DEICING PRODUCTION AND STORAGE TANK SYSTEM GUIDELINES

Prepared by:

Office of Environmental Stewardship

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Replaces the document, *Anti-Icing and De-Icing Production and Storage System Guidelines 2009*

DEPARTMENT OF TRANSPORTATION

CONTENTS

INTRODUCTION

The use of salt brine and other liquid anti/deicing products have proved successful as anti-icing and deicing agents. Consequently, many liquid anti/deicing production and storage systems have been installed at MnDOT facilities throughout the state. Several different approaches have been attempted in designing these systems. The objective of this document is to establish a recommended procedure for installing and operating salt brine and other anti/deicing systems, based on years of past practice.

MnDOT deicing tanks include salt brine generators and tanks, deicing chemical storage tanks, and automated bridge deicing systems, which include a storage tank and associated piping.

This document is based on information from MnDOT's May 2009 edition, *Anti-Icing and De-icing Production and Storage System Guidelines,* and the *Washington State Department of Transportation Statewide Snow and Ice Plan 2016-2017, Appendix I.*

The document was reviewed by representatives of the following groups: Maintenance Building Services Section, Facility Managers Group, and Building Trades.

ABOVEGROUND DEICER STORAGE TANK REQUIREMENTS

Aboveground storage tanks (ASTs) used to store deicing solutions are considered Other Regulated Substance ASTs by the Minnesota Pollution Control Agency (MPCA). Other Regulated Substances are liquids, other than petroleum, hazardous substances, or asphalt cement, that have the potential to pollute the waters of the state. Surface water includes, but is not limited to, lakes, ponds, streams, ditches, wetlands and storm sewer openings. ASTs storing Other Regulated Substances must be in compliance with specific requirements in Minnesota Rules Chapter 7151. In addition to these MN Rules, it is MnDOT Policy that some of these ASTs be registered with the MPCA.

See Appendix A for charts of deicer tank compliance requirements.

COMMON CAUSES OF POLYETHYLENE TANK FAILURES ARE:

1. Improper installation (including unsupported fittings pulling away from tanks).

2. Stress cracks.

Stress cracks may be caused by improper installation of the tank or tank anchors, exposure to environmental elements (e.g. ultraviolet light (UV) from the sun), an uneven foundation, and/or impact (e.g. during tank delivery or vehicle collision).

Over time the tanks may degrade. Tank degradation typically results in a thinning of the tank walls. Degradation may also cause the tank walls to become either brittle or soft.

The plumbing and valves usually fail at joint connections or fittings. Pipe failures are typically caused by excessive vibration, vehicle impact, or degradation due to sun exposure.

PURCHASING

Tanks should have uniform thickness from top to bottom. 'Tapered' tanks are not recommended because the upper sidewalls, domes, and bottoms are thinner than the bottom sidewall. The domes of tapered tanks are more likely to be weakened by sun exposure (i.e. experience UV deterioration) and may collapse under a snow load.

Tanks and brine generators must be manufactured to hold liquid products that are denser than water. Calcium, Magnesium and Sodium Chloride solutions typically have a specific gravity range between 1.2 and 1.3. Tanks that are manufactured with lower specific gravity ratings (e.g. close to 1) are more likely to fail. Tanks with a higher specific gravity rating (e.g. a heavy duty tank) will last longer, especially if the tank will be exposed to extreme sun and/or consistent temperatures over 100° F. Contact tank manufacturers or vendors for tank specifications and recommendations.

Tanks should be manufactured with UV resistant or UV stabilized plastics.

Tanks should be thoroughly cleaned and rinsed before changing from one product to another. Avoid combining liquids in the same tank. The materials are very often not compatible.

SITING AND INSTALLING

Tanks must be vented to avoid pressurization while loading or unloading product. Venting is built into most tanks (e.g. an opening built into the top lid). Tanks can also be vented by installing a pipe opening near the upper part of the tank. Typically the pipe has an elbow fitting facing down to prevent rain from entering the tank.

