Circular Shell

t = Shell Thickness

R = Shell Radius

A = Area Of Circular Shell

D = Diameter Of Shell

Shell:

$M = \text{SUM} (F H)$

$F_b = M / S = M / (\pi R^2 t), A = \pi 2 R t$

$EVL = F_b A$

$EVL = (M / (\pi R^2 t)) (\pi 2 R t) = 2 M / R = 4 M / D$

	Elev. ft	OTM Wind ft-lbs	OTM Seismic ft-lbs	Max EVL lbs
Eave	5.92	6310	11912	3423
	11.84	25106	34572	9935
	17.76	55622	68256	19614
	19.55	67017	80587	23157
	38.44	243396	248337	71361

**SHELL LOADS FROM PRODUCT**

Ref: Jenike, A.W., Effect Of Solid Flow Properties And Hopper Configuration On Silo Loads

**Vertical Pressure (q)**

$$q \text{ (psf)} = w D [1 - (\exp (-4 k u Z / D))] / (4 k u)$$

$$u \text{ (For Vertical Pressure)} = \tan (\text{Hopper Friction Angle})$$

**Horizontal (Hoop) Pressure (p)**

$$p \text{ (psf)} = k q$$

$$\text{Hoop Load (lb/in)} = p (D/2) / 12$$

**Vertical Load (v)**

$$v \text{ (lb/ft)} = (w D Z / 4) - \{(w D^2) [1 - (\exp (-4 k u Z / D))] / (16 k u)\}$$

$$u \text{ (For Vertical Load)} = \tan (\text{Shell Friction Angle})$$

$$\text{Total Vertical Load (lbs)} = v D \pi$$

w = Product Bulk Density (lb/ft<sup>3</sup>)

D = Tank Diameter (ft)

k = Ratio Of Horizontal To Vertical Pressure In Cylinder  
(k = 0.4 For Funnel Flow)  
(k = 0.6 For Mass Flow)

Z = Head Of Solid In Cylinder (ft)

**Shell Loads From Product**

Ref: Jenike, A.W., Effect Of Solid Flow Properties And Hopper Configuration On Silo Loads

Mat'l: A36  
 Tank Diameter (D) = 13.920 ft      4243 mm  
 Actual Product Bulk Density = 35.0 pcf  
 (Ref. ACI Overpressures For Off-Center Fill,  $w = (\text{Actual Product Wt.}) \times 1.25 \times (e / (D/2))$ )  
 Inlet Radius (e) = 6.96 ft  
 Product Design Bulk Density (w) = 43.8 pcf      701 kg/m<sup>3</sup>  
 Angle Of Repose = 0.0 deg  
 Repose Centroid From Top Of Shell = 0.00 ft  
 Ratio Of Horizontal To Vertical Pressure In Cylinder (k) = 0.6  
 (k = 0.4 For Funnel Flow -or- k = 0.6 For Mass Flow)  
 u' = Coeff Of Friction Between Solid And Tank Wall = Tan 25.0 deg = 0.466  
 u = Coeff Of Friction Between Solid And Hopper Wall = Tan 15.0 deg = 0.268  
 Internal Tank Pressure (p') = 0.5 psi = 8.00 oz/in<sup>2</sup>      34.5 mBar

Ring Depth ft	Product Depth Z ft	Vertical (Hoop)		Lateral		Shell		Stress Load/t psi	Allow Stress psi	Vertical Load lb/ft	Vertical Load lbs
		Press. q psf	Press. p psf	Lateral Load lb/in	Shell t in      mm						
5.92	5.92	299	179	104	0.1875	4.8	554	15120	184	8053	
11.84	11.84	471	283	164	0.1875	4.8	874	15120	640	27984	
17.76	17.76	602	361	210	0.1875	4.8	1118	15120	1264	55294	
19.55	19.55	635	381	221	0.2500	6.4	884	15120	1475	64525	

$$\text{Vertical Pressure (q)} = \{w D [1 - (\exp(-4kuZ/D))]\} / (4 k u) + (144 p')$$

$$\text{Lateral (Hoop) Pressure (p)} = k q \Rightarrow 144 p'$$

$$\text{Lateral Load} = p (D/2) / 12$$

$$\text{Vertical Load} = (w D Z / 4) - \{(w D^2) [1 - (\exp(-4kuZ/D))]\} / (16 k u')$$

