634 COMPANION DOCUMENT

Guidance for Following the WI NRCS 634, Waste Transfer Standard.

The information provided here includes recommendations and considerations. The information is intended to provide the designer examples of how to comply with the standard. The standard provides the criteria for waste transfer design.

Edited by Amanda Crowe
10-10-12

Agricultural Waste Management Field Handbook
Notice WI-33, October 2012

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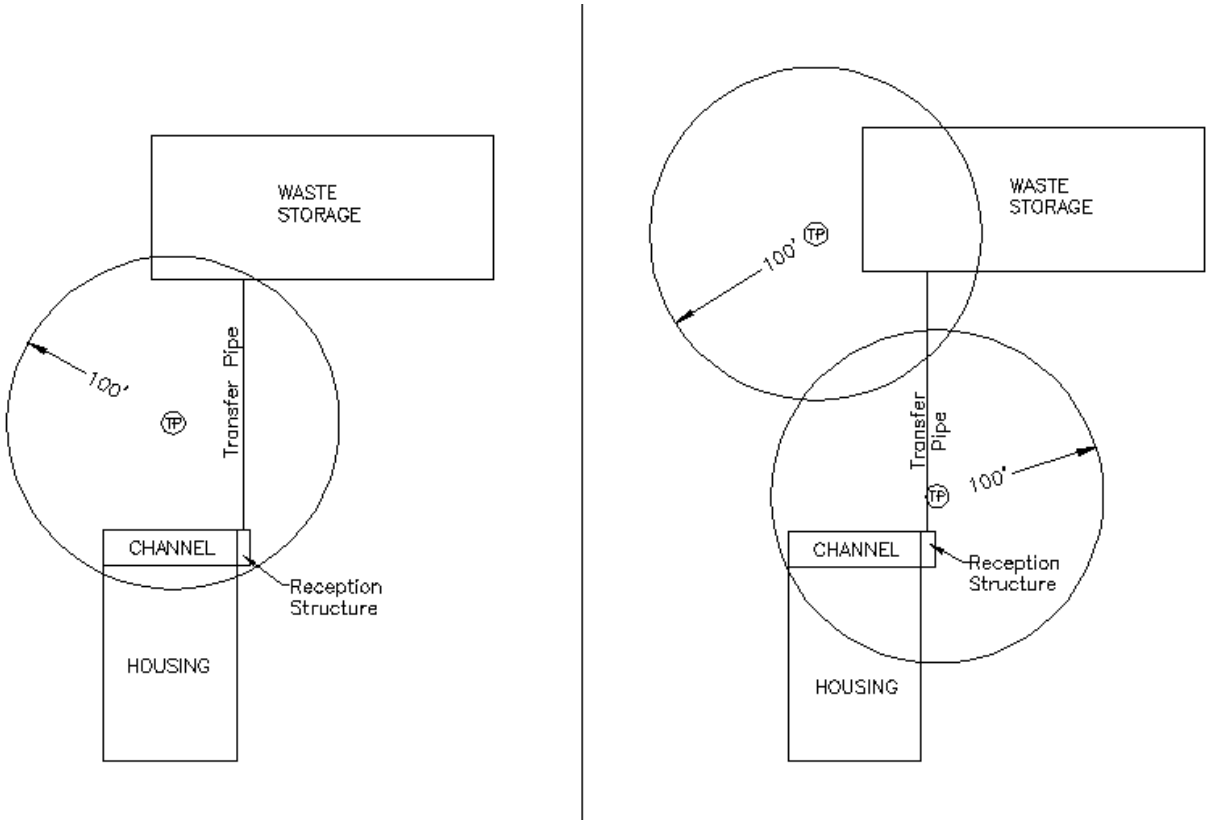
SUBSURFACE SOIL INVESTIGATION EXAMPLES



TP = Test Pit

Both examples meet the minimum requirement of the WASTE TRANSFER standard (NOTE these distances do NOT apply to waste storage facilities.) The designer must decide if additional test pits are needed to characterize the site.

At a minimum, subsurface investigations for reception structures, channels and transfer pipes in the animal production area shall be placed such that no portion of the structure, channel or pipe is greater than 100 linear feet from a subsurface investigation point.

Each soil investigation can be used for multiple components. These examples show a soil investigation being used for the waste transfer line, channel, and the reception structure.

LEAK TESTING OF POLYETHYLENE PIPE (PE), HIGH DENSITY POLYETHYLENE PIPE (HDPE), AND POLYVINYL CHLORIDE (PVC)

This publication is for informational purposes and is intended for use as a reference guide for leak testing of Polyethylene Pipe (PE), High Density Polyethylene Pipe (HDPE), and Polyvinyl Chloride (PVC). It should not be used in place of the advice of a professional engineer.

Leak testing may be used to find leaks in a newly constructed or newly modified piping system or in an established system where an apparent loss of integrity has been experienced. If they exist, leaks typically occur at joints or connections in the system.

Leak testing does not verify pressure rating or potential long-term performance. The system design and the pressure ratings of the installed components are the sole determinants of system pressure rating and long-term performance.

Safety is of paramount importance. Leak tests can apply high stress to untried joints and parts in the system. Failure can occur by leaking or by catastrophic rupture that can cause sudden, violent movement. In some cases, leakage may immediately precede catastrophic rupture.

It shall be the responsibility of the contractor to ensure that appropriate safety precautions are observed during testing.

WARNING – Ensure that there is no air trapped in the test section. Failure with entrapped air can result in explosive release and result in death or serious bodily injury. Use equipment vents at high points to remove air.

WARNING – Death or serious injury and property damage can result from failure at a joint or connection during pressure leak testing. Keep all persons a safe distance away during testing. The test section is to be supervised at all times during the test.

Ensure that all piping is restrained against possible movement from catastrophic failure at a joint or connection. When pressurized, faulty joints or connections may separate suddenly causing violent and dangerous movement of piping or parts. Correctly made joints do not leak.

Leakage at a joint or connection may immediately precede catastrophic failure. Never approach or attempt to repair or stop leaks while the test section is pressurized. Always depressurize the test section before making repairs.

Polyethylene (PE)

Leak testing is described in ASTM F2164, "Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure."

Before applying pressure, all piping and all components in the test section must be restrained. This means that if piping or parts move or separate during the test, it will not result in damage or injury. ***Never conduct leak tests on unrestrained piping.***

- Heat fusion joints must be properly cooled before testing.
- Mechanical connections must be completely installed and tightened per manufacturer's instructions.
- If backfill provides restraint, it must be properly placed and compacted. Joints and connections may be exposed for inspection.
- End closures must be suitable for pressure service and pressure-rated for the test pressure.
- Ensure that all connections to test equipment are secure. Disconnect or isolate all low pressure filling lines and all other parts that are not to be subjected to test pressure. Restrain, isolate or remove expansion joints before leak testing.

Testing may be conducted on the full system or in sections. Test section length is determined by the capacity of the testing equipment. Lower capacity pressurizing or filling equipment may not be capable of completing the test within permissible time limits. If so, use higher capacity test equipment or select a shorter test section.

Before applying test pressure, allow time for the test fluid and the test section to equalize to a common temperature.

Do not subject lower pressure rated, non-polyethylene parts or devices to pressures above their pressure rating. Lower pressure rated parts may be removed or isolated from the test section to avoid damage or failure. Vent isolated parts or equipment to atmosphere.

High Density Polyethylene Pipe (HDPE)

Procedure for HDPE pipe (listed below) is from the PPI Technical Report TR-31 by the Plastic Pipe Institute.

The test procedures consist of two steps; the initial expansion and the test phase. When test pressure is applied to a water filled pipe, the pipe expands. During the initial expansion of the pipe under test, sufficient make-up water must be added to the system at hourly intervals for 3 hours to maintain the test pressure. After about 4 hours, initial expansion should be complete and the actual test can start.

Polyvinyl Chloride (PVC)

Procedure listed below is from the Uni-Bell PVC Pipe Association Publication 9-10 "Installation Guide for PVC Pressure Pipe"

Preparation of the PVC pipe includes sufficiently backfilling the pipe (approximately 1 -1.5 times the pipe diameter) to prevent lifting of the pipe. Testing should begin only after the pipe has been properly filled, flushed, and purged of all air. The test pressure shall not exceed the design pressure of the pipe, fittings, valves, or thrust restraints. All visible leaks shall be stopped. All defective elements shall be repaired or removed and replaced and the test repeated until the test requirements have been met.

UPLIFT DESIGN EXAMPLE FOR RECEPTION STRUCTURES (BUOYANCY)

Depending on the site conditions, uplift or buoyancy forces may be large enough to displace the reception structure. This typically occurs when the soil is wet and the tank is empty. The reception structure may be able to resist the buoyancy forces based on the weight of the reception structure itself, or the design may need to be altered. To check the buoyancy forces compare the weight of the tank with the weight of the water. Below is an example reception structure design for a rectangular tank.

If the reception structure is small it may be appropriate to include the weight of the walls, the soil directly above the footings and the tank lid (as done in this example). For larger structures it may be more appropriate to only use the weight of the slab, as the slab could fail due to uplift but the walls could stay in place. Alternatively, the slab could be designed structurally to resist the buoyant uplift forces. **The designer must determine the appropriate method to use.**

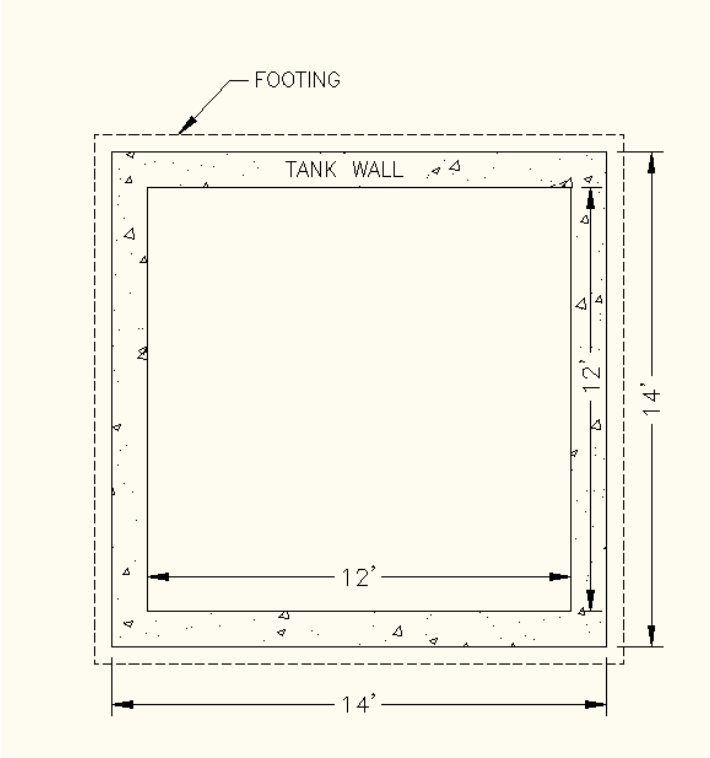
NOTE: The designer must determine the condition values.

