Inventory and Use of Material Spreader Systems

Synthesis Report

CLEAR ROADS

research for winter highway maintenance

CTC & Associates LLC

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16. Abstract

Material spreader systems are among the largest equipment expenses for winter road maintenance departments. These systems typically include a hopper or similar container to hold a supply of solid granular material; many also include a tank for dispensing a liquid. A chain conveyor or single/double auger system moves the granular material to the spinner, which disperses the material onto the roadway. Agencies often make their spreader purchase decisions after much research, comparison and discussion.

This synthesis sought to identify and describe the material spreader systems currently used by Clear Roads member agencies. A national survey of winter maintenance practitioners at state departments of transportation gathered descriptive information about material spreader systems and how they function, assessments of the spreader systems' operational capacities and effectiveness in a range of weather conditions, and the agencies' overall satisfaction with the material spreader systems.

Supplementing the summary of survey responses in this report are the individual material spreader system descriptions presented in Appendix B. Each system description is presented separately, organized by vendor and in alphabetical order by state, to allow for review and excerpting of individual system assessments.

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Executive Summary

Winter road maintenance teams in state departments of transportation (DOTs) use a wide range of tools throughout the winter months to maintain levels of service that promote safe traveling for motorists. Budgets and environmental impacts are a constant concern as DOTs select, purchase and maintain winter maintenance equipment. Material spreader systems are among the largest equipment expenses for winter road maintenance departments, and DOTs often make their spreader system purchase decisions after much research, comparison and discussion.

A material spreader system typically includes a hopper or similar container to hold a supply of solid granular material; many also include a tank for dispensing a liquid. A chain conveyor or single/double auger system moves the granular material to the spinner, which disperses the material onto the roadway. Methods of prewetting materials in spreader systems are common today as a means to reduce bounce and scatter and better manage dispersal. All types of spreaders require calibration for optimal effectiveness.

Material spreader systems have evolved to frequently include a computer-based controller connected to the spreader, allowing numerous operations to be managed in the truck cab. This project's focus is on the features and value of the material spreader rather than the associated computer-based controller.

This synthesis project builds on the December 2014 Clear Roads research project CR12-05, Comparison of Materials Distribution Systems, which collected an inventory of material spreader systems with the goal of developing a method to test the systems. The current synthesis effort used a survey of Clear Roads members to gather information about the agencies' material spreader systems. The survey sought descriptive information about the systems and how they function, an assessment of the spreader systems' operational capacities and effectiveness in a range of weather conditions, and the agencies' overall satisfaction with the material spreader systems.

Survey of Practice

An online survey distributed to the 36 Clear Roads member agencies gathered information about the material spreader systems currently used. Respondents could describe up to three of the most frequently used systems.

Participants from 16 states responded to the survey; respondents from five states provided information for multiple material spreader systems. In all, respondents described 29 systems. The Clear Roads member agencies responding to the survey are listed below, including the number of respondents if more than one and the number of material spreader systems described by respondents:

- Connecticut
- Delaware
- Idaho (2 systems)
- Kansas
- Maine (2 systems)
- Massachusetts
- Minnesota
- Montana (3 systems)
- Nevada
- New York
- Pennsylvania
- South Dakota
- Texas (6 respondents; 9 systems)
- Utah
- Vermont
- Wisconsin (2 systems)

Beginning on page 7, this synthesis report provides detailed and, in many cases, tabular presentations of individual survey responses. Highlights of these survey findings are presented below in six topic areas:

- Material spreader system selection
- System functionality
- System operation and assessment
- Factors affecting system selection
- Changing requirements
- Overall level of satisfaction

The material spreader systems described by respondents are also presented in Appendix B. Each system description is presented separately in the appendix, organized by vendor and in alphabetical order by state.

Material Spreader System Selection

All respondents reporting on material spreader systems identified a commercial system. The seven vendors or manufacturers providing the material spreader systems used by respondents appear in Table ES.1.

Table ES.1. Vendors/Manufacturers Providing Respondents' Material Spreader Systems

Vendor/Manufacturer	State/Respondent
Flink Company	Pennsylvania, Texas 2
Henderson Products	Delaware, Massachusetts, Montana, Nevada, New York, Utah, Wisconsin
Henke Manufacturing	Texas 2, Texas 6
Monroe Truck Equipment	Connecticut, Kansas, Montana, South Dakota, Wisconsin
Multiple Vendors	Minnesota
Schmidt	Maine
Swenson Products	Idaho 1, Idaho 2, Maine, Montana, Texas 1 through 6
Viking-Cives Midwest Inc.	Vermont

System Functionality

System Features and Functions

Respondents identified critical features of their agencies' spreader systems, selecting from among the following common functions:

- Spreads a range of materials
- Variable RPM control for different materials
- Material spread varies with speed of vehicle
- Adjustable spreader height above road surface
- Adjustable spreader dispersal pattern

Respondents' systems are least likely to allow for an adjustable spreader height. Almost all systems will spread a range of materials, and almost three-quarters of respondents' systems vary the material spread as the speed of the vehicle changes and allow for adjustable spreader dispersal.

Materials Delivered

Respondents were asked about the types of materials delivered by their spreader systems from among the following:

- Granular (sand, salt)
- Other solids (split stone)
- Prewetted solids
- Liquid
- Liquid combined with dry material
- Prewetted dry material and liquid

Unsurprisingly, almost all systems deliver granular materials. While only one system dispenses other solid materials such as split stone, two-thirds of respondents' systems dispense prewetted solids, and more than half dispense prewetted dry material and liquid.