Allowable Tensile Stress  
 Base Material Fy = 36000 psi      248 MPa  
 Plate Material Allow. Stress = 0.60 Fy  
 Joint Eff. = 0.70  
 Allow. Stress w/ Joint Eff. = 0.42 Fy = 15120 psi      104 MPa

**ALLOWABLE VERTICAL LOADS**

Shell Plate

Tank Diameter = 13.920 ft                      Material: A36  
 4243 mm

Ref: Baker's Structural Analysis Of Shells, Pg. 229 & 230

Nominal Sheet/Plate Designation (in)	(mm)	Design t (in)	Above Hopper	Above Hopper	Above Hopper	Below Hopper	Below Hopper
			Use S Critical (psi)	Use S Critical (psi)	S.F. = 2.0 (lbs)	S.F. = 2.5 (lbs)	Use S Critical (psi)
0.1345	3.4	0.1345	8249	291132	232906	8249	194088
0.1875	4.8	0.1875	13535	665867	532694	13535	443912
0.2500	6.4	0.2500	20519	1345943	1076754	20519	897295
0.3125	7.9	0.3125	28094	2303545	1842836	28094	1535696
0.3750	9.5	0.3750	36000	3542209	2833767	36000	2361472
0.5000	12.7	0.5000	36000	4722945	3778356	36000	3148630
0.6250	15.9	0.6250	36000	5903681	4722945	36000	3935787
0.7500	19.1	0.7500	36000	7084417	5667534	36000	4722945
0.8750	22.2	0.8750	36000	8265153	6612123	36000	5510102

Y = Theoretical Value For Buckling Coefficient =  $1 - (0.901(1 - (\exp(-1/16 (R/t)^{0.5})))$

t = Thickness Of Shell (in)

Critical =  $2 S \pi R t$ , Total Critical Vertical Shell Load (lbs)

Critical Buckling Stress (S), Cannot Exceed	36000 psi	248 MPa
$C_c = 1 / [3 (1 - u^2)]^{0.5} =$	0.6116	
Modulus Of Elasticity (E) =	29000000 psi	199949 MPa
Inside Radius Of Shell (R) =	83.5 in	2121.4 mm
Poisson's Ratio (u) =	0.33	

**Above Hopper**

S =  $Y C_c E t / R$ , Critical Buckling Stress Of Long Cylinder (psi)

Safety Factors For Shell Buckling:

2.0...H x D < 1000 Above Hopper

2.5...H x D >= 1000 Above Hopper

**Below Hopper**

S =  $Y C_c E t / R$ , Critical Buckling Stress Of Long Cylinder (psi)

S =  $K_c (\pi^2 E / (12(1 - u^2))) (t / L)^2$ , Critical Buckling Stress Of Short Cylinder (psi)

For Short Cylinders, Y Z <  $(\pi^2 K_{co} / (2 (3^{0.5})))$

Z =  $(L^2 / R t) ((1 - u^2)^{0.5})$

L = 226.7 in From Tank Base To Hopper/Sidewall Connection

L = 5759 mm

K<sub>co</sub> = 1.0

K<sub>c</sub> =  $K_{co} + (12 Y^2 Z^2 / (\pi^4 K_{co}))$

Safety Factor For Shell Buckling:

3.0...Below Hopper



**Total Shell Loads Per Ring**

---

Ring Ht. =	5.92 ft	<u>Vertical Loads</u>		
Elev. =	5.92 ft	Static	Dynamic	
		Product =	8053	8053
		Equip. + DL =	5389	5389
		Live Load =	15218	15218
		Seismic EVL =	0	3423
				<hr/>
				32084
				/ 1.33
		TOTAL =	28661 lbs	24123 lbs

H x D = 82		<u>Shell</u>		
	Nominal Designation =	0.1875 in =	4.8 mm	
	Design Thickness =	0.1875 in =	4.8 mm	
	Allow. Vert. Load =	665867 lbs		

---

Ring Ht. =	5.92 ft	<u>Vertical Loads</u>		
Elev. =	11.84 ft	Static	Dynamic	
		Product =	27984	27984
		Equip. + DL =	7374	7374
		Live Load =	15218	15218
		Seismic EVL =	0	9935
				<hr/>
				60511
				/ 1.33
		TOTAL =	50577 lbs	45497 lbs

H x D = 165		<u>Shell</u>		
	Nominal Designation =	0.1875 in =	4.8 mm	
	Design Thickness =	0.1875 in =	4.8 mm	
	Allow. Vert. Load =	665867 lbs		