Example Condition Values

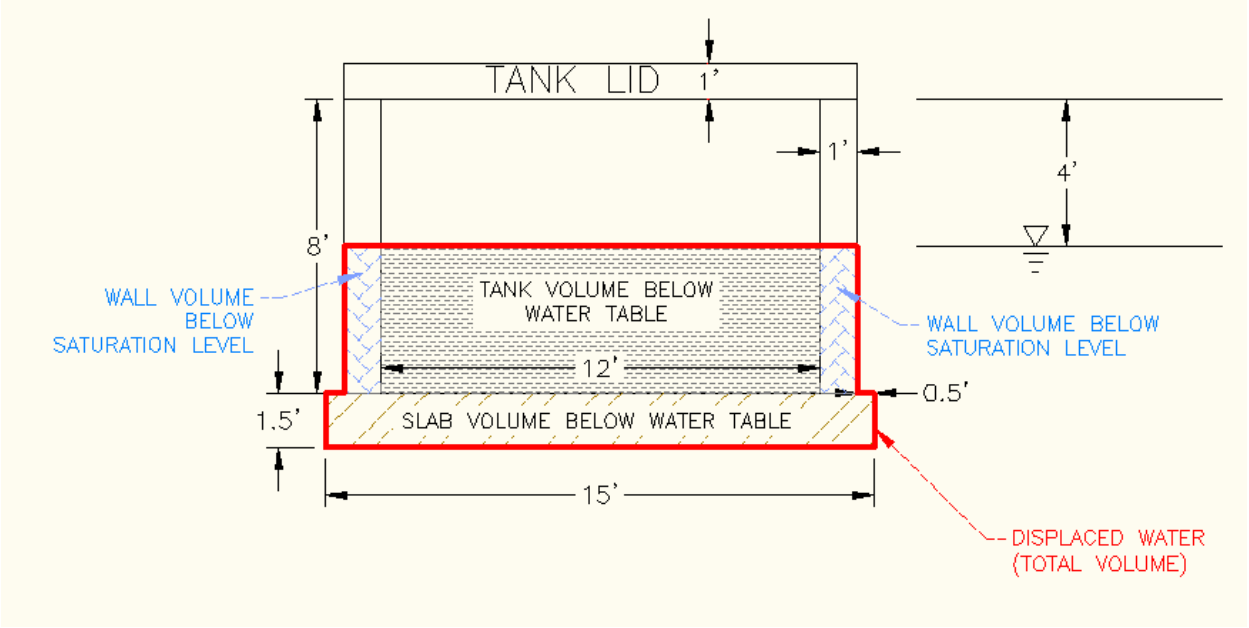
Weight of Concrete: 145 lb/ft^3
Weight of Water: 62.4 lb/ft^3
Weight of Dry Soil: 100 lb/ft^3 *(this is the soil that is backfilled around the reception structure and is exerting forces on the structure itself. Dry soil will give a more conservative answer; moist soil weight can also be used).*
Weight of Saturated Soil: 130 lb/ft^3 (*this is the soil that is completely saturated or has potential to be completely saturated).*

Example Reception Structure Details

Tank Dimensions:	12'W X 12'L X 8'D
Wall Thickness:	12"
Backfill Height:	7' (4' is saturated)
Wall Footing: & bottom of slab	18" Thick Extends 6" beyond the wall *considered to be fixed
Tank Lid:	1' Thick (assumed not to be fixed)



Top View



Cross Section View

CALCULATION STEPS

Determine Weight of Reception Structure

Weight of Walls = length * height * thickness * weight concrete
(14’ + 14’ + 12’ + 12’) * 8’ * 1’ * 145 lb/ft^3 = 60,320 lbs

Weight of Bottom Slab = length * width * thickness * weight concrete
(14’ + 1’) * (14’ + 1’) * 1.5’ * 145 lb/ft^3 = 48,937.5 lbs

Weight of Lid = length * width * thickness * weight concrete
(14’ + 1’) * (14’ + 1’) * 1’ * 145 lb/ft^3 = 32,625 lbs

Weight of Reception Structure = 60,320 + 48,937.5 + 32,625 = **141,882.5 lbs**

Determine Weight of Soil on Footing

Calculate the Soil area above the Footing = [(15’ * 15’) – (14’ * 14’)]
= 29 ft ^{2}

Calculate the Submerged Unit Weight = saturated unit weight of soil –
unit weight of water
130 lb/ft^3 - 62.4 lb/ft^3 = 67.6 lb/ft^3

Calculate the Submerged Soil Weight = Unit Weight of Saturated Soil * Height
67.6 lb/ft^3 * 4’ Saturated Backfill height
= 270.4 lb/ft^2

Calculate the Dry Soil Weight = Unit Weight of Dry Soil * Height
100 lb/ft^3 * 3’ Dry Backfill height
= 300 lb/ft^2

Calculate the Total Soil Weight = weight saturated soil + dry soil
= 270.4 lb/ft^2 + 300 lb/ft^2 = 570.4 lb/ft^2

Calculate the Weight of Soil on Footing = area of soil * weight soil
= 29 ft $^{2 *}$ 570.4 lb/ft$^{2 =}$ **16,541.6 lbs**

Determine Buoyancy Force

Area of Bottom Slab = length * width
(14' * 14') = 196 ft^2

Water Pressure = water head * unit weight of water
(height of saturated soil + slab thickness) * 62.4 lb/ft^3
(4' + 1') X 62.4 lb/ft^3 = 312 lb/ft^2

Buoyancy Force = area * pressure
196 ft^2 * 312 lb/ft^2 = **61,152 lbs**

Calculate the Factor of Safety

Ensure there is a suitable margin of safety between the uplifting forces and the weight of the structure that could cause buoyancy. A recommended minimum Factor of Safety of 1.3 should be used[1].

Safety Factor of the Structure = total resisting load / buoyancy force
(141,882.5 lbs + 16,541.6 lbs) / 61,152 lbs ~**2.59**

How to Increase your Factor of Safety

If your Factor of Safety is below the recommended 1.3 then the following methods can be used to increase the margin.

1) Increase the footing size
2) Increase the slab thickness
3) Increase the backfill height
4) Drain the water around the footing (lower the saturated soil level)

Sources:

[1] "3-8. Factors of Safety for Flotation" United States Corps of Engineers EM 1110-2-2100. Dec 2005. http://140.194.76.129/publications/eng-manuals

"Rectangular Concrete Tanks", 5th edition. 1998.

FAILURE ANALYSIS PLAN EXAMPLE *(must be modified for the specific site)*

Evaluate typical component failure scenarios so they may be prevented or resolved through system design solutions. Document in the O & M the component failure scenarios that cannot be prevented. Operations & Maintenance Plan shall instruct the operator as to what action might be taken to resolve the problem.

1) Transfer Pipe Blockage

   a) Design Solutions

      i) Cleanout valves installed at 150 ft maximum spacing.

      ii) Transfer line continuously sloped back toward reception structure to allow flushing of transfer line back to reception structure.

      iii) Valve located at storage facility to allow use of cleanouts when basin is full.

      iv) Pump & pipes configured so that load stand may be used for daily hauling while bypassing main transfer line.

      v) Air blow system installed in order to prevent and/or remove blockage.

   b) Operations & Maintenance Solutions

      i) Manually empty reception structure to allow back flushing back to reception structure.

      ii) Close in-line valves to prevent backflow from storage facility during pipe maintenance.

      iii) Remove cleanout covers to allow for jetting and/or vacuuming transfer lines.

      iv) If lines remain blocked, transfer manure to spreader with load stand.

      v) Do not over pressurize line with air blow system.

   c) Emergency Response Plan Solutions

      i) Contain effluent in field or waterway.

      ii) Prevent spill from entering “waters of the state.”

      iii) Report spill to authorities & clean up immediately.

2) Transfer Pipe Breakage

   a) Design Solutions

      i) Adequate pipe material and sizing shall be specified in construction plan in accordance with system design.

      ii) Consider installing backup system options.

   b) Operations & Maintenance Solutions

      i) Discontinue use of failed system components.

      ii) Implement backup system if available.

      iii) Repair system after re-evaluation of cause of failure.

c) Emergency Response Plan Solutions

i) Contain effluent in field or waterway.

ii) Prevent spill from entering “waters of the state.”

iii) Report spill to authorities & clean up immediately.

3) Cross Channel Blockage

a) Design Solutions

i) Port in reception structure cover allows for direct cleaning of scrape alley to reception tank if required.

ii) Recirculation line installed to allow effluent from reception structure to be recirculated through channel to aid in cleaning of channel.

iii) Removable channel covers to allow access.

b) Operations & Maintenance Solutions

i) Scrape directly into reception structure or manually haul while channel is being repaired.

ii) Periodically flush channel with recirculated water to reduce solids buildup in channel that may cause blockage.

c) Emergency Response Plan Solutions

i) Contain effluent in field or waterway.

ii) Prevent spill from entering “waters of the state.”

iii) Report spill to authorities & clean up immediately.

4) Crossover Pipe between two Storage Facilities with Different Top Elevations (could lead to overflow of lower storage facility).

Plugging of crossover pipe between storage facilities:

a) Design Solutions

i) Install two valves on crossover line in order to isolate pipe from storage facilities.

ii) Install bidirectional cleanouts.

iii) Install second crossover line with valves and/or manually pump material between storage facilities.

b) Operations & Maintenance Solutions

i) Keep both valves closed at all times unless crossover pipe is being operated.

ii) Exercise valves periodically to reduce risk of cease up of valves.

iii) Open one valve and clean to opposite storage facility, if possible.

iv) Utilize backup crossover line.

v) Manually pump material between storage facilities.

vi) Exercise vales periodically to reduce risk of cease up of valves.

vii) Close valves prior to removing cleanout caps

c) Emergency Response Plan Solutions

i) Contain effluent in field or waterway.

ii) Prevent spill from entering “waters of the state.”

iii) Report spill to authorities & clean up immediately.

5) Overflow of Waste Material onto Lot, etc.

a) Design Solutions

i) Lot / alley / or other overflow containment area shall be made relatively impervious per NRCS practice standards as required.

ii) Overflow containment area shall have required temporary storage volume and freeboard capacity.

b) Operations & Maintenance Solutions

i) Maintain planned overflow containment area in a condition that could accept overflow while maintaining required freeboard.

ii) VTA or other designed treatment area shall be maintained in good working order.

c) Emergency Response Plan Solutions

i) Contain effluent in field or waterway

ii) Prevent spill from entering “waters of the state”

iii) Report spill to authorities & clean up immediately.

QUALITY ASSURANCE PLAN EXAMPLE *(must be modified for the specific site)*

A. Site and Contact Information

The project is located in _____ County, in the town of ____. T__N, R__E, Sec.__.

The owner is_____ phone number is_____ mobile number_____.

The primary project quality assurance (QA) inspector for this project will be ___(name), ____(title) LCD/NRCS/DATCP/PE

_____,_____ (phone# , alt. #__).

Alternate project QA inspectors include _____ (phone #) and _____ (phone #).

Agency/Regulatory Quality Assurance Staff include _____(name)_____ (phone #).