Method to Control Material Spread Rate

Most respondents' systems use a ground speed closed loop system to control material spread rate. The method used to control spread rate does not appear to be tied to a specific manufacturer's material spreader.

Frequency of Calibration

Respondents were most likely to report calibrating their systems at the start of the season and when operators notice a discrepancy. No respondents calibrate their systems weekly, only two respondents reported calibrating monthly and six calibrate when new material is used.

Maintenance Costs

A few respondents provided details of the maintenance costs associated with their spreader systems:

- *Maine* (Schmidt). $1,000 year, compared to about $3,000 for the agency's other spreaders.
- *Massachusetts* (Henderson). Calibration costs less than $200 each season per unit.
- *Texas 4* (Swenson). $1,000 to $1,200 per year.

Other respondents commented more generally on maintenance costs, with both Idaho respondents noting that their Swenson systems, which were customized to meet agency specifications, had minimal maintenance costs. Other respondents noted that hoses are the most common maintenance items (Minnesota) and maintenance costs are minimal when the spreader is cleaned and preventive maintenance is completed after each use (Texas 1).

Other System Features

Other system features and functions are described in Appendix B, which contains a detailed summary of each material spreader system described by respondents. These additional system features and related functions include:

- Height from road surface the material is released
- Typical operating speed

- Operating speed variance
- Usage data retrieval

System Operation and Assessment

Operational Capacities

Respondents rated the following operational capacities using the following rating options: poor, fair, good, very good and excellent:

- Efficient use of manpower
- Flexibility to change with the weather
- Loading and unloading techniques

Respondents' ratings varied widely for each of these capacities, both within and among vendor systems, with most falling in the good to excellent range. Overall, averages for each of the three operational capacities were similar, with all three average ratings falling between good and very good.

Effectiveness in Different Weather Conditions

Again using the ratings options of poor, fair, good, very good and excellent, respondents rated their material spreader systems' effectiveness in addressing the following weather conditions:

- All winter storm conditions
- Before the snow falls
- After some snow has fallen
- During freezing rain

Most respondents provided good, very good or excellent ratings. Overall, averages for each of the weather conditions were similar, with all average ratings falling between good and very good.

Effectiveness of System Features and Functions

Respondents also rated the effectiveness of key system features and functions using the following rating options: poor, fair, good, very good and excellent:

- Accurate placement of chemicals
- Ease of calibration
- Effective use of chemicals

While still offering no consensus within vendors, respondents tended to rate their systems as good, very good or excellent.

Ease of System Upgrade

The ease with which the material spreader system can be upgraded was assessed by respondents using the rating options of very difficult, difficult, neutral, easy and very easy. Most respondents provided the neutral rating.

Bounce and Scatter

Respondents described their level of satisfaction with the degree of bounce and scatter of granular material after application using the rating options of not at all satisfied, slightly satisfied, moderately satisfied, very satisfied and extremely satisfied. More than half of respondents are extremely or very satisfied with their systems' results in terms of bounce and scatter.

Factors Affecting System Selection

Respondents most often cited price when asked about the system features that most influenced their agencies' selection of the present material spreader system over other competing systems. Other factors driving agency decision-making include reliability, safety and specific system features.

Changing Requirements

Only a few respondents noted that their agencies' requirements for a material spreader have changed since the purchase of the current system. In Maine, prewetting has become more important and the agency prefers belts when they work properly. The Minnesota respondent noted that when the agency changes the configuration of the truck, the spreader is often changed, and New York State DOT requires a spreader system that is automatic vehicle location (AVL)-compatible.

Overall Level of Satisfaction

Using the rating options of not at all satisfied, slightly satisfied, moderately satisfied, very satisfied and extremely satisfied, respondents described their agencies' overall level of satisfaction with their material spreader systems. Almost two-thirds of respondents are extremely or very satisfied with their systems.

Vendors and Manufacturers

This section of the report provides links to websites of the vendors or manufacturers providing the material spreader systems used by respondents.

Conclusion

This synthesis report provides a snapshot of the material spreader systems used by a subset of Clear Roads member agencies at the time of publication. The majority of respondents are satisfied with individual features and functions and reported overall satisfaction with the system. While price was a significant motivating factor in system selection for some agencies, other agencies sought specific features, and one agency—Idaho Transportation Department—developed special specifications for the manufacturer to meet at a designated price.

Appendix B, which provides individual respondents' assessments of their material spreader systems, can be used to inform future material spreader system purchases.

1 Introduction

Winter road maintenance teams in state departments of transportation (DOTs) use a wide range of tools throughout the winter months to maintain levels of service that promote safe traveling for motorists. Budgets and environmental impacts are a constant concern as DOTs select, purchase and maintain their equipment. Material spreader systems are among the largest equipment expenses for winter road maintenance departments. Many manufacturers offer material spreader systems, and there are many features and options to choose from. DOTs often make their spreader system purchase decisions after much research, comparison and discussion.

A material spreader system typically includes a hopper or similar container to hold a supply of solid granular material; many also include a tank for dispensing a liquid. A chain conveyor or single/double auger system moves the granular material to the spinner, which disperses the material onto the roadway. Methods of prewetting materials in spreader systems are common today as a means to reduce bounce and scatter and better manage dispersal. All types of spreaders require calibration for optimal effectiveness.

Material spreader systems have evolved to frequently include a computer-based controller connected to the spreader, allowing numerous operations to be managed in the truck cab. This project's focus is on gathering information about the features and value of the material spreader rather than the associated computer-based controller.