New tank and generator installations should be tested to insure the tank and piping hold water before filling with product. Tanks should be filled with water prior to use. Check for unsecured fittings, shipping damage, or manufacturing defects. Tanks should be tested for a minimum of 5 hours.

The circumference of the tank must be measured and recorded the first time the tank is filled. See Circumference Measurements.

A sump should be located in the brine generating area. The purpose of the sump is to contain any spilled brine, thus preventing contamination of native soil, surface water and/or groundwater. Runoff from the product transfer area should also be directed into the sump to contain any spills generated during tank filling or from a ruptured hose. Depending on cleanliness, brine collected from the sump may be used in truck brine saddle tank or pumped back into generator.

All electrical components shall be listed by Nationally Recognized Testing Laboratory (NTRL) acceptable to OSHA. Control panels shall be listed as an assembly. Exceptions to control panel listing: 1) field evaluation by a NRTL or by a registered or licensed electrical engineer who has no financial or other interest in the manufacture or sale of the equipment, or 2) the panel contains 8 or fewer listed components, other than wires, cables, cords, terminal assemblies, and nonelectrical components.

The current salt brine production system specification also requires wiring the system to a ground fault interrupter to prevent hazardous electrical shock.

References – more specifics:

OSHA – Complete List of NRTLs: https://www.osha.gov/dts/otpca/nrtl/nrtllist.html

Minnesota Rules 3801.3620 Approval of Electrical Equipment:

https://www.revisor.leg.state.mn.us/rules/?id=3801.3620

Location

Tanks should be protected against wind. Wind may move tanks. Movement may be an issue with fixed piping. Tie downs may also assist with empty tanks floating inside containment structures. Empty tanks may float in a little as 5 inches of water.

Tanks, valves, and piping should be protected from vehicle impact. Vehicle impact protection may be provided by either physical barrier (e.g. median barrier or guardrail) or by siting the tank away from vehicle movement areas (e.g. inside a shed or storage bay), as appropriate.

Tank should be protected from UV and temperature deterioration. Unprotected tanks exposed to sunlight for an extended period of time, absorb ultraviolet light (UV) which can cause discolorations, make the tank brittle, and eventually crack. Most tanks have an optimal operation temperature range between 0°F and 100°F. However, most tanks are rated for minimum and maximum temperatures lower or higher than this range. Tank locations should minimize exposure to the sun, especially during the summer months, when temperatures are the highest (e.g. locate tanks on the north or east side of buildings). Shaded areas and covered storage (e.g. roof or building) will lessen the damaging effects from UV rays.

Brine systems should have own shelter. Salt brine systems have been responsible for producing a corrosive atmosphere when placed inside maintenance facilities. It is recommended that salt brine systems be housed separately from maintenance facilities or salt emissions to the atmosphere be reduced by using a tarp and/or rubber boots to seal tank openings.

Plumbing

If multiple tanks are located onsite, the tanks must be plumbed to insure that complete failure of one tank will not drain all the tanks in the system (tank operations must be isolated). Tank isolation may be achieved by placing valves between the tanks, installing separate pumping systems, or any other method that insures the contents of one tank will not unintentionally flow into another tank. Valves between tanks must be kept closed unless transferring product from one tank to another.

Efforts should be made to minimize seeping and leaking at fittings.

Examples include:

- Support hose brackets and flanges (and anything else that hangs on the tank) so the weight of the attachments don't pull against the tank.

- Consider using bolted fittings (bolts on both the inside and outside of tank) rather than threaded fittings (flange on inside with bolt on outside).

- Install fittings above the knuckle of the tank (at least 1 foot from the bottom of the tank) where the wall thickness is most even.

- Use a flexible connector or expansion joint to allow the tank to move naturally.

- Use corrosion resistant fittings (e.g. poly, reinforced nylon, or stainless steel).