B. Introduction and Project Description –Narrative Format

The work to be completed on this project shall consist of construction of a new waste transfer system that includes a reception structure that is X' W * X' L * X' D, a X" type (ASTM XXXX SCH/SDRXX) transfer pipe that is XX ln ft, and a XX pump.

This project is designed according to the following NRCS practice standards: 634- Waste Transfer

Applicable NRCS Wisconsin Construction Specifications are: 2-Excavation, 3-Earthfill, 4-Concrete, 15-Plastic Pipe Conduits, and 634-Waste Transfer Pipes.

This is a NRCS Job Approval Class **XX** project based on the design XXX of the XXXX. The original plan was submitted by ____ and approved by ____ of the ____ LCD/NRCS/DATCP/PE. **Any changes to this construction plan must be approved by ____.**

C. Identification and Responsibilities of Key Parties (To be established before construction begins):

1. **Owner (Name, Phone, Responsibilities):** May serve as General Contractor. Keep Agency informed of progress. Follow all federal/state/local laws, zoning regulations. Be available for consultations. Meet program requirements. Host site showing/preconstruction meeting. Hire competent contractors. Notify utilities about construction. Authorize contractor to start work. Protect cultural & historical resources. Verify plans & specifications are met. Shut down job for safety reasons. Stop work of contractor, when justified. Seed and fence, as required. Pay bills. Complete items in construction plan not hired out.

2. **Designer (Name, Phone, Responsibilities):** Assist owner with site showing. Inform owner of safety responsibility. Certify materials, components and that the entire system meets standards and specifications. Inform landowner if contractor is not following construction plan. Prepares as-built drawings.

3. **Project QA Inspector (Name, Phone, Responsibilities):** Inform owner of safety responsibility. Follow the QA plan. Observe and inspect construction, perform needed surveys, verify materials, maintain job diary, and make tests in order to determine that construction meets requirements of the plan. Inform landowner and designer if contractor is not following construction plan. Provide data to the person attesting to the construction.

4. **Contractor(s) (Name, Phone, Responsibilities):** Read and follow construction plans and specifications. Must have foreman on site. Must have all required materials and equipment on site. Use materials specified in construction plan (no substitutions without prior approval by the designer). Use dimensions in construction plan (no alterations without prior approval by the designer). Check utility locations. Follow OSHA requirements. Practice safety at all times. Provide adequate notice to Agency before starting job. Keep Agency informed of progress. Document materials used. Meet plans & specifications. Repair or replace improper construction.

5. **Certifying (Attesting) entity (Name, Phone, Responsibilities):** Construction approval upon verification all components meet standards and specifications.

6. **Regulatory entity (Name, Phone, Component):**

D. Pre-Construction Meeting

Prior to starting work, the project QA inspector and designer shall meet and discuss the project with the contractor and the landowner. That discussion should include these items and others as appropriate:

1. **Review QA plan**
   - What documentation is needed
   - When will construction start
   - Items that require inspection or testing and the timing of the inspections
   - Safety precaution, utilities, and any information needing clarification by the technical agencies
2. **Construction plans and specifications**
   - Who will do what, when
   - Equipment to be used.
   - Material acquisition.
3. **Change orders**
   - Who can authorize and approve
   - Material changes
4. **Review responsibilities of Key Parties**
   - Owner
   - Designer
   - Project QA Inspector
   - Contractor(s)
   - Certifying (Attesting) entity
   - Regulatory entity

E. Quality Assurance

Inspection will be intermittent during the construction period and at the times stated in the QA Plan. The project QA inspector will visit the site as needed during construction to see that the work is completed according to the plans specifications.

1. **Items to be inspected and sequencing**

   All materials shall be inspected to insure that they meet NRCS practice standards and Wisconsin Construction Specifications.

2. **Surveying, staking and benchmark**

3. **Notification of need for inspection**

   It is the responsibility of the Landowner and/or the Contractor to notify the project QA inspector at least 24 hours prior to the needed inspection of the items listed below.

4. **Onsite testing**

F. Data Collection and Documentation

WASTE TRANSFER ITEMS TO BE INSPECTED

Transfer Pipe Placement

1. Check each section of pipe for defects of damage from handling. ☐Completed
2. Verify pipe diameter (X") type (ASTM_____ SCH/SDR___) –circle in plan. ☐Completed
3. Check excavation, subgrade elev. is correct –circle in plan. ☐Completed
4. Ensure the backfill material is adequate and compaction requirements are met. ☐Completed

Cast in Place Concrete Reception Structure

5. Verify the separation distance to bedrock or water, document depths and soil types
6. Check fill material to ensure it meets Spec 3 and compaction is achieved. ☐Completed
7. Check subgrades–circle in plan. ☐Completed
8. ***It is required that the project QA inspector be on site after the steel is placed, but before the concrete is poured.***
9. Check rebar spacing, size, and condition. Be sure rebar is clean. Be sure the rebar is probably chaired above subgrade -circle in the plan. ☐Completed
10. Check that waterstop, dowels, etc. are secured in place at the proper location. ☐Completed
11. Check forms to be sure they are smooth and clean on the inside. Ensure forms are oiled before placement, and rebar is free from debris and oil. ☐Completed
12. Concrete Batch Tickets shall be provided to the project QA inspector during inspection and follow Spec 4.
13. Verify slump of the concrete. Attach slump readings, date and truck number. Note where concrete was placed.
14. Check the final concrete grades-circle on the plan. ☐Completed
15. Check if the curing compound was applied correctly. ☐Yes ☐No
16. Wall forms shall remain in place at least 24 hrs. _____time/date of pour _____time/date of form removal.
17. Document tie removal with cavity patch with non-shrink grout. ☐Completed _____date
18. Walls shall not be backfilled for at least 7 days after pour. _____time/date of pour _____time/date of fill
19. Check backfill fill grades. Ensure drainage away from site. ☐Completed

Seeding

20. Check the placement of topsoil has adequate coverage and is deep enough. ☐Completed
21. Check that seed is planted at the proper time of year and that mulch is applied. ☐Completed

Fence

22. Verify the fence meets current fence standard criteria.

Fence is_____ date_____

G. As-built Plans and other Certification (Attesting) Documentation

___(name), ____(title)___ LCD/NRCS/DATCP/PE, will provide construction approval and attest the project meets applicable standards. As-built plans must be prepared and all documentation will be provided from the project QA inspectors.

SALT (STRUVITE) BUILD UP IN PIPES

Source: "Crystallization in Lagoon Effluent Recycle Lines" Charles Fulhage. Published by University of Missouri Extension. April 2003.

Struvite, which is a crystal made of magnesium, ammonium, and phosphate ($MgNH_4PO_4 \cdot 6H_2O$) can cause problems in waste transfer systems. Struvite is especially common in waste systems that recycle anaerobic effluent water from the waste storage, such as flush flume systems. Common components that can have struvite build up include the pump impellers, pipes, flush tanks, flush gutters and drain lines. Problems resulting in the struvite buildup include leaking seals, decrease in pump performance, and reduced flow (or no flow) in pipes. How severe the struvite build up can become depends on the chemical makeup of the effluent, the transfer system components, and flow rates in the transfer system. However, there may be other factors so predicting the severity is very challenging.

At this time there is not a simple, feasible method to preventing struvite, but there are some design practices that can help control struvite.

1. (For systems that recirculate grey water) Properly sizing the waste storage. Under sizing the waste storage results in higher concentration ions, thus increasing the possibility of struvite.
2. Avoid using metallic components in the waste transfer system when possible. This implies using pumps with plastic impellers, plastic pipe, plastic valves, etc. (Note. Plastic valves may not work well with system that handle sand laden manure.)
3. Keep the number of elbow and wye fittings to a minimum. Changes in direction allow for more accumulation of struvite than straight pipe. Long radius bends are preferable over short radius bends.
4. Increase the pipe diameter to increase the pipe cross sectional area, in order to allow for some buildup without excessive losses of performance.

Common practices to remove struvite include:

1. Acid washing (use of a descaling product) on a regular basis is the most common method. Circulation of the acid wash has proven more effective than filling the lines and letting the solution sit. Be sure to follow all label instructions and use safety precautions when using acids. If struvite is completely blocking the flow, acid washing will not be effective and the entire system may have to be replaced.
2. High pressure washing can be effective if used at the proper pressure and flow. Use of a "sewer nozzle" or "jetter" has been found to work well and has a forward facing port that discharges water at a high velocity and a rear facing port that forces the nozzle forward through the pipe. Systems must have long straight pipe and long radius elbows for the hose to pass easily.

Image from Tamilnadu Agricultural University, India. http://www.tnau.ac.in/

OPERATION AND MAINTENANCE PLAN *(must be modified for the specific site)*

WASTE TRANSFER

Cooperator: _____ Date: _____

By: _____ Title: _____

Project Location: _____

PROJECT DESCRIPTION

The transfer system was designed for: (describe the waste stream, animal type, numbers, bedding, and any additional pertinent items considered in the design of the system), and how the system is intended to operate.

The working pressure (maximum designed operating pressure of the transfer system) is_____. **NOT to exceed the maximum pressure if a clean out it needed**. The transfer system pressure rating (lowest pressure rating of any pipe, pipe fittings, and other appurtenances) is _____.

The work to be completed on this project shall consist of: (describe the size and type of the system including reception structures, pumps, pipes, etc. and how and where the waste is being transferred to).

OPERATION and ROUTINE INSPECTION

1. The following is the list of routine inspection and testing of the waste transfer system components, appurtenances, and safety features: (describe in full detail the frequency of the inspection and testing and how the inspection or testing shall be completed).

2. The following start-up and shutdown procedures shall be used in the operation of the pumped transfer systems: (provide detailed instructions on how the pump shall be operated specific to starting the pump and shutting off the pump).

3. Make certain that all electrical equipment is properly grounded and wiring is in good working condition.

4. Operate system in a manner that minimizes odor and air drift.

CONFINED SPACE OPERATION

Confined Space Operation shall follow ASABE Standard EP470.

The following summary includes practices used for enhancing safety, but is not an all inclusive list and does not include all possible hazardous confined space situations.

5. The location of safety equipment should be clearly marked and equipment should be stored in proper conditions (i.e. warm, dry area). Equipment may have expiration dates; frequent checks should be made to ensure equipment is in operational condition. Emergency Contact numbers should be posted near all confined space entry locations, all telephone locations and in all buildings.

6. If it is necessary to enter a confined space, such as a reception tank, waste storage, etc. then specialized equipment must be used by those qualified to do so. Additional practices are needed and include, but not limited to, shutting off any manure pumps, ventilating at a proper rate, testing the air for oxygen and toxic gas levels, attaching a safety harness and rope to the working person with at least one person standing by to help with a mechanical retrieval device, and having an extra set of proper respirator equipment for the person standing by.

7. Consult with your physician if you have been exposed to toxic gases including hydrogen sulfide (H_2S) or ammonia (NH_3) in concentrations severe enough to cause irritation to the respiratory tract (as indicated by difficulty in breathing).

MAINTENANCE

1. The following is a schedule of maintenance items for all mechanical components (power unit, pump, drive train, etc.) in accordance with the manufacturer's recommendations:

2. The following is a schedule of maintenance of debris removal and/or cleaning operations (such as jetting, air blasting, rodding, flushing, etc.).