This synthesis project builds on the December 2014 Clear Roads research project CR12-05, Comparison of Materials Distribution Systems, which collected an inventory of material spreader systems with the goal of developing a method to testi the systems. The current synthesis effort used a survey of Clear Roads members to gather information about the agencies' material spreader systems. The survey sought descriptive information about the systems and how they function, an assessment of the spreader systems' operational capacities and effectiveness in a range of weather conditions, and the agencies' overall satisfaction with the material spreader systems.

2 Survey of Practice

2.1 Overview

An online survey distributed to Clear Roads member agencies gathered information about the material spreader systems currently used. Respondents were asked to describe up to three of the most frequently used spreader systems, describing each system in the following topic areas:

- System description (the model and make of the system, features and maintenance costs)
- System functionality (materials delivered, operating speed and calibration)
- System operation and assessment (operational capacities and effectiveness)
- System selection and value (influential features)

Survey questions are provided in Appendix A. The full text of the survey responses is available from the Clear Roads administrator.

Participants from 16 states responded to the survey; respondents from five states provided information for multiple material spreader systems. In all, respondents described 29 systems. The Clear Roads member agencies responding to the survey are listed below, including the number of respondents if more than one and the number of material spreader systems described by the respondents:

- Connecticut
- Delaware
- Idaho (2 systems)
- Kansas
- Maine (2 systems)
- Massachusetts
- Minnesota
- Montana (3 systems)
- Nevada
- New York
- Pennsylvania
- South Dakota
- Texas (6 respondents; 9 systems)
- Utah
- Vermont
- Wisconsin (2 systems)

Survey findings are highlighted below in six topic areas:

- Material spreader system selection
- System functionality
- System operation and assessment
- Factors affecting system selection
- Changing requirements
- Overall level of satisfaction

The material spreader systems described by respondents are also presented in Appendix B. Each system description is presented separately in the appendix, organized by vendor and in alphabetical order by state.

2.2 Material Spreader System Selection

All respondents reporting on material spreader systems identified a commercial system. The seven vendors or manufacturers providing the material spreader systems used by respondents appear in Table 2.1.

Table 2.1. Vendors/Manufacturers Providing Respondents' Material Spreader Systems

Vendor/Manufacturer	State/Respondent
Flink Company	Pennsylvania, Texas 2
Henderson Products	Delaware, Massachusetts, Montana, Nevada, New York, Utah, Wisconsin
Henke Manufacturing	Texas 2, Texas 6
Monroe Truck Equipment	Connecticut, Kansas, Montana, South Dakota, Wisconsin
Multiple Vendors	Minnesota
Schmidt	Maine
Swenson Products	Idaho 1, Idaho 2, Maine, Montana, Texas 1 through 6
Viking-Cives Midwest Inc.	Vermont

2.3 System Functionality

Survey results from responding agencies are summarized below in the following topic areas:

- System features and functions
- Materials delivered
- Method to control material spread rate
- Frequency of calibration
- Maintenance costs
- Other system features

Further details of the material spreader systems described by respondents are available in the system descriptions included in Appendix B.

System Features and Functions

Respondents identified critical features of their agencies' material spreader systems. These systems are least likely to allow for an adjustable spreader height. Almost all systems will spread a range of materials, and almost three-quarters vary the material spread as the speed of the vehicle changes and allow for adjustable spreader dispersal. Table 2.2 summarizes survey responses.

Table 2.2. Material Spreader Features and Functions

Vendor/Manufacturer	State/Respondent	Spreads Range of Materials	Variable RPM Control for Materials	Material Spread Varies with Vehicle Speed	Adjustable Spreader Height	Adjustable Spreader Dispersal Pattern
Flink Company	Pennsylvania	X	X		X	
	Texas 2	X	X			X
Henderson Products	Delaware	X	X	X	X	
	Massachusetts	X	X	X		X
	Montana	X		X	X	X
	Nevada	X	X	X		X
	New York	X	X	X	X	X
	Utah	X		X		
	Wisconsin		X	X	X	X
Henke Manufacturing	Texas 2	X			X	X
	Texas 6	X	X	X		X
Monroe Truck Equipment	Connecticut	X	X	X		
	Kansas	X		X		X
	Montana	X		X	X	X
	South Dakota	X	X	X		X
	Wisconsin	X	X	X		X
Multiple Vendors	Minnesota	X	X	X	X	X
Schmidt	Maine	X	X	X		X

Vendor/Manufacturer	State/Respondent	Spreads Range of Materials	Variable RPM Control for Materials	Material Spread Varies with Vehicle Speed	Adjustable Spreader Height	Adjustable Spreader Dispersal Pattern
Swenson Products	Idaho 1	X	X	X	X	X
	Idaho 2	X	X	X	X	X
	Maine		X	X		X
	Montana	X		X	X	X
	Texas 1	X	X	X		X
	Texas 2	X			X	X
	Texas 3	X	X	X	X	X
	Texas 4	X	X	X	X	X
	Texas 5	X		X		X
	Texas 6	X	X	X		X
Viking-Cives Midwest Inc.	Vermont	X	X	X		X
	Total	**27**	**21**	**25**	**14**	**25**

Materials Delivered

Almost all systems deliver granular materials. Only one system dispenses other solid materials such as split stone, and half dispense prewetted dry material and liquid. The types of materials delivered by respondents' spreader systems are identified in Table 2.3.