- Install valves close to the tank wall.

- Use flexible hoses to help absorb impacts from vehicles and/or handling.

- Use lightweight hoses and valves to minimize stress at the hose/tank connection. Large, heavy fittings, valves, connections, and hoses add stress to the tank walls

- Use separate port valves to fill and to empty the tank. This will reduce stress at the valves.

It is critical to properly clean pipe ends and couplings before applying joint compound. This should help to prevent leaks from pipe unions.

Brine production areas are high hazard areas and the Minnesota Plumbing Code requires backflow prevention. The brine building water system must be isolated from the truck station potable water supply system by an RPZ.

Ensure that pump components such as the impellor are constructed of non-corrosive material such as bronze or stainless.

Drips from hoses should be minimized. Consider placing hoses in non-permeable trenches or using drip-less nozzles to reduce repeated small spills.

Secondary Containment

Secondary containment of tanks is required and piping shall not extend outside the secondary containment system. Spills must be contained within immediate vicinity of the tank or generator, kept out of storm water drains, and away from surface water.

Interior Tanks: A secondary containment volume equal to 100% of the largest tank is required.

Exterior Tanks: An outdoor secondary containment area system equal to 110% of the tank is required. If more than one tank occupies the same containment area, the containment volume must be 110% the volume of the largest tank.

Materials used in constructing the containment must be compatible with the substance being stored.

Secondary containment may be achieved by using double-walled tanks that are constructed to industry standards or surrounding the tank with an impermeable dike and floor.

It is required that concrete treated with an appropriate sealer be used for the containment floor and dikes.

Guidance for Concrete and Buildings Used to Provide Secondary Containment

Concrete

- Berms must be designed to ACI 350 Code that stops the movement of deicer (e.g. concrete barrier).

- Berms constructed of concrete barrier should have water stops at construction joints and the slab-to-wall connections to prevent the movement of product.

- Berms should be less than three (3) feet tall. Berms that are two (2) feet tall or less are recommended.

- If the site is located in an area where precipitation ponds inside the berm, the berm should have a manually operated drain at the low point to release rain water and snow melt.

- Drain valves that release water from the bermed area must be closed when there is product in the tank.

Buildings

- Existing structures may be modified, with MnDOT Building Services approval, to provide secondary containment.

- New and remodel construction must be authorized by MnDOT Building Services Section and may require capital funds.

- Building floor drains must be dead end sump.

Buildings may be used to provide other benefits besides secondary containment.

- Reduce tank to UV exposure from the sun

- Protect from vandalism

- Keep snow and rain out of containment structures

- Shelter employees from weather

OPERATIONS

Maintenance BMPs

Pooled water inside containment areas must be inspected for the presence of deicers or other contaminants before opening any drain valves or pumping water out of containment systems. Deicer is typically darker than water (brown or yellow brown). Deicer appears thicker than water. Deicer may foam when agitated. The release of clean water should be specified on the monthly inspection log.

Drain valves on secondary containment systems must be kept closed whenever there is product in the tank (unless draining rainwater or snowmelt). **Containment is not provided when valves are open.**

Drain valves on secondary containment systems must be manually operated (not automatic). Manual valves should be used on all drains.

If spilled products flow into a municipal sanitary system, the municipality must be notified of the potential for deicer products entering the system. The documentation records of the spill event should be kept onsite or at the District office.

Tanks must be monitored for stress cracks. Stress fractures typically develop near the bottom of the tank. Visually inspect the exterior of the tank for obvious defects each time the tank is filled. Elevated temperatures can accelerate deterioration and weaknesses. Stress cracks should not be ignored. Details on routine inspections can be found in the following section.

Sight tubes, if used, should be protected from impact and frequently inspected for deterioration. Fittings and pipes must be checked monthly. Check fittings for tightness (don't over tighten). Replace gaskets when brittle or when tightening the fitting does not fix seepage. Replace fittings as needed. A detailed description of annual inspections for pipes and fittings can be found in the following section.