3. The following is a schedule of inspection and maintenance of the following safety requirements (such as fences, gates, signs, etc).

4. Maintain all pumps, agitators, pipes, valves, electrical and mechanical equipment in good operating condition following the manufacturer's recommendations.

5. Maintain all safety shields on pumps, motors, electrical or mechanical equipment.

6. All fencing, railings, grates and/or warning signs shall be maintained to prevent unauthorized human or livestock entry.

7. Reception structures or hoppers must not be entered without proper preventions because they may contain noxious gases. When it becomes necessary for someone to enter one for repairs, follow ASABE Standard 470.

8. Immediately repair any vandalism, vehicular or livestock damage to the system.

9. Repair spalls, cracks and weathered areas in concrete surfaces.

8. Repair or replace rusted or damaged metal. Protect with paint.

FAILURE ANAYLSIS ACTIONS (Operation and maintenance needed to avoid potential component failure).

EMERGENCY RESPONSE ACTIONS (see Emergency Response Plan)

Emergency Response Plan

Farm Name: _____

Owner/Operator: _____ Phone:_____ Cell:_____

Owner/Operator: _____ Phone:_____ Cell:_____

Farm Address:_____

Farm Location: T _____ N, R _____ E / W Section _____ County:_____

Driving Directions or Emergency Coordinates:_____

_____

In Case of Injury, Fire, or Rescue Emergency, Immediately Implement the Following:

1. Assess the condition of the victim, extent of the emergency (fire, rescue) and call for help.
2. Stabilize the victim, use on-site rescue equipment, evacuate buildings, or begin fire suppression as necessary.
3. Brief emergency responders upon arrival on current status of situation.

In Case of a Spill, Leak, or Failure at the Storage Facility, During Transport, or Land Application, Immediately Implement the Following:

1. Stop the source of the leak or spill. For example:
   - Turn off all pumps/valves and clamp hoses or park tractor on hoses to stop the flow of manure.
2. Assess the situation and make appropriate calls for people, equipment, and materials. See contacts below.
   - Notify DNR spill hotline: 1-800-943-0003 (Spill reporting is mandatory by state law.)
   - Call sheriff's office if spilled on public roads or its right-of-ways for traffic control.
   - Clear the road and roadside of spilled material immediately.
3. Contain the spill and prevent spillage from entering surface waters, tile intakes, or waterways.
   - Use a skid loader or tractor with a blade to build dikes to contain or divert the spill or leak.
   - Insert sleeves around tile intakes (or plug/cap intakes) and block down slope culverts.
   - Use tillage implements to work up the ground ahead of the spill or use absorptive materials.
4. Begin cleanup.
   - Use pumps to recover liquids.
   - Land apply on approved cropland at appropriate rates.

5. Document your actions. **Emergency Contacts**	**Contact Person (or Company)**	**Phone Number**
Fire/Rescue		911 or
County Sheriff		911 or
Farm Emergency Coordinator		
DNR Hazardous Spill Line		1-800-943-0003
DNR Permit Contact/Warden		
Veterinarian		
Equipment/Supplies	**Contact Person (or Company)**	**Phone Number**
On-Farm Equipment Operator		
Excavation Contractor		
Manure Hauler		
Septic Tank Pumping Truck		
Mortality Disposal Contractor		
Local Government Contacts	**Contact Person**	**Phone Number**
Town Chairman		
LCD County Conservationist		
NRCS District Conservationist		

Be prepared to provide the following information:

- Your name and contact information
- Farm address, location and other pertinent identification information.
- Nature of emergency (employee injury, fire, discharge of manure or hazardous materials).
- Emergency equipment and personnel that are needed.
- Potential for manure or hazardous materials to reach surface waters or major field drains.
- Current status of containment efforts.
- Location of hazardous/flammable materials, fire suppression equipment, emergency cut off switches or valves.

ADDITIONAL RECOMMENDATIONS SPECIFIC TO THE TRANSFER SYSTEM:

AGREEMENT

The following cost share program was used to fund the waste transfer system _____.

I agree to perform the operation and maintenance items for the next _____ years.

Cooperator's signature: _____ Date: _____

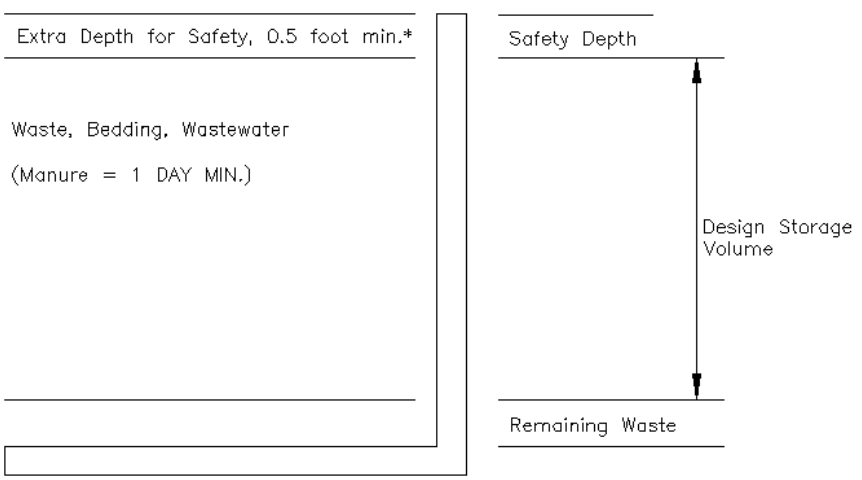
I have discussed the operation and maintenance guidelines with the above cooperator.

Conservationist's signature: _____ Date: _____

SIZING RECEPTION STRUCTURES

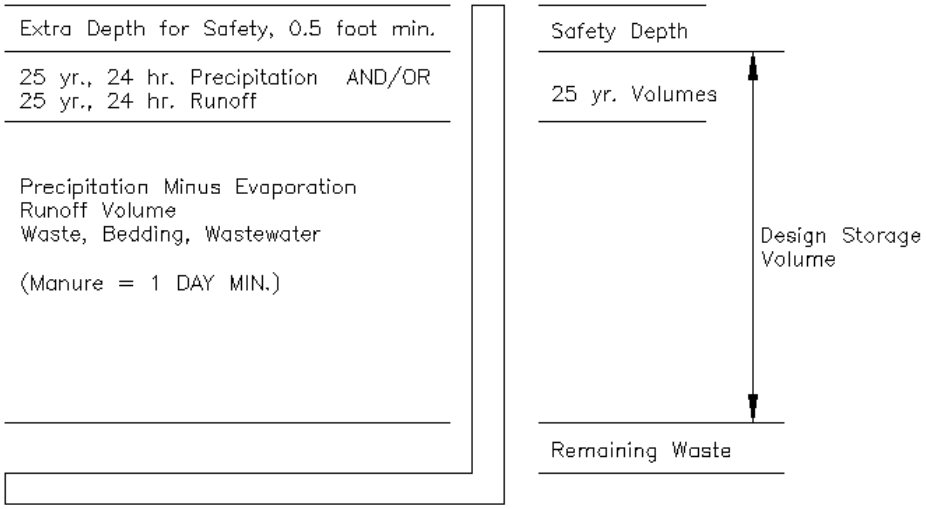
RECEPTION STRUCTURES RECEIVING MANURE

WI NRCS Standard 634 Section V.B.1.c.(1)(i): Reception structure without precipitation and runoff collection (Roof or Covered Structure)

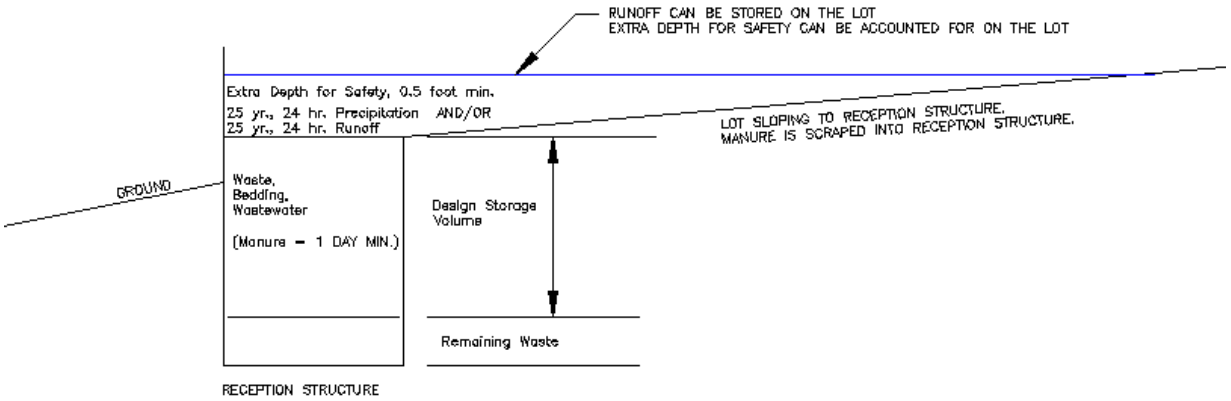


* Under floor structures should have 1' extra depth of safety.

WI NRCS Standard 634 Section V.B.1.c.(1)(ii): Reception structure with precipitation and runoff collection.

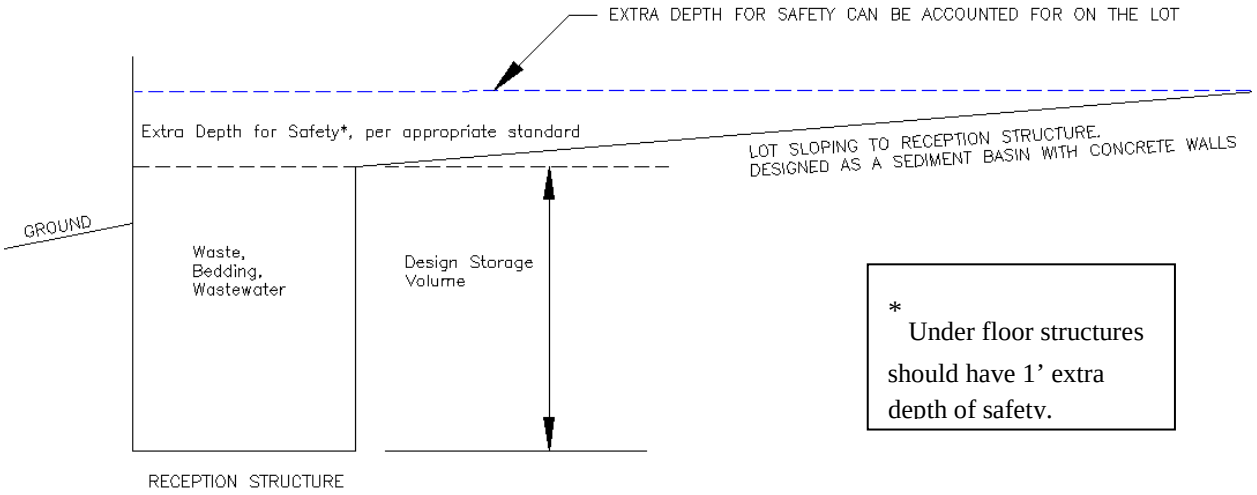


WI NRCS Standard 634 Section V.B.1.c.(1)(ii): Reception Structure with storage in waste system (typically barnyard or feed storage runoff systems).