Table 2.3. Materials Delivered by Respondents' Spreader Systems

Vendor/Manufacturer	State/Respondent	Granular (Sand, Salt)	Other Solids (Split Stone)	Prewetted Solids	Liquid	Liquid Combined with Dry Material	Prewetted Dry Material and Liquid
Flink Company	Pennsylvania	X	X	X			X
	Texas 2	X		X			X
Henderson Products	Delaware	X			X	X	
	Massachusetts	X		X	X		
	Montana	X					
Henderson Products	Nevada				X	X	X
	New York	X		X	X	X	X
	Utah	X		X	X	X	X
	Wisconsin	X		X			
Henke Manufacturing	Texas 2	X		X			X
	Texas 6	X		X			X
Monroe Truck Equipment	Connecticut	X			X		
	Kansas	X		X	X	X	X
	Montana	X					

Vendor/Manufacturer	State/Respondent	Granular (Sand, Salt)	Other Solids (Split Stone)	Prewetted Solids	Liquid	Liquid Combined with Dry Material	Prewetted Dry Material and Liquid
Monroe Truck Equipment	South Dakota	X		X	X	X	X
	Wisconsin	X		X			
Multiple Vendors	Minnesota	X		X	X	X	X
Schmidt	Maine	X		X	X	X	X
Swenson Products	Idaho 1	X		X		X	X
	Idaho 2				X		
	Maine	X		X			
	Montana	X					
	Texas 1	X			X		
	Texas 2	X		X			X
	Texas 3	X					
	Texas 4	X					
	Texas 5	X		X			
	Texas 6	X		X			X
Viking-Cives Midwest Inc.	Vermont	X		X	X	X	X
	Total	**27**	**1**	**19**	**13**	**10**	**15**

Method to Control Material Spread Rate

Tables 2.4, 2.5 and 2.6 summarize the methods used by respondents' material spreader systems to control the material spread rate. Systems are most likely to use a ground speed closed loop system. Two respondents using Swenson systems provided additional details:

- Some closed loop, others open loop (Maine).
- Ground speed plus gate opening (Texas 4).

Table 2.4. Controlling Spread Rate: Ground Speed Closed Loop Systems

Vendor/Manufacturer	State/Respondent
Flink Company	Pennsylvania
Henderson Products	Delaware
	Massachusetts
Henderson Products	Montana
	New York
	Wisconsin
Henke Manufacturing	Texas 6
Monroe Truck Equipment	Kansas
	Montana
	South Dakota

Vendor/Manufacturer	State/Respondent
Multiple Vendors	Minnesota
Schmidt	Maine
Swenson Products	Idaho 1
	Idaho 2
	Montana
	Texas 6
Viking-Cives Midwest Inc.	Vermont

Table 2.5. Controlling Spread Rate: Ground Speed Open Loop Systems

Vendor/Manufacturer	State/Respondent
Henderson Products	Utah
Monroe Truck Equipment	Connecticut
Swenson Products	Texas 1
	Texas 5

Table 2.6. Controlling Spread Rate: Manual Systems

Vendor/Manufacturer	State/Respondent
Flink Company	Texas 2
Henke Manufacturing	Texas 2
Swenson Products	Texas 2
	Texas 3

Frequency of Calibration

Respondents were most likely to report calibrating their systems at the start of the season and when operators notice a discrepancy. No respondents calibrate their systems weekly, only two calibrate monthly and six calibrate when new material is used. Table 2.7 presents survey responses.

Table 2.7. Frequency of Material Spreader System Calibration

Vendor/Manufacturer	State/Respondent	Every Time New Material Used	Monthly	Start of the Season	When Operators Notice Discrepancy	When the System Repaired
Flink Company	Pennsylvania			X	X	X
	Texas 2				X	
Henderson Products	Delaware			X		
	Massachusetts[1]					

Vendor/Manufacturer	State/Respondent	Every Time New Material Used	Monthly	Start of the Season	When Operators Notice Discrepancy	When the System Repaired
Henderson Products	Montana	X		X	X	X
	Nevada			X		
	New York	X	X	X	X	X
	Utah			X		
	Wisconsin	X		X	X	X
Henke Manufacturing	Texas 2				X	
	Texas 6			X	X	X
Monroe Truck Equipment	Connecticut			X	X	
	Kansas			X	X	
	Montana	X		X	X	X
	South Dakota			X	X	X
	Wisconsin			X	X	X
Multiple Vendors	Minnesota			X	X	
Schmidt	Maine			X	X	X
Swenson Products	Idaho 1		X	X	X	X
	Idaho 2				X	X
	Maine			X	X	X
	Montana	X		X	X	
	Texas 1			X		
	Texas 2				X	
	Texas 3			X		
	Texas 4			X	X	
	Texas 5			X		
	Texas 6			X	X	X
Viking-Cives Midwest Inc.	Vermont	X		X	X	X
	Total	**6**	**2**	**24**	**22**	**14**

1 The agency tries to calibrate all spreaders annually. The respondent noted that the agency relies on contracted spreaders for more than 90% of its fleet, and these spreaders must be calibrated annually.

Maintenance Costs

Some respondents provided details of the maintenance costs associated with their spreader systems:

- *Maine* (Schmidt). $1,000 year, compared to about $3,000 for the agency's other spreaders.
- *Massachusetts* (Henderson). Calibration costs less than $200 each season per unit.
- *Texas 4* (Swenson). $1,000 to $1,200 per year.

Other respondents commented more generally on maintenance costs:

- *Idaho 1* (Swenson). Moderate to low maintenance costs so far.