---

Ring Ht. =	5.92 ft	<u>Vertical Loads</u>		
Elev. =	17.76 ft	Static	Dynamic	
		Product =	55294	55294
		Equip. + DL =	9359	9359
		Live Load =	15218	15218
		Seismic EVL =	0	19614
				<hr/>
				99485
				/ 1.33
		TOTAL =	79872 lbs	74801 lbs

H x D = 247		<u>Shell</u>		
	Nominal Designation =	0.1875 in =	4.8 mm	
	Design Thickness =	0.1875 in =	4.8 mm	
	Allow. Vert. Load =	665867 lbs		

**Total Shell Loads Per Ring**

**Springline**

Ring Ht. = 1.79 ft  
Elev. = 19.55 ft

Vertical Loads

	Static	Dynamic
Product =	64525	64525
Equip. + DL =	10158	10158
Live Load =	15218	15218
Seismic EVL =	0	23157
		<hr/>
		113058
		/ 1.33
TOTAL =	89901 lbs	85006 lbs

H x D = 272

Shell  
Nominal Designation = 0.2500 in = 6.4 mm  
Design Thickness = 0.2500 in = 6.4 mm  
Allow. Vert. Load = 1345943 lbs

**Total Loads At Base**

Ring Ht. = 18.89 ft  
Elev. = 38.44 ft

Vertical Loads

	Static	Dynamic
Product =	124064	124064
Equip. + DL =	26000	26000
Live Load =	15218	15218
Seismic EVL =	0	71361
		<hr/>
		236643
		/ 1.33
TOTAL =	165282 lbs	177927 lbs

Shell  
Nominal Designation = 0.2500 in = 6.4 mm  
Design Thickness = 0.2500 in = 6.4 mm  
Allow. Vert. Load = 897295 lbs

## Anchor Bolt Design

Ref: AISC Part 4, ACI 349 App B & ACI 355

Phi = 0.65  
 Fu = 60000 psi  
 f'c = 3000 psi  
 s = Anchor Bolt Spacing = 25.29 in

Ft = Allowable Tensile Strength Of Anchor Bolt = 0.33 Fu Ab  
 Ab = Gross (Nominal) Area Of Anchor Bolt  
 Fut = Ultimate Tensile Strength Of Anchor Bolt = As Fu  
 As = Tensile Stress Area Of Anchor Bolt  
 Pd = Concrete Pull Out Strength = Acp (4 Phi (f'c^0.5))  
 Pd => Fut  
 Acp = Area Of Concrete Cone Radiating At 45 Deg From Bolt Head  
 Acp (req'd) = Fut / (4 Phi (f'c^0.5))  
 Ld = Embedment Depth R = Ld + (1.5 d / 2)  
 d = Anchor Bolt Diameter Ah = (1.5 d)^2 Pi / 4  
 Ab = Area Of Anchor Bolt

For Anchor Bolts Spaced => 2R

$$Acp = (Pi R^2) - Ah$$

For Circ. Anchor Bolts Spaced < 2R (Overlapping Cones)

$$Acp = (Pi R^2) - ((a - Sin(a)) R^2) - Ah$$

$$a \text{ (rad)} = 2 (\text{Cos}-1(s / 2R))$$

d (in)	Ab (in^2)	Ft Allowable (lbs/bolt)	As (in^2)	Fut Ultimate (lbs/bolt)	Acp req'd (in^2/bolt)	R req'd (in)	Ld req'd (in)	Ld Actual (in)
0.750	0.442	8747	0.334	20068	140.9	6.71	6.15	13.5
0.875	0.601	11906	0.462	27704	194.5	7.90	7.24	13.5
1.000	0.785	15551	0.606	36345	255.2	9.04	8.29	13.5
1.125	0.994	19682	0.763	45797	321.6	10.15	9.30	19.5
1.250	1.227	24298	0.969	58147	408.3	11.44	10.50	19.5
1.375	1.485	29401	1.155	69293	486.6	12.48	11.45	25.5
1.500	1.767	34989	1.405	84315	592.1	14.04	12.91	25.5

d (in)	Min. m (in)	Min. R (in)	Use Min. Edge Dist. (in)
0.750	3.35	6.71	6.71
0.875	3.93	7.90	7.90
1.000	4.51	9.04	9.04
1.125	5.06	10.15	10.15
1.250	5.70	11.44	11.44
1.375	6.22	12.48	12.48
1.500	6.86	14.04	14.04

$$m = \text{Min. Edge Distance At Bolt Head} = (0.25 \text{ Fut} / (4 \text{ Phi} (f'c^0.5) \text{ Pi}))^0.5$$