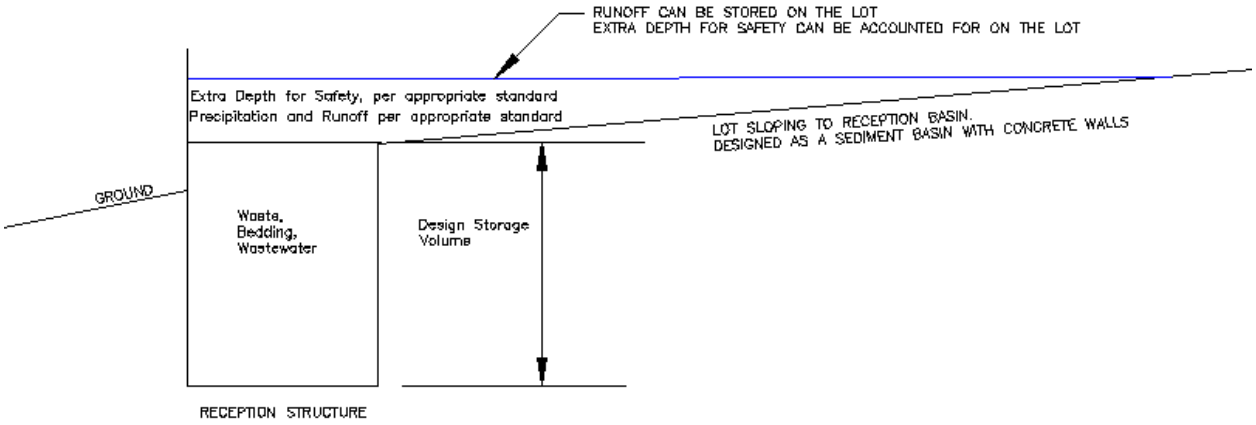


RECEPTION STRUCTURES RECEIVING RUNOFF OR WASTEWATER

WI NRCS Standard 634 Section V.B.1.c.(2)(i): Reception structure without precipitation and runoff collection (roofed or covered structure). Designed per the appropriate standards (i.e. sediment basin) typically barnyard or feed storage runoff system.



WI NRCS Standard 634 Section V.B.1.c.(2)(ii): Reception Structure designed per the appropriate standard (i.e. sediment basin), typically barnyard or feed storage runoff systems.



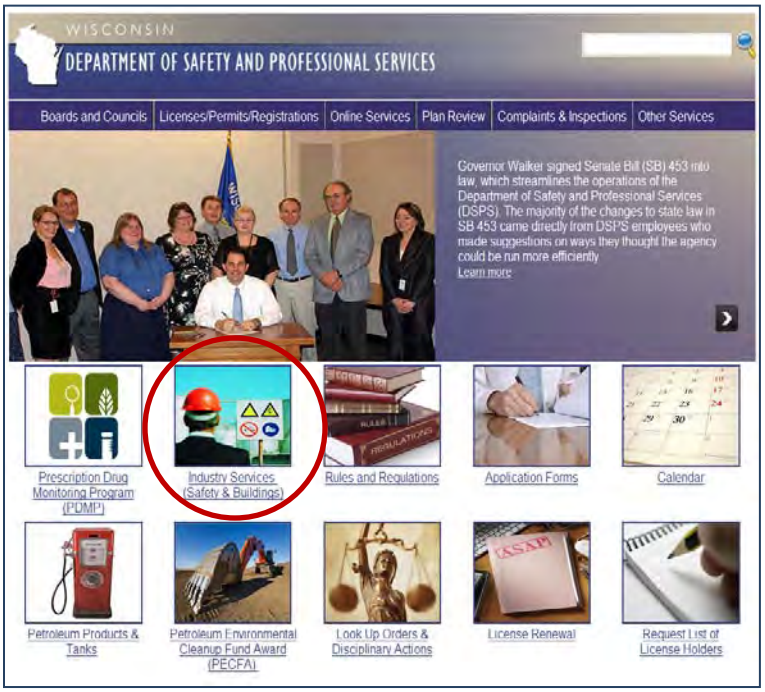
DEPARTMENT OF SAFETY AND PROFESSIONAL SERVICES (DSPS) APPROVAL DATABASE

These instructions are current as of November 7, 2012.

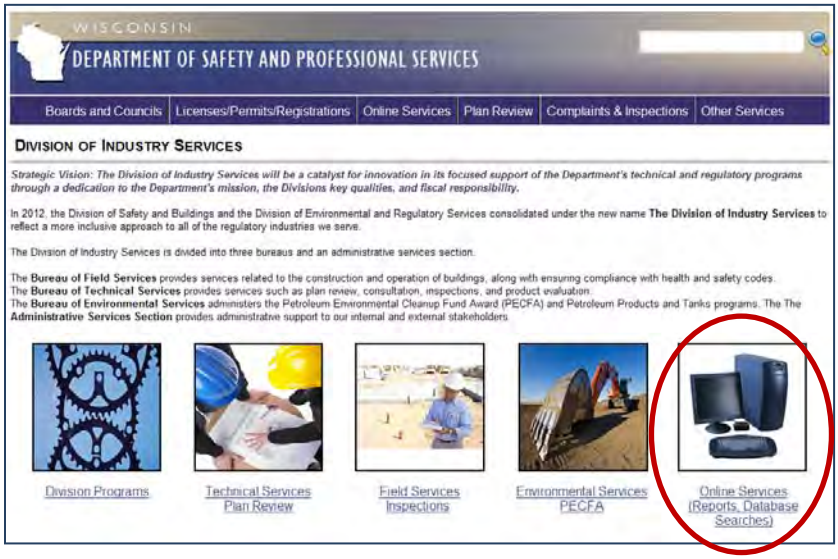
Navigating the Wisconsin Department of Safety and Professional Services website to find approved products.

1. Go to the Wisconsin Department of Safety and Professional Services homepage: http://dsps.wi.gov/.

2. Select ***"Industry Services (Safety & Buildings)"***

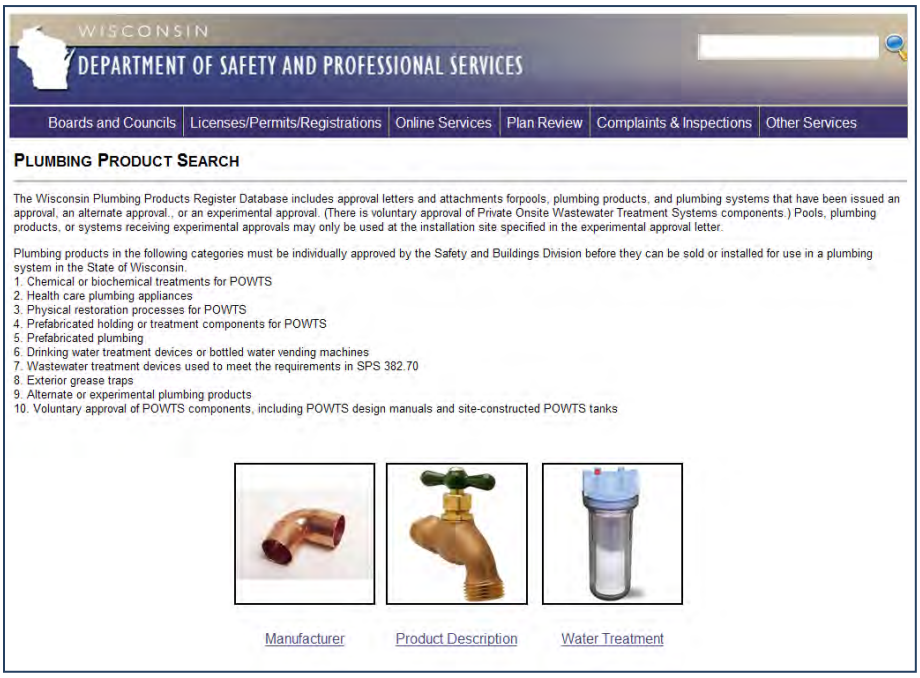


3. Select ***"Online Services (Reports, Database Searches)"***

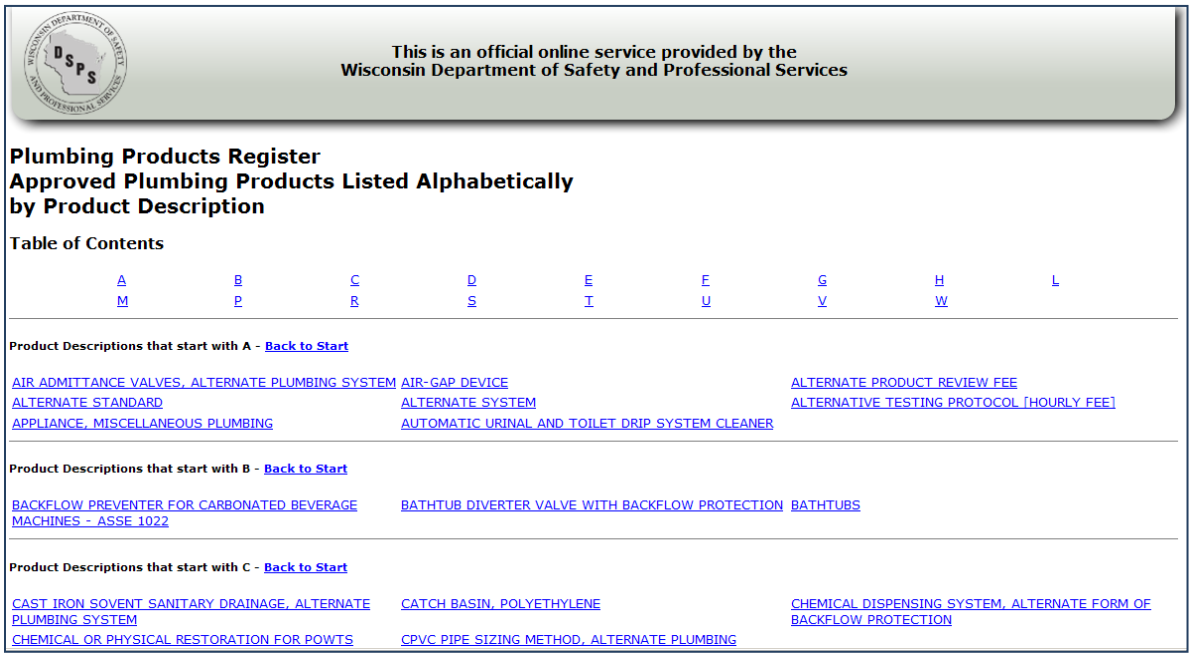


4. Under the heading, “Product Related”, select ***“Plumbing Products Search”***

5. From this point, search by ***“Manufacturer”*** or ***“Product Description”***.



6. Click on ***"Product Description" (***or ***"Manufacturer"*** if known).



This is an official online service provided by the
Wisconsin Department of Safety and Professional Services

