VERIFICATION PROTOCOL FOR PARKING LOT SALT SPREADERS

SALT APPLICATION VERIFIED EQUIPMENT (SAVE) PROGRAM

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Introduction

For years, the snow and ice management industry has been pre-occupied with risks associated with liability for slips, falls and other ice related accidents. These concerns, combined with a lack of tools to effectively challenge slip and fall claims, has encouraged contractors to over-apply road salts on parking lots and sidewalks. The application of salt in excess of what is needed drives up the price of winter maintenance contracts, accelerates corrosion of building infrastructure and adversely impacts neighbouring soils, vegetation and waterways.

Between 2012 and 2015, a consortium of provincial, municipal and non-governmental organizations, coordinated through Landscape Ontario, have established scientifically defensible salt application rates for parking lots, based on extensive monitoring by researchers at the University of Waterloo. These rates show the potential for at least a 25% reduction over current rates, and are helping to provide the long needed evidence for contractors to effectively challenge law suits and prove their due diligence. In order to use the established rates, however, salt spreading equipment needs to be calibrated and verified to ensure that target application rates verified through scientific testing are being achieved in practice.

Currently, operators of snow and ice management equipment for sidewalks and parking lots rarely, if at all, calibrate their salt spreaders. Instead, operators use a combination of sight and experience as a means of assessing whether ‘enough’ salt has been applied. How much is ‘enough’ is determined based on the visible presence of salt on the road surface at a density that seems appropriate based on previous experience. This method of assessment leads to highly subjective determinations of how much salt to apply in a given situation – a problem that is compounded in most cases by the failure to use equipment that automatically adjusts spreading rates to ground speed.

Purpose of this Document

The purpose of this calibration procedure is to provide guidance on how to verify salt spreader application rates in order to ensure operators of spreading equipment are able to apply salt at application rates that are appropriate for the condition and level of service being sought. By understanding and recording the amount of salt being applied, contractors can better estimate their annual operational costs, apply salt responsibly and offer evidence of due diligence when challenged.

How Salt Spreaders Work

The application rate of a spreader is affected by the speed of the truck, speed of the auger/conveyor, area of gate opening and the speed of the spinner. The speed of the auger/conveyor determines how fast the granular material is dropped onto the spinner through the area of the gate opening. The speed of the spinner determines how wide the granular salt melting material is spread horizontally as it is dropped from the moving vehicle; increasing the speed of the spinner will widen the spread of the dropped material and reduce the density of application. To maintain the spreader at a constant application rate, the speed of the auger/conveyor needs to increase when the speed of the truck and/ or spinner is increased. Conversely, if the spinner speed is increased to widen the spread, the auger/conveyor speed needs to be increased to maintain constant application rates.

Figure 1. Tailgate spreader.

Figure 2. Tailgate spreader showing auger and underside of spinner.

Figure 3. V-box salter gate opening and conveyor belt.

Figure 4. V-box spreader dropping salt onto spinner.

Spreader units have different levels of sophistication in feedback systems that control the auger/conveyor and the spinner in relation to the speed of the truck and to each other. Currently, spinner settings are usually disregarded during verification and are not integrated into the automatic feedback systems of ground speed controlled spreaders. It is assumed that the speed of the spinner and thereby the width of the spread would be set to salt/cover the width of highway lane(s) and, therefore, application rates are appropriately considered in terms of pounds per lane distance. However, standard application rates for parking lots are given in pounds per area, requiring that spinner settings be carefully considered in verification procedures.

Spreader Types

There are three main types of spreaders used on private parking lots and sidewalks. In order of sophistication in control settings and feedback systems, from lowest to highest, these are:

- Manually controlled: auger and spinner speeds are controlled manually. Discharge rate from the auger remains constant and does not change with speed; therefore, changes in the speed of the truck will change the application rate.

- Ground speed – open loop: spinner speed is manually controlled but the auger/conveyor speed is adjusted by a control valve to a predetermined setting based on the speed of the truck to keep application rates consistent at varying speeds. This system is susceptible to error if the truck's speed is miscalculated or if there are changes to the hydraulics of the system.

- Ground speed – closed loop: Auger speed is also monitored by a sensor and is adjusted to the speed of the truck to comply with predetermined ratios between the two for consistent application rates. Some manufacturers compensate for the spinner speed within their feedback system using signal relays on the spinner.

Figure 5. Manual controls for auger and spinner settings.

Figure 6. Interface for automatic settings of auger and spinner speeds in ground speed controlled spreader (© Robert Roszell 2016).

Figure 7. Interface for manual settings of auger and spinner speeds in ground speed controlled spreader (© Robert Roszell 2016).