Brine Generator Cleaning

When cleaning the system, the bottom sludge can be collected and incorporated within a salt or salt/sand pile. Must ensure that sludge does not flow from the pile and impact soil or surface water.

See Appendix B for guidance document.

Management of Salt Piles and Truck Washing Operations

Salt run-off from salt or salt/sand piles must be prevented at all sites. Minnesota Rules 7060.0600 prohibits discharge into the subsurface that may result in polluting groundwater. Salt and salt/sand mixture piles must be housed or completely covered to prevent run-off. If stockpiles are covered with a tarp, curbing should be placed on the up-slope side of the pile to prevent surface water run-off from flowing beneath the stockpile. This will reduce salt leaching from the pile. Tarps must be of sufficient thickness to withstand the elements and remain intact. ***Applying brine to sand piles must be done with extreme care because of the high potential to produce brine run-off. Any materials used to control brine run-off must be impermeable to brine solutions. Under most circumstances, bituminous is not an impermeable substance.***

Outside truck washing operations are prohibited. Cleaning trucks outside must be limited to dry removal of salt. All truck washing must be completed inside maintenance garages where wash water is directed to the building sewer. Truck wash water generated at facilities with septic systems are directed to an onsite holding tank through a dedicated industrial sewer system. Contact Facility Manager for assistance with wash water management.

INSPECTIONS

Monthly Documented Inspection

Stress cracking, brittle, spongy, or discoloration of tank wall material, and excessive swelling or deflection of a tank wall all are indicators of tank deterioration. Similar indicators of deterioration may occur at fittings, gaskets and connectors.

Visually inspect tanks, piping, and secondary containment monthly and keep documentation. During the visual inspection of tanks and piping record any of the following observations to your Facility Manager or Safety Administrator:

- cracks of any kind

- separation of any components

- breaks in piping

- evidence of leaks

- discoloration (deicer soaking into the tank)

- physical damage (e.g. impact, gouges, bulges, or dents)

- vibrating or flexing portions of tank wall or piping

- deficient foundation and supports

Repair or replace damaged components where appropriate. Tank replacement guidelines can be found in the last section.

Annual Inspection Documentation of Piping and Equipment

The integrity of secondary containment systems must be checked annually, preferably before the first delivery of the season. Integrity tests typically consist of allowing the containment system to fill with water and checking that the water level doesn't drop over a period of time.

Exposed piping, joints, welds, and connections must be examined at least annually and documented for degradation, misalignment, and tightness.

Annual inspections are intended to be more comprehensive and detailed than monthly visual inspections. Typically annual inspections will occur while preparing for the winter maintenance season.

1. Examine pipe runs for leaks, drips, or unusual moisture.

2. Examine pipe joints and connections (e.g. flanges and flange gaskets) for misalignment, tightness, and deterioration.

3. Check pipe systems for deficiencies resulting from vibration, expansion, contraction, settlement, or impact.

4. Insure pumps and all other equipment function properly.

5. Inspect pumps and other equipment for leakage, fouling, corrosion, and wear.

Replace or repair pipes and equipment as appropriate.

Annual Physical and Stress Crack Inspections for Tanks Over 5 Years Old

Physical Inspection

Inspect the tank for any cuts, permeation, bulging, softening, or becoming brittle. Other things to look for:

- webs of cracks (excessive brittleness)

- deformation that is different than normal expansion (swelling)

- spongy tank walls (softening)

- discoloration of the tank wall (permeation)

- deep crack or gouges

Some cracks and gouges can be repaired. Adding a tank “girdle” or metal banding at the bottom of the tank will not help control deterioration.

Stress Crack Inspection

1. Choose an area of the tank where cracking is likely to occur (e.g. near the top of the tank, on the lower sidewall, or near fittings and connections). Cracking is more likely to be found where the tank has the most exposure to the sun.