### Hopper Design (Mass Flow)

Ref: Jenike, A.W., Effect Of Solid Flow Properties And Hopper Configuration On Silo Loads & API 620 Section 3.10, & 3.12

Material: A36			
Tank Diameter (D) =	13.920 ft	4243 mm	
Hopper Outlet Diameter (d) =	5.670 ft	1728 mm	
Hopper Slope From Horz. (O) =	60 deg		
Hopper Slope From Vert. (o) =	30 deg		
Hopper Height To Apex (h) =	12.06 ft		
Hopper Height (H) =	7.14 ft		
Product Wt. (w) =	35 pcf	561 kg/m <sup>3</sup>	
Head Ht. of Product (Z) =	19.55 ft		
Area (A) =	152 ft <sup>2</sup>		
Volume (V) =	570 ft <sup>3</sup>		
Internal Tank Pressure (Pt) =	0.50 psi =	8.0 oz/in <sup>2</sup>	34.5 mBar
Equipment Load (E) =	5000 lbs	22.241 kN	
Assumed For Hopper Evaluation Only			

k = Ratio Of Horizontal Pressure To Vertical Pressure =	0.4
u = Coeff. Of Friction Between Solid And Hopper Wall = Tan 15 deg =	0.268
Vertical Pressure (q) = {w D [1-(exp(-4kuZ/D))] / (4 k u)} + (144 Pt) =	586 psf
Lateral Pressure (p) = k q =	234 psf
Pressure Caused By Solid In Hopper (q1) = w V / A =	131 psf
Total Vertical Pressure (q2) = q + q1 =	717 psf
Vertical Load (qv) = ((q2 A) + E) / (Pi D)/12 =	217 lbs/in
Horizontal Load (qh) = qv / Tan O =	126 lbs/in
Non-Dim. Solids Press. Normal To Wall, Based On Radial Stress (B) =	0.52
RADK (Dynamic) = 1/(((2/3)(1+(Tan u/ Tan o))) - (1/(6(B) Tan o))) =	2.376
n (Dynamic) = (2 RADK (1+(Tan u/Tan o))) - 3 =	3.957
RADK (Static) =	1.000
n (Static) = (2 (1.0) (1+(Tan u/Tan o))) - 3 =	-0.072

$p' = \text{Hoop Pressure Normal To Hopper Wall} = w \text{ RADK } \{((h-z) / n) + (((q/w) - (h/n)) ((1-(z/h))^{(n+1)}))\}$

#### Compression Area Design

Hoop Compressive Load (qc) = qh (D/2) 12 =	10487 lbs	
Effective Shell Compression Area =	2.00 in <sup>2</sup>	
Shell Compression Yield Stress (Fy) =	36000 psi	248 MPa
Effective Hopper Compression Area =	1.00 in <sup>2</sup>	
Hopper Compression Yield Stress (Fy) =	36000 psi	248 MPa
Min. Compression Bar Area =	0.00 in <sup>2</sup>	
Compression Bar Yield Stress (Fy) =	36000 psi	248 MPa
Total Resisting Compressive Load = Sum (A (0.5 Fy)) =	54000 lbs	

#### Hopper Allowable Tensile Stress

Plate Material Allow. Stress =	0.60 Fy	
Joint Eff. =	0.70	
Allow. Stress w/ Joint Eff. =	0.42 Fy =	15120 psi 104 MPa

Analyzed Vertical Height Down From Springline (z) = 1.00 ft = 0.30 m  
 Slope Distance From Top Of Hopper = 1.15 ft  
 Radius Normal To Hopper (r) = 7.37 ft  
 Hopper Diameter (D') = 12.77 ft  
 Hopper Area (A') = 128 ft<sup>2</sup>  
 Hopper Volume Below (V') = 430 ft<sup>3</sup>  
 Hopper Height To Apex (h') = 11.06 ft  
 Vertical Pressure (q') = {w D' [1-(exp(-4ku(Z+z)/D'))] / (4 k u)} + (144 Pt) = 591 psf  
 Lateral Pressure (p) = k q' = 237 psf  
 Vertical Load (qv') = {(((w V' / A') + q') A') + E} / (PI D') / 12 = 199 lbs/in

Nominal Designation = 0.2500 in  
 t = 6.4 mm  
 Design Thickness (t) = 0.2500 in  
 t = 6.4 mm  
 Allowable Tensile Stress = 15120 psi

Horz. Seam Design (T1)