Manually controlled spreaders (Figure 5) are currently the most common type of spreader used on private parking lots in Ontario, but open and closed loop ground speed controllers are becoming increasingly common (Figure 6, Figure 7). If the spreader only has manual controls, the verification procedure would benchmark application rates associated with currently used settings and show what combination of auger and spinner settings achieve standard low, medium and high application rates at frequently travelled speeds. Ground speed controlled spreaders that are used with overriding manual settings may require additional manufacturer specific calibration to verify the feedback system. Ground speed controlled spreaders using desired application rates as input would be verified using this protocol and the contractor

would be informed whether further calibration, repairs and/or modifications are required for the purposes of calibration.

Manufacturer Specific Calibration

Manufacturer-specific calibration ensures that all parts of the spreader system are working as they should. New equipment should always be calibrated before first use. Hydraulic/ electric systems must be verified to ensure that the preset ratios of truck speeds to auger speeds are accurate. Equipment calibration must be conducted regularly as the age and wear of augers and spinners can significantly affect their performance. Spreaders should also be calibrated after repairs, modifications or any changes to the hydraulic system, and at a minimum once per year.

Qualified Personnel

Manufacturer specific calibration can be done by any qualified person but must be verified by an authorized technician accredited through the SAVE program.

Pre-requisites for Verification/Calibration

- Spreader must have been previously calibrated (if applicable)
- Equipment must be no older than 7 years
- Contractor must be licensed and insured
- Spreader must be installed securely to the truck chassis and in working order
- Must be able to turn off or remove the spinner (i.e., for drop test)
- All of the snow melt material must flow directly onto the spinner

Required Equipment for Verification

1. Drop test box with dimensions of: 70 X 70 X 20.4 cm (bottom not required). The test box has a volume of 0.1 m^3.

2. Stop watch

3. Tape measure

4. S.A.V.E. program initial settings form and work sheet

Equations

The salt application rate is affected by the gate opening, conveyor or auger speed, spread width of the the spinner, and truck speed. The following equations are used to determine spreader application rates while keeping the gate opening constant:

Salt flow rate (Kg/ sec) = weight of salt in the filled box (Kg) / time to fill box (sec)

where the weight of salt is determined based on the box capacity of 0.1 m^3 and the density of salt being used (Sodium chloride is 1.30 metric tonne/ m^3, as per OPSS 2502)

Area covered (m^2/ sec) = speed (m/ sec) X spread width(m)

Spreader application rate (Kg/ 100m^2) = (salt flow rate (Kg/ sec) / area covered (m^2/ sec))*100

Preparation for Verification

Preparation for all spreaders

1. Select dry, solid material for calibration that is representative of the bulk material, uniform in size, relatively lump free, and free of excessive moisture.

2. Load the spreader truck to at least ½ full of the selected dry material.

3. For hopper-box or V-box spreaders, select a single gate opening that will accommodate a full range of solid material application rates to be used during operations. The size of the opening should be kept constant during the test and for operations thereafter.

4. For tailgate spreaders, verify that the truck bed can be raised to an operational elevation and make sure that the auger/conveyor can be fully charged with salt during the complete calibration process.

5. Ensure that the truck's hydraulic temperature has been given time to warm up prior to beginning verification.

Preparation for ground-speed controlled spreaders

If the spreader is a ground speed controlled system (open or closed) it must be put into simulated speed control, either through the existing cab interface or by an external electronic speed simulation device, to accurately verify the amount being spread. Alternatively, if it can be accomplished safely, the truck can be jacked to lift the drive wheels and allow them to spin at the desired speed. If simulating the speed cannot be achieved by any means, the truck's controls can be placed into manual operating mode and verification can be completed as it would for a manually controlled spreader. The interfaces of some ground speed controlled spreaders display the manual auger and spinner setting values for the selected application rate during regular operations in automatic mode. These manual values can be used to verify their corresponding application rates but this protocol will not be able to verify the system that is utilized to provide feedback signals between the speed of the truck, auger, and/or spinner of ground speed controlled spreaders if speed is not simulated. If application rates to be verified are given in kg/lane distance, the width of the lane should be used to convert the application rates to kg/ 100m^2).

Verification Procedure

Step 1: Collect and record user information into the SAVE worksheet

Begin by recording existing information of the spreader system and truck onto the SAVE worksheet. The information should include:

a) Company's name, address, phone number, and contact person
b) make and model of the spreader, hydraulic or electric?
c) year manufactured
d) current auger gate opening size(both height/ width of opening and any notches or holes being used for referencing)

e) make, model, year, and license plate of the truck
f) usual speeds at which truck operates during spreading (may have more than one speed)
g) currently used controller settings for auger and spinner

Commonly used settings will be tested first to benchmark the existing settings and will guide the verifier in determining the range of spreader and auger settings to be tested to reach the target spread rates.