2. Use a black, water-soluble marker to fill in an approximately 3 inch square area.

3. Before the marked area dries, quickly rub off the excess ink with a soft cloth.

4. Stress cracking will show up as a web of fine lines. Small UV cracks may appear near the surface, but are usually not very deep. Impact cracking and damage may also show up using the marker ink test

Repair or replace damaged tanks where appropriate. Tank replacement guidelines can be found in the last section.

Baseline and 5-year Circumference Measurements

1. Measure the circumference of the tank (distance around) at a fixed height (e.g. 2' from bottom of tank) the first time the tank is filled to capacity after installation. This is the baseline measurement. Future measurements should be taken at the same height.

2. Measure the tank at the same fixed height every five years. The tank should be full when the measurement is taken. Ambient air temperature may affect the measurement.

3. If the circumference measurement is more than 1% but less than 2% of the baseline measurement, take circumference measurements every two years.

Replace damaged tanks where appropriate. Tank replacement guidelines can be found in the following section.

Tank Replacement

If any of the following conditions are observed during any of the tank inspections, the tank must be taken out of service.

1. If there is a crack at least 2" long with a depth of more than 1/3 of the thickness of the tank shell in the area of the bottom 25% of the tank.

2. If there is crack at least 4" long with a depth of more than 1/3 the thickness of the tank shell in the area of the top 75% of the tank.

3. If any significant brittleness or softness is noticed in the area of the bottom 25% of the tank.

4. If the circumferential measurement is greater than the baseline measurement by more than 2%.

The absence of any of the above criteria does not guarantee the tank is structurally sound.

Where appropriate, use best professional judgment, consult the tank vendor, or have the tank tested by a third party to determine if a tank is fit for use. Bulges or localized discoloration, though not noted above, can indicate a problem. Additional inspections (e.g. acoustic emission testing or ultrasonic testing) can be performed by professional testing companies.

Appendix A

Summary of Compliance Requirements for Deicer and Salt Brine Tanks — **1/1/2018**

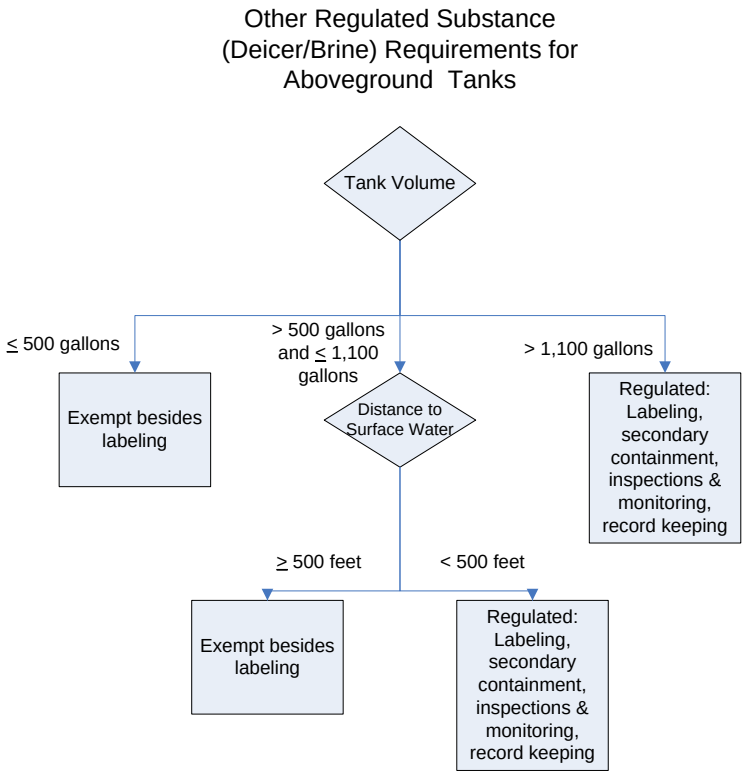
Capacity (gallons)	Location/Construction	General Requirements[1]	Registration	Labeling	Secondary Containment	Inspections/ Monitoring	Comments
≤ 500	does not apply	Yes- only spill reporting	Yes	Yes	No		
> 500 and ≤ 1100	not within 500' of Class 2 surface water[2]	Yes- only spill reporting	Yes	Yes	No		
> 500 and ≤ 1100	within 500' of Class 2 surface water[2]	Yes	Yes	Yes	Yes		
> 1100	indoor tank[3]	Yes	Yes	Yes	No- if double-walled		
> 1100	non-indoor tank[3]	Yes	Yes	Yes	Yes	single-walled=72 hour, double=monthly -both documented	
> 1100	stainless steel tank	Yes	Yes	Yes	Yes		MnDOT policy
> 1100	tank truck[4]	Yes	No	Yes	No		