Plumbing Products Register
Approved Plumbing Products Listed Alphabetically by Product Description

Table of Contents

A B C D E F G H L
M P R S T U V W

Product Descriptions that start with A - Back to Start

AIR ADMITTANCE VALVES, ALTERNATE PLUMBING SYSTEM
AIR-GAP DEVICE
ALTERNATE PRODUCT REVIEW FEE
ALTERNATE STANDARD
ALTERNATE SYSTEM
ALTERNATIVE TESTING PROTOCOL [HOURLY FEE]
APPLIANCE, MISCELLANEOUS PLUMBING
AUTOMATIC URINAL AND TOILET DRIP SYSTEM CLEANER

Product Descriptions that start with B - Back to Start

BACKFLOW PREVENTER FOR CARBONATED BEVERAGE MACHINES - ASSE 1022
BATHTUB DIVERTER VALVE WITH BACKFLOW PROTECTION
BATHTUBS

Product Descriptions that start with C - Back to Start

CAST IRON SOVENT SANITARY DRAINAGE, ALTERNATE PLUMBING SYSTEM
CATCH BASIN, POLYETHYLENE
CHEMICAL DISPENSING SYSTEM, ALTERNATE FORM OF BACKFLOW PROTECTION
CHEMICAL OR PHYSICAL RESTORATION FOR POWTS
CPVC PIPE SIZING METHOD, ALTERNATE PLUMBING

7. Scroll down to the bottom of the screen to **Product Descriptions that start with S** and select ***"SEWAGE TANKS, CONCRETE"***

This is an official online service provided by the
Wisconsin Department of Safety and Professional Services

Go back to the Product Description Alphabetical Listing start page

Plumbing Products Register

Products approved for:
SEWAGE TANKS, CONCRETE

AL'S CONCRETE PRODUCTS INC.
AL'S CONCRETE PRODUCTS, INC.
ANDERSEN CONSTRUCTION
ANDRY RASMUSSEN & SONS, INC.
ANTIGO BLOCK CO., INC.
CHAMPION, INC.
CHURCHILL CONCRETE & STONE LLC
COUNTY MATERIALS CORP.
CREST PRECAST, INC.
CRIVITZ REDI-MIX CO.
DALMARAY CONCRETE PRODUCTS, INC
DEL ZOTTO PRODUCTS INC
DEL ZOTTO PRODUCTS, INC.
DTR CONCRETE PRODUCTS, LLC
EVERGREEN CONCRETE PRODUCTS
FRANCIS MELVIN INC.
GREATENS SEPTIC SERVICE, INC.
GROVE CONCRETE & SUPPLY INC.
H & H PRECAST
HELBACH EXCAVATING
HUFFCUTT CONCRETE, INC.
IRON CITY ENTERPRISES, INC.
LAKE SHORE BURIAL VAULT CO. INC.
LAKE SHORE BURIAL VAULT CO., INC.
LEDGEVIEW PRECAST CONCRETE, INC.
LEWIS BJORK, LLC
MARSHFIELD WILBERT VAULT WORKS, INC.
MEADE CONSTRUCTION CO., INC.
MIDWAY CONCRETE CORPORATION
MURPHY SEPTIC SERVICE
MURPHY SEPTIC SERVICE
N.E.W. TANKS, INC
ONEIDA CONCRETE PRODUCTS, INC.
PROCON
SCHMALZ PRECAST CONCRETE
SHERIDAN SEPTIC TANKS
SKAW PRE-CAST
TRAPP BROTHERS, INC.
TRI-COUNTY PRECAST LLC
TRI-COUNTY PRECAST, LLC
VAN GOETHEM SEPTIC SYSTEMS, INC.
VAN HANDEL CONCRETE PRODUCTS
WEEKS CONCRETE PRODUCTS
WEIS CAST
WENDT'S SEWER & EXCAVATING, INC.
WIESER CONCRETE PRODUCTS, INC.
WIESER CONCRETE PRODUCTS, INC.

At the top of each screen is a list of companies that carry the specified product type (in this case, concrete sewage tanks). Scrolling down, there is a list of companies, contact information, products, and product descriptions.

8. Stipulations for each product can be accessed by selecting the Product File No. of interest.

   For example, choose the first product that comes up for Concrete Sewage Tanks, under Al's Concrete Products, Inc., Product File No. 20110130

AL'S CONCRETE PRODUCTS INC.
Attention: BRUCE WIESER
800 TOWNHALL RD
LA CRESCENT, MN 55947
Telephone: 507-895-4509
Fax: 507-895-6805

Go to top of page

Product Name: HOLDING, SEPTIC/SEPTIC, SEPTIC/PUMP, SEPTIC/SIPHON, SEPTIC/SEPTIC/SEPTIC, SEPTIC/SEPTIC/PUMP, SEPTIC/SEPTIC/SIPHON
Model Number(s): 2250/750 (3000- two or three compartment) (47 IN. L.L., 32/32 GAL/IN, 96 IN. MAX. BURY DEPTH, 1436 G.P.D. WHEN USED AS A SEPTIC/SEPTIC TANK OR 1078 G.P.D. WHEN USED AS A SEPTIC/PUMP OR SEPTIC/SIPHON TANK BASED ON A 3 YR. SERVICE INTERVAL FOR RESIDENTIAL WASTEWATER; TANK DIMENSIONS = 168 IN. L X 107 IN. W X 47 IN. H)
Product File No: 20110130

Product Name: SEPTIC, HOLDING, PUMP OR SIPHON
Model Number(s): 1000 LP OVAL (37.0 IN. L.L., 27.3 GAL/IN., 96 IN. MAX. DEPTH OF BURY, 1067 GALS. HOLDING TANK; 484 G.P.D. WHEN USED AS A SEPTIC TANK BASED ON A 3 YR. SERVICE INTERVAL FOR RESIDENTIAL WASTEWATER; TANK DIMENSIONS = 95 IN. L X 77 IN. W X 37 IN. H)
Product File No: 20100448

Product Name: SEPTIC, HOLDING, PUMP OR SIPHON
Model Number(s): 1000 LP RECT. (37.0 IN. L.L., 27.4 GAL/IN., 96 IN. MAX. DEPTH OF BURY, 1070 GAL. AS HOLDING TANK; 486 G.P.D. WHEN USED AS A SEPTIC TANK BASED ON A 3 YR. SERVICE INTERVAL FOR RESIDENTIAL WASTEWATER; TANK DIMENSIONS = 92 IN. L X 84 IN. W X 37 IN. H)
Product File No: 20100447

Product Name: SEPTIC, PUMP, HOLDING
Model Number(s): 2000 X LOW 2085 GAL. SEPTIC, 2209 GAL. HOLDING, 2085 GAL. PUMP [32 IN. L.L., 96 IN. MAX. DEPTH OF BURY; 942 G.P.D. WHEN USED AS A SEPTIC TANK BASED ON A 3 YR. SERVICE INTERVAL FOR RESIDENTIAL WASTEWATER; TANK DIMENSIONS = 158 IN. L X 92 IN. W X 32 IN. H]
Product File No: 20120102

9. A product-specific document will open. The stipulations are listed as bullet points.

commerce.wi.gov
Wisconsin Department of Commerce

SAFETY AND BUILDINGS DIVISION
Plumbing Product Review
P.O. Box 2658
Madison, Wisconsin 53701-2658
TTY: Contact Through Relay

Scott Walker, Governor
Paul F. Jadin, Secretary

May 3, 2011

AL'S CONCRETE PRODUCTS INC.
BRUCE WIESER
800 TOWNHALL RD
LA CRESCENT MN 55947

Re: Description: SEWAGE TANKS, CONCRETE
Manufacturer: AL'S CONCRETE PRODUCTS INC.
Product Name: HOLDING, SEPTIC/SEPTIC, SEPTIC/PUMP, SEPTIC/SIPHON, SEPTIC/SEPTIC/SEPTIC, SEPTIC/SEPTIC/PUMP, SEPTIC/SEPTIC/SIPHON
Model Number(s):2250/750 (3000- two or three compartment)
(47 IN. L.L., 32/32 GAL/IN, 96 IN. MAX. BURY DEPTH, 1436 G.P.D. WHEN USED AS A SEPTIC/SEPTIC TANK OR 1078 G.P.D. WHEN USED AS A SEPTIC/PUMP OR SEPTIC/SIPHON TANK BASED ON A 3 YR. SERVICE INTERVAL FOR RESIDENTIAL WASTEWATER; **TANK DIMENSIONS = 168 IN. L X 107 IN. W X 47 IN. H)**
Product File No: 20110130

The specifications and/or plans for this plumbing product have been reviewed and determined to be in compliance with chapters Comm 82 through 84, Wisconsin Administrative Code, and Chapters 145 and 160, Wisconsin Statutes.

The Department hereby issues an approval based on the Wisconsin Statutes and the Wisconsin Administrative Code. **This approval is valid until the end of MARCH 2014.**

This approval is contingent upon compliance with the following stipulation(s):

- This tank must be designed to withstand the pressures to which it will be subjected.
- The manufacturer must keep at the manufacturing plant a set of plans and specifications bearing the department's stamp of approval. The plans and specifications must be open to inspection by an authorized representative of the department.
- When this product has an effluent filter installed in an interior wall, the space between the top of the interior wall and bottom of the tank cover must be sealed with a material that will withstand the environment in the tank and in a manor that will prevent waste from passing over the interior wall.
- When this product receives wastewater from dwellings and is used as a septic tank, it will produce an effluent quality with a maximum monthly average value for BOD5 of greater than 30 mg/L and less than or equal to 220 mg/L TSS, or greater than 30 mg/L or less than or equal to 150 mg/L TSS, and F.O.G. of less than 30 mg/L.
- **Bedding: A minimum of 4 in. sand or gravel bedding overlying a firm and uniform base is recommended, unless otherwise specified. Tanks should not bear on large boulders or massive rock edges. Correct compaction of bedding material is critical to ensure there is no differential settling.**
- **BACKFILL: Sidewall backfill must consist of material 100% of which will pass through a 2-in. screen and**

ULTRAVIOLET (UV) PROTECTION OF ABOVEGROUND PIPE

Aboveground pipe can be protected from Ultraviolet (UV) degradation by painting the pipe, burying the pipe, putting a sleeve or wrapping around the pipe, or shading the pipe. Some pipe, such as polyethylene (PE), can have an ultraviolet light resistance agent mixed into the PE raw material, such as 2% carbon black).

The presence of an opaque surface between the sun and the pipe prevents UV degradation, since UV radiation will not penetrate thin shields such as paint coatings or wrappings. Polyvinyl chloride (PVC) pipe should be covered with an opaque material while permitting adequate air circulation around the pipe. This prevents excessive heat accumulation.

Burial provides complete protection.

To properly apply paint to PVC and PVC you must follow the following steps:

1. Clean the pipe and fittings of oil, dust and grime by wiping with a naphtha-based fluid.

2. Spray or paint on a **water based latex paint**. Water based latex products are readily available in most paint and hardware stores. It is recommended to use one coat of light pigmented colors, such as white, for their heat reflection capabilities and their ultraviolet resistance.