Step 2: Measure spreader width

During testing, the truck's engine speed should be kept at the usual operating RPM. Run the auger and spinner on the setting most often used by the client. Observe where the majority of the salt lands and the extent of the spread. Record the measurement approximately 10-12 inches less than the furthest material thrown, which is considered to be the overlap zone when spreading in parking lots. Measure the width with a tape measure and record it along with the spinner setting used.

Figure 8. Measurement of the width of salt spread for selected spinner setting.

The standard widths used during spreading are 3.05 m (10 ft), 6.1 m (20 ft), and 9.14 m (30 ft). Gauge whether the most often used spinner setting produces a spread width similar to the standards and test higher and lower spinner settings to satisfy the standard range of widths. Enter the tested spinner settings and corresponding measured spread widths into the SAVE worksheet.

Step 3: Measure auger salt discharge rate

Remove or turn off the spinner assembly (by controls or by disconnecting hoses) on the truck. If the spinner cannot be turned off or removed, calibration cannot proceed using this protocol. Discharge a small amount of solids to make sure that the spreader's distribution mechanism is fully charged. Discard these amounts. Set up the drop test box below the auger exit orifice to capture the solids. Turn on the auger at the setting that is most often used and measure the time it takes to fill up the standard drop test box using a stop watch. Safely even the distribution of the salt falling into the test box as it fills to the top (Figure 10). Once filled, record in the SAVE worksheet the time in seconds it took to fill and the auger

setting used. Transferring these values into the Excel worksheet will automatically update cells to give calculated spread rates (kg/ 100 m^2) for the auger setting tested in combination with the different spinner settings. Compare calculated spread rates for each spinner setting and continue to alter auger settings until desired standard application rates are reached. Empty the test box and repeat the auger test with the new setting.

Figure 9. Timing drop test until test box is filled (© Robert Roszell 2016).

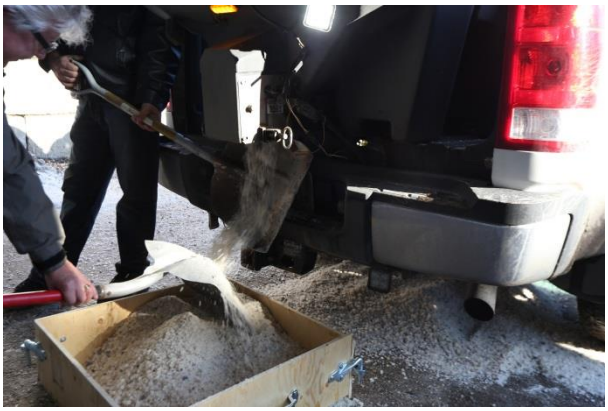

Figure 10. Ensure salt fills evenly into the test box during auger drop test.

Step 4: Determine optimal settings for standard low, medium, and high application rates (5, 10, 15 lb/ 1000 ft^2)

Once all the spread widths and drop test times have been recorded, transferring the values to the Excel worksheet will automatically highlight the closest calculated spread rates to the low, medium, and high application rates for each user entered speed. Use the chart to identify the auger and spinner setting that will produce these rates and record it in the “optimal settings” section. The entire chart or just the optimal settings can be printed and must be placed in a visible location in the cab for the operator’s reference.

The cab chart displaying the required auger and spinner settings based on desired salt application rates is unique to the tested spreader and truck combination and is deemed valid only for the verified combination. Should the spreader be moved to another truck, the spreader will need to be re-verified for the new spreader- truck combination and a new cab chart will be produced to reflect the change. The chart shall be clearly displayed next to the spreader controls or with a copy of the calibration sheet and placed on the vehicle instrument panel in full view.

When to Calibrate/Verify

The verification is only valid for the tested spreader/controller unit and for the tested combination of spreader/controller and truck. If the controller unit is repaired/ replaced or when speed sensors for the truck or auger/conveyor are replaced, the unit must be recalibrated and verified. Verification followed by manufacturer specific calibration/recalibration (if necessary) are to occur (i) annually prior to the winter maintenance seasons, (ii) after major maintenance of the spreader truck, including replacement of hydraulic fluid or filters, and (iii) before using newly delivered snow and ice control material.

SAVE Program
Salt Spreader Verification Worksheet

Company	
Address	
City	
Province	
Phone Number	
Email	
Website	

Calibration Date	

Truck Make	
Truck Model	
Truck Year	
License Plate	
Spreader Make	
Spreader Model	
Spreader Year	
Hydraulic or Electric Controls	
Gate opening height (cm)	
Gate opening width (cm)	
Gate opening area (cm^2)	

Auger Setting	Gate Opening (mm)	Time to Fill Box (sec)

Spinner Setting	Spread Width (ft)	Spread Width (m)