- *Idaho 2* (Swenson). Minimal maintenance costs. Most issues are either electrical or flow meter faults.
- *Minnesota* (Multiple Vendors). Hoses are the most common maintenance items, but occasionally the agency has had to replace some motors.
- *Montana* (Monroe). Price varies periodically and annually. Weather, breakdowns, maintenance, corrosion issues, inflation, tariffs, parts availability and accidents are among the many factors contributing to periodic and annual costs.
- *Texas 1* (Swenson). Minimal cost when the spreader is cleaned and preventive maintenance is completed after each use.
- *Texas 6* (Henke). Costs are consistent with most spreader boxes. The savings come in the form of life expectancy.
- *Texas 6* (Swenson). Costs are fairly consistent with other V-box spreaders. Cost savings come in the form of longer life expectancy.

Other System Features

Other system features and functions are described in Appendix B, which contains a detailed summary of each material spreader system described by respondents. These additional system features and related functions include:

- Height from road surface the material is released
- Typical operating speed
- Operating speed variance
- Usage data retrieval

2.4 System Operation and Assessment

Respondents evaluated their material spreader systems in a variety of categories:

- Operational capacities, including:
  - Efficient use of manpower
  - Flexibility to change with the weather
  - Loading and unloading techniques
- Effectiveness in different weather conditions
- Effectiveness of system features and functions, including:
  - Accurate placement of chemicals
  - Ease of calibration
  - Effective use of chemicals
- Level of satisfaction with degree of bounce and scatter of granular material

Operational Capacities

Respondents rated three operational capacities using the following rating options: poor, fair, good, very good and excellent. Respondents' ratings varied widely for each of these capacities, both within and among vendor products, with most falling in the good to excellent range. Overall, averages for each of

the three operational capacities were similar, with all three average ratings falling between good and very good. Table 2.8 presents survey responses.

Table 2.8. Respondents' Ratings of Operational Capacities

Vendor/Manufacturer	State/Respondent	Efficient Use of Manpower	Flexibility to Change with the Weather	Loading and Unloading Techniques
Flink Company	Pennsylvania	Good	Very good	Good
	Texas 2	Good	Good	Fair
Henderson Products	Delaware	Good	Good	Fair
	Massachusetts	Very good	Very good	Very good
	Montana	Very good	Very good	Very good
	Nevada	Good	Good	Good
	New York	Fair	Fair	Fair
Henderson Products	Utah	Very good	Very good	Very good
	Wisconsin	Good	Very good	Good
Henke	Texas 2	Good	Good	Good
	Texas 6	Very good	Very good	Very good
Monroe Truck Equipment	Connecticut	Very good	Very good	Good
	Kansas	Excellent	Excellent	Good
	Montana	Very good	Very good	Very good
	South Dakota	Excellent	Excellent	Very good
	Wisconsin	Very good	Very good	Very good
Multiple Vendors	Minnesota	Very good	Very good	Very good
Schmidt	Maine	Very good	Very good	Good
Swenson Products	Idaho 1	Very good	Very good	Good
	Idaho 2	Excellent	Excellent	Excellent
	Maine	Fair	Fair	Fair
	Montana	Very good	Very good	Very good
	Texas 1	Good	Good	Good
	Texas 2	Good	Good	Fair
	Texas 3	Very good	Fair	Good
	Texas 4	Very good	Very good	Very good
	Texas 5	Good	Good	Fair
	Texas 6	Very good	Very good	Very good
Viking-Cives Midwest Inc.	Vermont	Excellent	Excellent	Excellent

Effectiveness in Different Weather Conditions

Again using the rating options of poor, fair, good, very good and excellent, respondents rated their material spreader systems' effectiveness in addressing a range of weather conditions. Most respondents provided good, very good or excellent ratings. Overall, averages for each of the weather conditions were

similar, with all average ratings falling between good and very good. Table 2.9 presents survey responses.

Table 2.9. Respondents' Ratings of Effectiveness in Different Weather Conditions

Vendor/Manufacturer	State/Respondent	All Winter Storm Conditions	Before the Snow Falls	After Some Snow has Fallen	During Freezing Rain
Flink Company	Pennsylvania	Good	Good	Good	Good
	Texas 2	Good	Good	Good	Good
Henderson Products	Delaware	Good	Good	Good	Good
	Massachusetts	Very good	Very good	Very good	Very good
	Montana	Very good	Very good	Very good	Very good
	Nevada	Fair	Fair	Good	Fair
	New York	Fair	Fair	Fair	Fair
	Utah	Very good	Very good	Very good	No response
	Wisconsin	Good	Very good	Good	Good
Henke Manufacturing	Texas 2	Good	Good	Good	Good
	Texas 6	Very good	Excellent	Very good	Fair
Monroe Truck Equipment	Connecticut	Very good	Very good	Very good	Very good
	Kansas	Excellent	Excellent	Excellent	Excellent
	Montana	Very good	Very good	Very good	Very good
	South Dakota	Excellent	Excellent	Excellent	Excellent
	Wisconsin	Very good	Excellent	Very good	Good
Multiple Vendors	Minnesota	Very good	Very good	Very good	Very good
Schmidt	Maine	Very good	Very good	Very good	Very good
Swenson Products	Idaho 1	Excellent	Good	Excellent	Good
	Idaho 2	Excellent	Excellent	Excellent	Excellent
	Maine	Good	Poor	Good	Good
	Montana	Very good	Very good	Very good	Very good
	Texas 1	Good	Good	Good	Good
	Texas 2	Good	Good	Good	Good
	Texas 3	Very good	Very good	Very good	Good
	Texas 4	Good	Very good	Very good	No response
	Texas 5	Good	Good	Good	Good
	Texas 6	Very good	Excellent	Very good	Fair
Viking-Cives Midwest Inc.	Vermont	Excellent	Excellent	Excellent	Excellent

Effectiveness of System Features and Functions

Respondents also assessed the effectiveness of key system features and functions using the following rating options: poor, fair, good, very good and excellent. While offering no consensus on this set of features and functions, respondents tended to rate their systems as good, very good or excellent with

regard to accurate placement of chemicals; ease of calibration; and effective use of chemicals. Table 2.10 presents survey responses.