3. Dry for one day. System is serviceable in 24 hours.

Use of lacquers, varnishes, or stains is **NOT** recommended because their solvents may attack the PVC and CPVC surfaces.

THERMAL EXPANSION AND CONTRACTION OF PIPE

Source: NRCS National Engineering Handbook Part 636, Chapter 52

All pipe products expand and contract with changes in temperature. Typically buried pipe for NRCS applications will not experience significant changes in temperature and thermal stress or dimension change will be minimal. However, changes in the ambient temperature prior to backfilling around the pipe may lead to excessive expansion or contraction. Therefore, the backfill should be placed as construction progresses (if possible).

Various pipe joints that allow some movement because of expansion and contraction are available. Gasketed pipe joints (such as bell and spigots) for plastic, steel, or ductile iron pipe and expansion joints for steel pipe allow some movement at the joint. The allowable movement at the joint should be obtained for the particular joint and compared to the length change caused by a change in temperature. Welded steel or plastic pipes or solvent cemented plastic pipes do not allow movement at the joint.

LENGTH CHANGE

Unrestrained pipe will experience a length change with changing temperature. The length may be estimated by:

$$\Delta L = L_{ur}\,\alpha\Delta T$$

where:

ΔL = change in length, inches
L_{ur} = length of unrestrained pipe, inches
α = coefficient of thermal expansion, in/in/°F
ΔT = change in temperature, °F

STRESS CHANGE

A pipe restrained or anchored at both ends will experience a change in stress with changing temperature because of expansion and contraction. The longitudinal stress in the pipe wall caused by temperature changes may be estimated by:

$$S_{ec} = E\,\alpha\Delta T$$

where:

S_{EC} = stress due to temperature change, lb/in2
E = short term modulus of elasticity, lb/in2
α = coefficient of thermal expansion, in/in/°F
ΔT = change in temperature, °F

Pipe Material	Coefficient of Thermal Expansion (in/in/°F)
PVC	3.0x10–5
HDPE	1.2x10–4
ABS	5.5x10–5
Aluminum	1.3x10–5
Ductile Iron	5.8x10–6
Steel	6.5x10–6

(210-VI-NEH, First Edition, June 2005) Source: AWWA, 2002

Material	Modulus of Elasticity (lb/in^2)	
PVC	400,000 (short term)*	140,000 (long term)*
ABS	300,000 (short term)*	65,000 (long term)*
Polyethylene	110,000 (short term)*	22,000 (long term)*
Steel Aluminum Ductile iron	29,000,000 10,000,000 24,000,000	

* Modulus of elasticity varies with the cell class of each plastic. Specific values may be obtained from the manufacturer.

Modulus of Elasticity Adjustments based on Temperature Factors

The modulus of elasticity (E) of plastic pipe is a function of the temperature. Since the temperature change does not occur rapidly, the average temperature is recommended for use in determining the appropriate modulus of elasticity. The modulus of elasticity should be adjusted for temperature by the factors shown in table below:

Temperature ^oF	PVC factor	ABS factor	PE factor
73.4	1.00	1.00	1.00
80	0.88	0.94	0.92
90	0.75	0.84	0.81
100	0.62	0.68	0.7
110	0.5	0.56	0.65
120	0.4	0.49	0.6
130	0.3	0.44	0.55
140	0.22	0.4	0.5

(210-VI-NEH, First Edition, June 2005) Source: Uni-Bell, 2001; ASTM 1176, 1993; and Plastic Pipe Institute, 2003

THRUST CONTROL

Source: NRCS National Engineering Handbook Part 636, Chapter 52

Abrupt changes in pipeline grade, horizontal alignment, or reduction in pipe size normally require an anchor or thrust blocks to absorb any axial thrust of the pipeline. Thrust control may also be needed at the end of the pipeline and at in-line control valves.

Thrust blocks and anchors must be large enough to withstand the forces tending to move the pipe, including those of momentum and pressure as well as forces due to expansion and contraction. The positioning of the thrust blocks must consider whether connections adjacent to the thrust block are capable of movement, as well as the anticipated direction of movement.

The internal pressure of a pipe acts perpendicular to any plane with a force equal to the pressure, P, times the area of the pipe, A. The radial forces within the pipe are balanced by the tension in the pipe wall. The axial components of pressure through a straight section are balanced by the same pressure in the opposite direction.

The pipe manufacturer's recommendations for thrust control shall be followed. In the absence of the pipe manufacturer's requirements, the following equation can be used in designing thrust blocks:

$A = [98HD^2)/B]\sin (a/2)$

Where:

A = Area of thrust block required in ft^2
H = Maximum working pressure in feet
D = Inside diameter of pipe in feet
B = Allowable bearing pressure of the soil in lb/ft^2
a = Deflection angle of pipe bend in degrees

Note: The bearing areas of thrust blocks for dead ends, risers, and tees shall be 0.7 times the bearing area required for a 90° deflection angle pipe bend. "ZEE" pipe thrust blocks shall be calculated as for 45° deflection angle pipe bends.

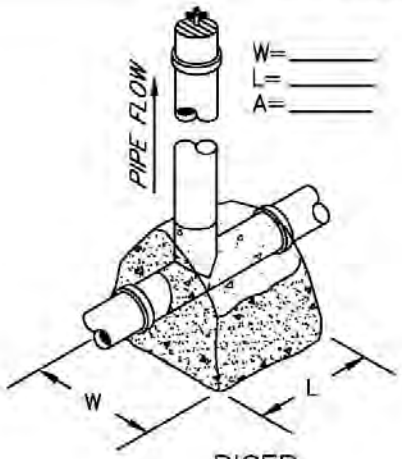
If adequate soil tests are not available, the bearing soil pressure may be estimated from Table 52-6 of NEH Part 636 Chapter 52 (also below).

Allowable Soil Bearing Pressure in lb/ft^2

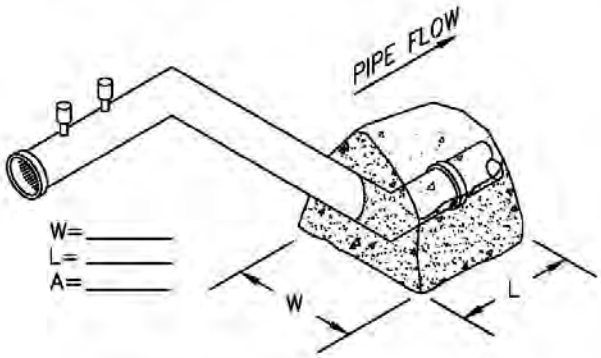
Natural soil material	Depth of cover to center of thrust block			
	2 ft	3 ft	4 ft	5 ft
	lb/ft^2			
Sound Bedrock	8,000	10,000	10,000	10,000
Dense sand and gravel mixture (assumed θ=40°)	1,200	1,800	2,400	3,000
Dense fine to coarse sand (assumed θ=35°)	800	1,200	1,650	2,100
Silt and clay mixture (assumed θ=25°)	500	700	950	1,200
Soft clay and organic soils (assumed θ=10°)	200	300	400	500

Source: 210-VI-NEH, First Edition, June 2005

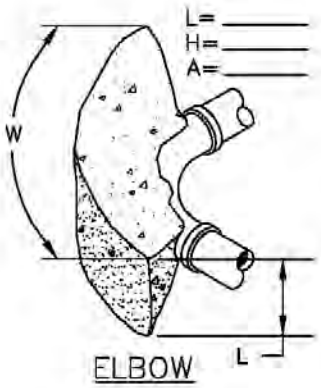
NOTE: STANDARDIZED DESIGNS – MUST BE ADAPTED TO THE SPECIFIC SITE



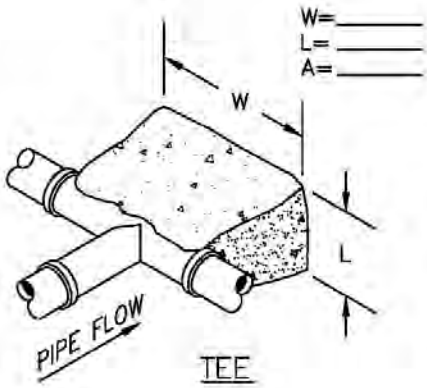
RISER



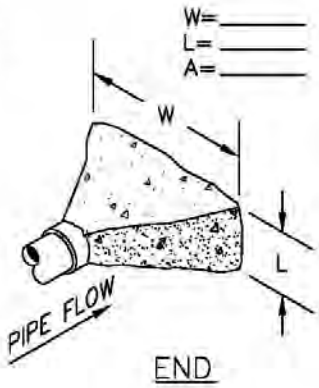
ZEE FITTING



ELBOW



TEE



END

NOTES:

A= MIN. BEARING AREA REQUIRED. (W x L)

THRUST BLOCKS SHALL:
- BE CAST IN PLACE,
- MIN. THICKNESS OF CONCRETE AROUND PIPE = 8".
- AT PIPE TO CONCRETE CONTACT, EXTEND BELOW THE BOTTOM OF THE PIPE AND ABOVE THE TOP OF THE PIPE.
- BE PLACED AGAINST UNDISTURBED OR COMPACTED TRENCH WALL.
- MIN. COMPRESSIVE STRENGTH 3500 PSI CONCRETE.

IT IS NOT NECESSARY TO FORM THRUST BLOCKS.

ZEE FITTING BLOCKS SHALL BE PLACED ON MIN. 1' LAYER OF COMPACTED GRAVEL.

NRCS Natural Resources Conservation Service United States Department of Agriculture	CONCRETE THRUST BLOCK CLIENT: #### COUNTY: ####	Designed #### Date #### Drawn Checked Approved	Drawing Name WI-XXX Date 6/2010 Sheet X of ###

Design and installation of thrust blocks from Part 636 Structural Engineering National Engineering Handbook. Chapter 52 Structural Design of Flexible Conduits.

Thrust blocks are required at: abrupt changes in pipeline direction: horizontal and vertical, elbows, reductions in pipe size, and pipeline ends. Thrust blocks may also be required at inline control valves.

The pipe manufacturer's recommendations for thrust control shall be followed. In absence of the pipe manufacturer's requirements, the following formula is used in designing thrust blocks:

$$A = \frac{98\ H\ D^2\ \sin\left(\frac{a}{2}\right)}{B}$$

Where:

A = bearing area of thrust block required (ft^2)

H = maximum working pressure in head (ft) *1 psi = 2.31 ft of head*

D = inside diameter of the pipe (ft)

B = allowable bearing pressure of the soil (lb/ft^2)

a = deflection angle of pipe bend (degrees)

Note: The bearing areas of thrust blocks for dead ends, risers, and tees shall be 0.7 times the bearing area required for a 90° deflection angle pipe bend. "ZEE" pipe thrust blocks shall be calculated as for 45° deflection angle pipe bends.

Example:

Given a pipe diameter of 8", a maximum working pressure of 120 psi, and an allowable bearing pressure for the soil (silt and clay mixture at 3ft deep at center of thrust block) of 700 lb/ft2, calculate the required bearing area for a thrust block at a 45° elbow.