T1 = qv' / Sin O = 230 lbs/in  
 Radial Tensile Stress = T1 / t = 919 psi

Radial Seam Design (T2)

p' (Static) = 579 psf  
 p' (Dynamic) = 982 psf  
 p' = 982 psf  
 T2 = (p' r) / 12 = 603 lbs/in  
 Hoop Tensile Stress = T2 / t = 2413 psi

**Pressure Check For Deck**

Tank Diameter (D) =	13.92 ft =	167.0 in	4243 mm
Deck Slope From Horz. (O) =	10 deg		
Internal Tank Pressure (P) =	0.50 psi =	8.00 oz/in <sup>2</sup>	34.5 mBar
Deck Thickness (Th) =	0.2500 in		6.4 mm
Top Ring Thickness (Tc) =	0.1875 in		4.8 mm
Area Of Reinforcing Member (Ar) =	0.125 in <sup>2</sup>		81 mm <sup>2</sup>
Deck To Be Welded On	2 Side(s) To Sidewall		
Weld Thickness =	0.1345 in		3.4 mm
Weld Throat (Tw) =	0.0951 in		2.4 mm
Density (q) =	0.2833 pci		
Tank Cross-Sectional Area (A) =	21915 in <sup>2</sup>		
Radius Normal To Shell (Rc) =	6.96 ft =	83.5 in	
Radius Normal To Deck (Rh) =	40.08 ft =	481.0 in	

		<b>Ey</b>	
Deck Sheet:	S1 =	36000 psi	248 MPa
Top Ring:	S2 =	36000 psi	248 MPa
Reinforcement:	S3 =	36000 psi	248 MPa
Weld:	Sw =	36000 psi	248 MPa

**Deck To Sidewall Junction Analysis**

Wh = 0.3 (Rh Th) <sup>0.5</sup> =	3.290 in
Wc = 0.6 (Rc Tc) <sup>0.5</sup> =	2.374 in
Ah = Wh Th =	0.822 in <sup>2</sup>
Ac = Wc Tc =	0.445 in <sup>2</sup>

**Allowable Pressure (Pa)**

Pa = [(30800 (Ah + Ac + Ar) Tan O) + (8 Th)] 0.578 = 23.72 oz/in<sup>2</sup> 102.2 mBar

**Weld Allow Pressure (Pwa)**

Pwa = Weld Qty. (16 {Tw (0.4 Sw) Sin O / (Rc)}) = 91.12 oz/in<sup>2</sup> 392.6 mBar  
 Allowable Pressure = 23.72 oz/in<sup>2</sup> 102.2 mBar

**Deck Sheet Analysis**

Vertical Pressure = P =	0.50 psi
Vertical Load (qv) = P A / (Pi D) =	21 lbs/in
Plate Material Allow. Stress =	0.60 S1
Joint Eff. =	0.70
Allow. Stress w/ Joint Eff. =	0.42 S1 = 15120 psi 104 MPa

**Radial Tension Design (T1)**

T1 = qv / Sin O = 120 lbs/in  
 Stress = T1 / Th = 481 psi <= 15120 psi

**Hoop Tension Design (T2)**

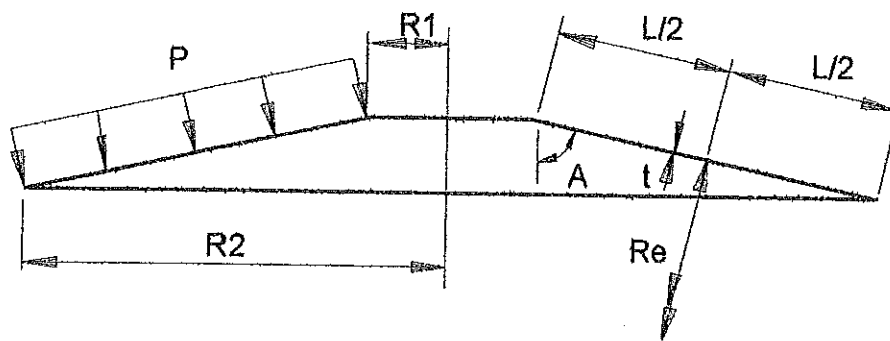
T2 = P Rh = 240 lbs/in  
 Stress = T2 / Th = 962 psi <= 15120 psi