Table 2.10. Respondents' Ratings of System Features and Functions

Vendor/Manufacturer	State/Respondent	Accurate Placement of Chemicals	Ease of Calibration	Effective Use of Chemicals
Flink Company	Pennsylvania	Very good	Good	Very good
	Texas 2	Good	Good	Good
Henderson Products	Delaware	Fair	Fair	Fair
	Massachusetts	Very good	Very good	Very good
	Montana	Very good	Very good	Very good
	Nevada	Fair	Fair	Fair
	New York	Fair	Good	Fair
	Utah	Very good	Very good	Very good
	Wisconsin	Very good	Very good	Very good
Henke Manufacturing	Texas 2	Good	Good	Good
	Texas 6	Very good	Very good	Very good
Monroe Truck Equipment	Connecticut	Good	Good	Very good
	Kansas	Very good	Good	Very good
	Montana	Very good	Very good	Very good
	South Dakota	Excellent	Excellent	Excellent
	Wisconsin	Very good	Very good	Very good
Multiple Vendors	Minnesota	Very good	Very good	Very good
Schmidt	Maine	Very good	Very good	Very good
Swenson Products	Idaho 1	Very good	Very good	Very good
	Idaho 2	Excellent	Excellent	Excellent
	Maine	Good	Good	Good
	Montana	Good	Good	Good
	Texas 1	Good	Good	Good
	Texas 2	Good	Good	Good
	Texas 3	Very good	Good	Very good
	Texas 4	Very good	Very good	Very good
	Texas 5	Good	Fair	Good
	Texas 6	Very good	Very good	Very good
Viking-Cives Midwest Inc.	Vermont	Excellent	Good	Excellent

Ease of System Upgrade

The ease with which the material spreader system can be upgraded was assessed by respondents using the rating options of very difficult, difficult, neutral, easy and very easy. Most respondents provided the neutral rating. Table 2.11 summarizes survey responses.

Table 2.11. Ease of System Upgrade

Rating	Vendor/Manufacturer	State/Respondent
Very Easy	Monroe Truck Equipment	Montana
		South Dakota
	Multiple Vendors	Minnesota
Easy	Henderson Products	Massachusetts
		Montana
	Schmidt	Maine
	Swenson Products	Texas 1
		Texas 4
Neutral	Flink Company	Pennsylvania
		Texas 2
	Henderson Products	Nevada
		Utah
		Wisconsin
	Henke Manufacturing	Texas 2
		Texas 6
	Monroe Truck Equipment	Connecticut
		Kansas
		Montana
		Wisconsin
	Swenson Products	Idaho 1
		Idaho 2
		Maine
		Montana
		Texas 2
		Texas 3
		Texas 6
	Viking-Cives Midwest Inc.	Vermont
Difficult	Henderson Products	New York
	Swenson Products	Texas 5

Bounce and Scatter

Respondents described their level of satisfaction with the degree of bounce and scatter of granular material after application using the rating options of not at all satisfied, slightly satisfied, moderately satisfied, very satisfied and extremely satisfied. More than half of respondents are extremely or very satisfied with their systems' results in terms of bounce and scatter. Table 2.12 summarizes survey responses.

Table 2.12. Respondents' Level of Satisfaction with Bounce and Scatter

Rating	Vendor/Manufacturer	State/Respondent
Extremely Satisfied	Monroe Truck Equipment	South Dakota
	Viking-Cives Midwest Inc.	Vermont
Very Satisfied	Henderson Products	Massachusetts
		Montana
		Utah
		Wisconsin
	Henke Manufacturing	Texas 6
	Monroe Truck Equipment	Montana
		Wisconsin
	Multiple Vendors	Minnesota
	Schmidt	Maine
	Swenson Products	Idaho 1
		Texas 1
		Texas 3
		Texas 4
		Texas 6
Moderately Satisfied	Flink Company	Pennsylvania
		Texas 2
	Henderson Products	Nevada
	Henke Manufacturing	Texas 2
	Monroe Truck Equipment	Connecticut
		Kansas
	Swenson Products	Maine
		Montana
		Texas 2
		Texas 5
Slightly Satisfied	Henderson Products	New York
Not At All Satisfied	Henderson Products	Delaware

2.5 Factors Affecting System Selection

Respondents most often cited price when asked about the system features that most influenced the selection of their current material spreader system over competing systems. Other factors driving agency decision-making include reliability, safety and specific system features. Table 2.13 summarizes survey responses.