$H = 120\ psi \times 2.31\ (ft / psi) = 277.2\ ft$

$D = 8\ inches \times (1\ ft / 12\ inches) = 0.67\ ft$

$B = 700\ lb / ft^2$

$a = 45°$

$$A = \frac{98 \times 277.2 \times (0.67)^2 \times \sin\left(\frac{45°}{2}\right)}{700}$$

$$A = \frac{98 \times 277.2 \times 0.45 \times 0.38}{700}$$

$Bearing\ area\ required\ (A) = 6.6\ ft^2$

Table-1 Allowable soil bearing pressure*

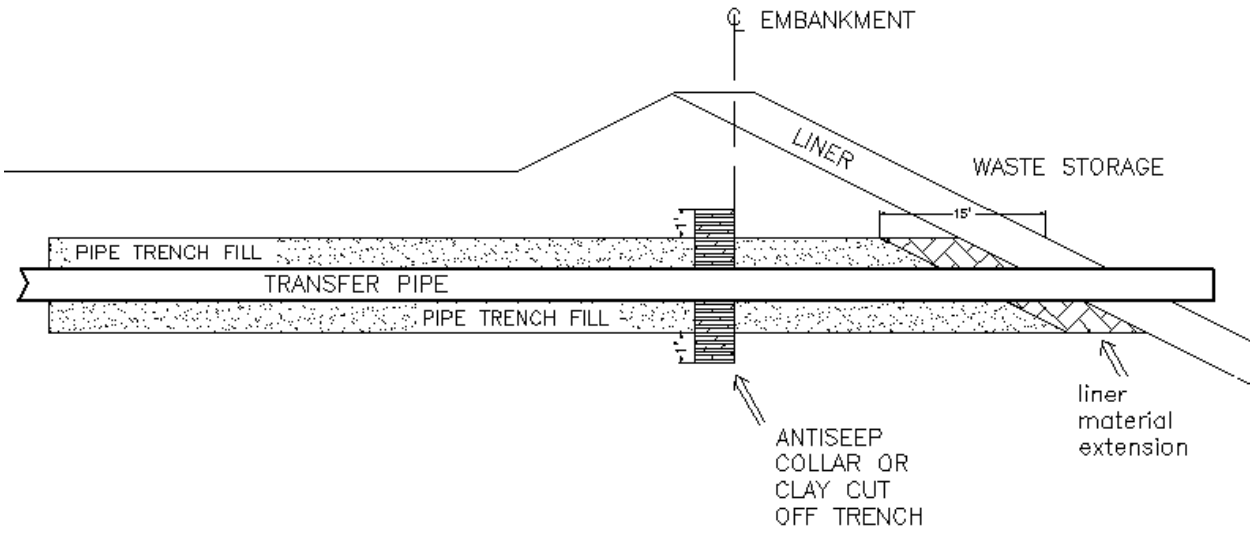
Natural soil material	Depth of cover to center of thrust block 2 ft	3 ft	4 ft	5 ft
	lb/ft^2			
Sound Bedrock	8,000	10,000	10,000	10,000
Dense sand and gravel mixture (assumed ø=40°)	1,200	1,800	2,400	3,000
Dense fine to coarse sand (assumed ø=35°)	800	1,200	1,650	2,100
Silt and clay mixture (assumed ø=25°)	500	700	950	1,200

*FROM TABLE 52-6 OF NEH PART 636 CHAPTER 52

NRCS Natural Resources Conservation Service United States Department of Agriculture	CONCRETE THRUST BLOCK CLIENT: #### COUNTY: ####	Designed #### Date #### Drawn Checked Approved	Drawing Name WI-XXX Date 6/2010 Sheet X of ###

SEEPAGE CONTROL

Use of clay cut off trenches with waste transfer lines can reduce the possibility of flow along the pipe and water running through the trench fill material which could eventually cause failure to the waste storage system. The designer must analyze the site conditions and determine the need for seepage control.



- The use of an antiseep collar or clay cut off collar may be needed to prevent subsurface water flowing preferentially along the outside of a transfer pipe or through the trench fill material which could exert hydrostatic pressure on the back side of waste storage facility.

If a cut off trench or anti-seep collar is determined to be warranted by the designer, the following design considerations are recommended:

- The cut off trench or collar should be located no closer to the footprint of the structure than the center line of the embankment.
- An antiseep collar and/or clay cut off trench should extend a minimum of 1' into the existing soil beyond the excavated pipe trench and a minimum of 1' beyond granular fill/ pipe bedding material.
- The clay cut off trench should be a minimum of 3' thick as measured along the pipe unless bentonite is used, then a minimum of 1' thick as measured along the pipe.
- A drainage tile to a surface outlet may be used to relieve the hydrostatic pressure upstream of the collar or trench, provided the tile is maintained outside the footprint of the waste storage facility and has a gravity outlet.

EQUIVALENT INSULATION FOR FROST PROTECTION

Source: Department of Safety and Professional Services, Chapter 382, Design, Construction, Installation, Supervision, Maintenance, and Inspection of Plumbing.

Pipes are typically protected from freezing by covering them with four feet of soil. If four feet of soil is not available, find an equivalent insulating material.

To find an equivalent insulating material, first determine the R-value of the material. The R-value is a measure of thermal resistance. The larger the R-value of an object, the more it insulates an object from outside temperature influences.

The following is a table of R-values for common materials:

Material	R-value per inch
Soil	1
Concrete	1
Snow	1
Plywood	1.2
Straw Bale	1.45
Blown cellulose insulation	3
Extruded Polystyrene (rigid insulation)	5

For example, soil provides R-1 per inch of soil. So each foot of soil (12 inches) provides R-12. If only two feet of soil is available to be placed over a pipe, R-24 is still needed (since there is two feet missing to obtain the required 4 feet of cover).

The most efficient way to provide the needed cover is with extruded polystyrene, the blue or pink rigid insulation. To get an R-24, 24/5 = 4.8 or roughly 5 inches of insulation is required.

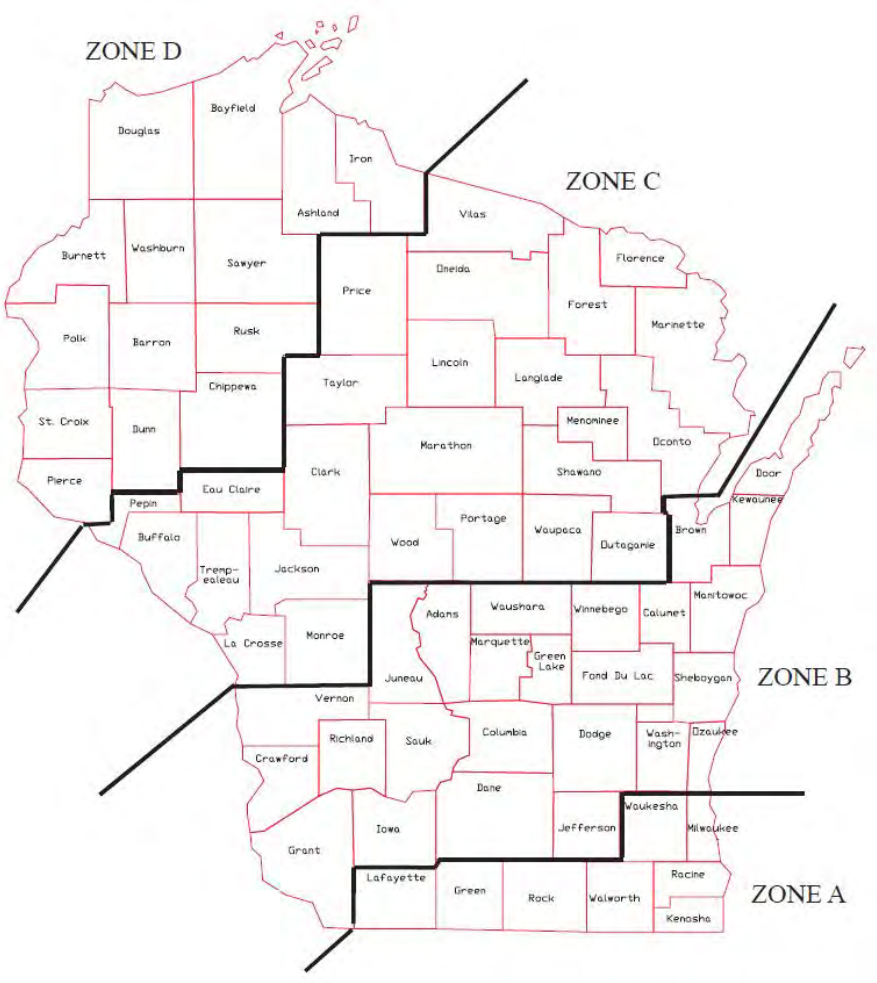
Therefore, 2.5 inches of rigid insulation are needed for every foot of soil cover missing.

RECOMMENDED FROST PROTECTION DEPTHS

Although NRCS practice standard 634 specifies a minimum of 4 feet of protection for frost, frost protection should be used if the top of pipe is buried less than 60" below the ground surface. If the pipe is buried deeper than depth of predicted frost (see table below), no frost protection is needed.

Installation of frost protection:

Install foam 18" below finished grade and within 6" from top of pipe



Source: Department of Safety and Professional Services, Chapter 382, Design, Construction, Installation, Supervision, Maintenance, and Inspection of Plumbing. Figure 382.30-1. Register December 2011 No. 672.

PREDICTED DEPTH OF FROST IN VARIOUS TYPES OF BACKFILL SOIL (in feet)

Soil Type	A	B	C	D
Clay, Clay Loam	2.5	3.0	3.5	4.0
Silt Loam, Silty Clay Loam	3.5	4.0	4.5	5.5
Sandy Clay Loam	4.0	4.5	5.5	6.0
Sandy Loam, Loamy Sand	4.5	5.0	6.0	6.5
Sand	5.0	5.5	6.5	7.5
Gravelly Sand	6.0	7.5	9.0	10.0

Source: Department of Safety and Professional Services, Chapter 382, Design, Construction, Installation, Supervision, Maintenance, and Inspection of Plumbing. Table 382.30-6. Register December 2011 No. 672.

MINIMUM WIDTH OF EXTRUDED POLYSTYRENE FOAM INSULATION (in feet)

Predicted Depth of Frost (feet)	Depth of Sewer (in feet)					
	2.0	2.5	3.0	3.5	4.0	4.5
2.5	2	NR				
3.0	3	2	NR			
3.5	4	3	2	NR		
4.0	5	4	3	2	NR	
4.5	6	5	4	3	2	NR
5.0	7	6	5	4	3	2
5.5	8	7	6	5	4	3
6.0	9	8	7	6	5	4
6.5	10	9	8	7	6	5
7.0	10	10	9	8	7	6
7.5	10	10	10	9	8	7
8.0	10	10	10	10	9	8
8.5	10	10	10	10	10	9
9.0	10	10	10	10	10	10
10.0	10	10	10	10	10	10

NR means Not Required.

Source: Department of Safety and Professional Services, Chapter 382, Design, Construction, Installation, Supervision, Maintenance, and Inspection of Plumbing. Table 382.30-7. Register December 2011 No. 672.