## DECK DESIGN

Ref: Baker's Structural Analysis of Shells, Pg. 251

Material: A36

R1 =	10 in	254.0 mm
R2 =	83.5 in	2121.4 mm
Deck Thickness (t) =	0.2500 in	6.4 mm
Roof Slope From Horiz. =	10 deg	
Deck Live Load =	100 psf	488.2 kg/m <sup>2</sup>
Deck Dead Load =	11.2 psf	
Vacuum Load On Deck =	4.5 psf	= 0.6 oz/in <sup>2</sup>
P = Total Load =	115.7 psf	565.1 kg/m <sup>2</sup>
Modulus Of Elasticity (E) =	29000000 psi	199949 MPa
Yield Strength (Fy) =	36000 psi	248 MPa



$$S_{cr} = K_p [3.1416^2 E / (12 (1 - \nu^2))] [(t / L)^2] [R2 / (R_e \cos A)]$$

Poisson's Ratio ( $\nu$ ) =	0.33
Roof Slope From Vert. (A) =	80 deg
$R_e = (R1 + R2) / (2 \cos A) =$	269.28 in
$L = (R2 - R1) / \sin A =$	74.65 in
$Z = (L^2 / (R_e t)) ((1 - \nu^2)^{0.5}) =$	78.15
From Fig. 10-30, $K_p =$	6.72

$S_{cr} =$	3602 psi $\leq F_y$
Use... $S_{cr} =$	3602 psi

$$P_{cr} = [S_{cr} (t) \cos A / R2] 144$$

$P_{cr} =$	269.6 psf
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$$\text{Safety Factor} = P_{cr} / P = 2.3$$

### Vacuum Check For Shells

Ref. Structural Analysis Of Shells, Baker, pg 236

$$\text{Stress} = K_p \{ \pi^2 E / (12(1-\nu^2)) \} (t/L)^2$$

$$P_{cr} = \text{Critical Vacuum} = \text{Stress } t / R$$

$$Z = \{ L^2 / (R t) \} (1-\nu^2)^{0.5}$$

$$K_p \text{ (For Lateral \& Axial Pressure)} = 1.04 (Z^{0.5})$$

$$p' = \text{Allowable Vacuum} = 16 \{ [K_p \{ \pi^2 E / (12(1-\nu^2)) \} (t/L)^2] t / R \} / 2$$

Tank Diameter =	13.92 ft	4243 mm
Vacuum =	0.50 oz/in <sup>2</sup>	2.2 mBar
Tank Radius (r) =	83.5 in	2121 mm
Modulus of Elasticity (E) =	29000000 psi	199949 MPa
Poisson's Ratio (ν) =	0.33	

Ring	Ring Thickness		Ring Ht.		Total Ring Ht.	Average Thickness	Z	Kp	Allowable Vacuum p'	Vacuum
	(in)	(mm)	(in)	(mm)	(in)	(in)				
1	0.1875	4.8	71	1804	71	0.1875	304	18.1	60.7	> 0.50
2	0.1875	4.8	71	1804	142	0.1875	1217	36.3	30.37	> 0.50
3	0.1875	4.8	71	1804	213	0.1875	2738	54.4	20.25	> 0.50
SL	0.2500	6.4	21	544	235	0.1932	3218	59.0	19.83	> 0.50



**Loadings At Tank Base**

Customer: Norit Americas  
 Sales Order Number: 00-1793  
 Date: 08/16/00  
 Engineer: Shedd

Tank Diameter =	13.920 ft	4.243 m
Tank Height =	38.44 ft	11.717 m
Hopper Angle =	60.00 deg	
Hopper Opening =	5.67 ft	1.728 m
Hopper Clearance =	11.75 ft	3.581 m
Tank Volume =	3545 cf	100 m <sup>3</sup>
Bulk Density =	35 pcf	561 kg/m <sup>3</sup>
Product:	Activated Carbon	
Deck Live Load =	100 psf	488.2 kg/m <sup>2</sup>
Equipment Weight =	1000 lbs	4.4 kN
Wind Velocity =	90 mph	Exp C
Seismic Zone =	0.10 = Aa	V = 0.056 W

BOCA 1999  
 BOCA 1999

I = 1.15

Product Load =	124.064 kips	551.9 kN
Total Tank Dead Load + Equip. =	26.000 kips	115.7 kN
Total Tank Live Load =	15.218 kips	67.7 kN
Base Shear Wind =	11.943 kips	53.1 kN
Overturning Moment Wind =	243.396 kip-ft	330.0 kN-m
Base Shear Seismic =	9.182 kips	40.8 kN
Overturning Moment Seismic =	248.337 kip-ft	336.7 kN-m

*Shedd*  
 8-22-2000