Table 2.13. Factors Affecting Selection of Current Material Spreader

Factor	State/Respondent	Vendor/Manufacturer	Description
Functionality	Kansas	Monroe Truck Equipment	Ability to spread uniformly at a low application rate.
Price	Idaho 1	Swenson Products	Pricing; all options met agency specification requirements.
	Texas 2	Flink Company	Price
	Texas 2	Henke Manufacturing	Pricing
	Texas 2	Swenson Products	Pricing
	Texas 5	Swenson Products	Price
Reliability	Maine	Schmidt	Reliability over time. The respondent noted that equipment purchased in 2004 is "still like new."
Safety	Texas 4	Swenson Products	Safety; newer pieces of equipment.
Specific Features	Texas 6	Henke Manufacturing	Stainless steel with removable conveyor.
	Texas 6	Swenson Products	Having stainless steel construction.
Multiple Factors	Connecticut	Monroe Truck Equipment	Pricing and ease of use for operators and technicians.
	Massachusetts	Henderson Products	Adaptability and ease of use.
	Montana	Monroe Truck Equipment	The ability to have all systems consistent for operators and mechanics; less down time; ease of training; and replacement parts.
	New York	Henderson Products	Safety and training as well as durability will be weighted most heavily.

Respondents also explained how factors such as system features and functions, pricing and compatibility with other equipment contributed to their agencies' purchasing decisions. More information about how purchasing decisions were made is included in the detailed descriptions of material spreader systems that appear in Appendix B.

2.6 Changing Requirements

Several respondents noted that their agencies' requirements for a material spreader have changed since the purchase of their current system. Table 2.14 summarizes survey responses.

Table 2.14. Changing Material Spreader System Requirements

State/Respondent	Vendor/Manufacturer	Description
Maine	Swenson Products	Prewetting has become more important, and the agency prefers belts when they work properly.
Minnesota	Multiple Vendors	The spreader is often changed when the agency changes truck configuration.
New York	Henderson Products	The agency requires a spreader system that is AVL-compatible.

2.7 Overall Level of Satisfaction

Using the rating options of not at all satisfied, slightly satisfied, moderately satisfied, very satisfied and extremely satisfied, respondents described their agencies' overall level of satisfaction with their material spreader systems. Almost two-thirds of respondents are extremely or very satisfied with their systems, with the level of satisfaction varying within manufacturers. Table 2.15 summarizes survey responses.

Table 2.15. Respondents' Overall Level of Satisfaction

Rating	Vendor/Manufacturer	State/Respondent
Extremely Satisfied	Monroe Truck Equipment	South Dakota
	Swenson Products	Idaho 2
	Viking-Cives Midwest Inc.	Vermont
Very Satisfied	Flink Company	Pennsylvania
	Henderson Products	Utah
		Wisconsin
	Henke Manufacturing	Texas 6
	Monroe Truck Equipment	Kansas
		Montana
		Wisconsin
	Multiple Vendors	Minnesota
	Schmidt	Maine
	Swenson Products	Idaho 1
		Texas 1
		Texas 3
		Texas 4
		Texas 6
Moderately Satisfied	Flink Company	Texas 2
	Henderson Products	Massachusetts
		Nevada
	Henke Manufacturing	Texas 2
	Monroe Truck Equipment	Connecticut
	Swenson Products	Maine
		Texas 2
		Texas 5
Slightly Satisfied	Henderson Products	Delaware
		New York

3 Vendors and Manufacturers

Below are links to websites of the vendors and manufacturers providing the material spreader systems described by respondents.

Flink Company
http://www.flinkco.com/index_files/spreaders.htm
This website provides information about the company's snowplows, spreaders (tailgate and hopper types) and wetting systems. See http://www.flinkco.com/index_files/hopperspreaders.htm for additional information.

Henderson Products
http://www.hendersonproducts.com/spreaders.html
From the website: Henderson Products is a leading manufacturer of premium sand [and] salt spreaders. Henderson spreaders (V-box sanders) offer various sizes and capacities designed to work with pickup trucks all the way up to heavy-duty tandem axle trucks. We start with the basics and begin adding custom options to fit your specific requirements. Available in either carbon steel (painted) or stainless steel.

Henke Manufacturing
https://henkemfg.com/spreaders/
This web page provides information about the company's cartridge, V-box and under tailgate spreaders.

Monroe Truck Equipment
http://www.monroetruck.com/Products.aspx?category=199&name=Spreaders
This web page provides information about the company's tailgate, V-box and all-season spreaders.

Schmidt (Aebi Schmidt Group)
https://www.aebi-schmidt.com/en/products-solutions/products/
This website provides information about the spreaders and other winter maintenance products offered by Schmidt.

Swenson Products
https://www.swensonproducts.com/
This website provides information about a range of Swenson spreader products.

Viking-Cives Midwest Inc.
https://www.vikingcives.com/Products/?CategoryID=5
This website provides information about slide-in and chassis-mount spreader systems and spreader stands.

Appendix A: Survey Questions

The following survey was distributed to representatives of the 36 Clear Roads member agencies to gather information for this synthesis report. The full text of survey responses, including contact information for respondents, is presented in a supplement to this report and available from the Clear Roads administrator.

Clear Roads Survey on Selection and Use of Material Spreader Systems
The survey questions below ask you to describe up to three of the material spreader systems your agency uses, including system features and effectiveness, and why you selected these systems. Please feel free to share this survey with others in your agency. Multiple people at the same agency may respond to this survey and answer only those questions that apply to them.

Material Spreader Systems

The next sections of the survey ask you to describe the material spreader systems your agency uses. The survey gives you the opportunity to describe three different systems. If your agency uses more than three spreader systems, please describe the **three most frequently used** systems.

Spreader System 1

System Description

1. Was the spreader system designed and developed in-house or is it a commercial product?
    - In-house system (Respond to **Question 1A**.)
    - Commercial product (Respond to **Question 1B**.)

1A. Please briefly describe the design of your in-house system.