[1] General requirements include spill reporting, procedures for taking tanks out-of-service, reactivating out-of-service tanks and use of used tanks.

[2] Class 2 surface water as defined in Minnesota Rule 7050.0200.

[3] An indoor tank is either a double-walled AST located indoors, or a single-walled AST located within an enclosed structure with an impermable floor and any part of 100% volume tank release could not escape through door openings or storm sewer drains.
Example: A single-walled AST located near floor drains, or a doorway, is not an indoor tank.
See Minnesota Rule 7151.1200, subp. 21.

[4] A tank truck is used to transport substances from one location to another and cannot contain substances at the same location for more than 30 consecutive days.



Appendix B

Salt Brine Tank Sludge

MnDOT Office of Environmental Stewardship
Environmental Investigation Unit

Contact Information:
Environmental Investigation Unit
Summer Allen-Murley: 651-366-3635

MnDOT has prepared this guidance document to provide its internal procedures and requirements for work performed on MnDOT rights of way, including MnDOT-owned facilities. This document should not be construed as a full description of all regulations pertaining to the subject matter. Contact the Environmental Investigation Unit in the MnDOT Office of Environmental Services for additional information or legal requirements.

Management of Salt Brine Tank Sludge

MnDOT operations require management of the salt brine sludge generated in brine mixers and storage containers. Generally this sludge is produced when brine production and storage tanks are cleaned out at the end of the deicing season. The following management practice allows for proper disposal of salt brine tank sludge. The options listed below are possible methods for sludge removal and disposal. Contact EIU for assistance in unusual situations regarding removal or disposal of brine sludge.

Sludge that accumulates in salt brine mixing tanks or storage tanks is likely the result of iron hydroxide or manganese hydroxide that precipitates in the brine solution. Iron and manganese may be introduced in the salt brine from well water used to make the brine solution. Iron hydroxide precipitates generally produce an off-white gelatinous slime that settle in the tank over time and form a semi-solid like material. However, depending on the amount of iron and manganese in the water, the color of the sludge may vary. Impurities, like coal dust present in train cars used to transport the salt, may also be introduced in the salt during shipping and produce a grey sludge in the brine solution.

Option #1:
With a sludge pump, remove what is left in the salt brine tanks into loader bucket or equivalent. Contain the sludge within the salt shed, allowing the liquid to evaporate. Once all liquid has evaporated, blend the salt into the salt pile. Absolutely no liquids can be allowed to escape from the salt shed, drain into a storm sewer or impact surface water, septic field or the ground.

Option #2:
District should contact the local wastewater treatment plant to see if they will accept the sludge in their treatment process. If the treatment plant gives written approval to accept the sludge, then it can be drained into the sanitary sewer. If the tank location is not connected to a sanitary sewer, contact the treatment plant for delivery options. Under no circumstances should the sludge be disposed of in the storm sewer, in a septic system, or allowed to discharge directly on the ground.