1B. What is the manufacturer, model and year of your commercial system?

2. What features does the spreader system offer? Select all that apply.
    - Spreads a range of materials
    - Variable RPM control for different materials
    - Material spread varies with speed of vehicle
    - Adjustable spreader height above road surface
    - Adjustable spreader dispersal pattern
    - Other (Please describe.)
3. Please describe any features this system offers that are not listed in Question 2.
4. Please characterize the importance of this system in your spreader fleet by selecting the best option below.
    - This is the spreader we use most often.
    - We frequently use this spreader.
    - We rarely use this spreader.
    - Other (Please describe.)
5. If available, please provide links to images or documents related to the spreader system. Send any images or files not available online to sharon.vansluijs@ctcandassociates.com.

System Functionality

1. What type of material will the spreader system deliver to the road surface? Select all that apply.
    - Granular (sand, salt)
    - Other solid (e.g., split-stone)
    - Prewetted solids
    - Liquid
    - Liquid combined with dry material
    - Prewetted dry material and liquid
    - Other (Please describe.)
2. At what height from the road surface is the material released?
3. What method does the system use to control the spread rate?
    - Ground speed (closed loop)
    - Ground speed (open loop)
    - Manual
    - Other (Please describe.)

1. What is the typical operating speed (mph) when applying material with the spreader system?
2. Does the operating speed vary during material application?
    - No
    - Yes (Please describe why the operating speed varies and when.)
3. How often is the spreader system calibrated?
    - Every time new material is used
    - Weekly
    - Monthly
    - At the start of the season
    - If operators notice discrepancies
    - When the system is repaired
    - Other (Please describe.)
4. Please describe how the spreader system's usage data is retrieved.

System Operation and Assessment

For the ratings questions below, the survey includes five numbered options: 1 = poor; 2 = fair; 3 = good; 4 = very good; and 5 = excellent.

1. What is your agency's level of satisfaction with the degree of bounce and scatter of granular material after application?
    - Not at all satisfied
    - Slightly satisfied
    - Moderately satisfied
    - Very satisfied
    - Extremely satisfied
2. Please rate the spreader system's operational capacities listed below using the rating scale of 1 = poor to 5 = excellent.
    - Efficient use of manpower
    - Flexibility to change with the weather
    - Loading and unloading techniques

2A. Please comment on and rate other significant operational capacities of the spreader system.

3. Please rate the spreader system's effectiveness in the weather conditions listed below using the rating scale of 1 = poor to 5 = excellent.
    - All winter storm conditions
    - Before the snow falls
    - After some snow has fallen
    - During freezing rain

3A. Please comment on and rate the effectiveness of the spreader system under other significant weather conditions.

4. Please rate the spreader system's features and functions listed below using the rating scale of 1 = poor to 5 = excellent.
    - Accurate placement of chemicals
    - Ease of calibration
    - Effective use of chemicals

4A. Please comment on and rate other significant features and functions of the spreader system.

5. What is your agency's overall level of satisfaction with the spreader system?
    - Not at all satisfied
    - Slightly satisfied
    - Moderately satisfied
    - Very satisfied
    - Extremely satisfied

System Selection and Value

1. Please provide the name of the other manufacturer(s) and model(s) your agency considered before purchasing this system.
2. Please briefly explain how the factors listed below contributed to your agency's decision to purchase this spreader system.
    - System features and functions
    - Pricing
    - Compatibility with other equipment
    - Other (Please describe.)
3. Which system features most influenced your agency's choice of it over the "second best" system?
4. Please describe the maintenance costs associated with the spreader system. Indicate if these costs are periodic or annual.
5. Please describe the ease with which the spreader system can be upgraded by selecting the best option below.
    - Very difficult
    - Difficult
    - Neutral
    - Easy
    - Very easy
    - Other (Please describe.)
6. Have your agency's requirements for a material spreader changed since the purchase of the present system?
    - No
    - Yes (Please describe how your agency's requirements have changed.)

7. Would your agency purchase the same spreader system again?
    - Yes
    - No (Please indicate why you wouldn't repeat this purchase.)

Note: In the online survey, the question blocks presented above for Spreader System 1 were repeated for Spreader System 2 and Spreader System 3 based on the respondent's reply to the question in **Other Spreader Systems** (see below).

Respondents providing information for all three sets of spreader system questions were directed to the **Wrap-Up** section after responding to the questions under Spreader System 3.

Other Spreader Systems

(Required) Our agency uses a second/third material spreader system.

- Yes (Skips the respondent to **Spreader System 2/Spreader System 3** questions.)
- No (Skips the respondent to the **Wrap-Up** section.)

Wrap-Up

Please use this space to provide any comments or additional information about your previous responses.

Appendix B: Material Spreader System Descriptions

Detailed summaries of the material spreader systems described by respondents are presented in this appendix, organized by system vendor and in alphabetical order by state. Table B.1 identifies the seven vendors providing the spreader systems and the states/respondents providing the system descriptions.

Table B.1. Vendors/Manufacturers Providing Respondents' Material Spreader Systems

Material Spreader System Descriptions
Flink Company

Agency: Pennsylvania Department of Transportation

System Description	
Vendor, Model, Year	Flink, various years
System Features	• Spreads a range of materials • Variable RPM control for different materials • Adjustable spreader height above road surface
Type of Use	This is the spreader we use most often.
Maintenance Costs	Not provided
Documents or Images	Not provided

System Functionality	
Material Types Delivered	• Granular (sand, salt) • Other solid (e.g., split-stone) • Prewetted solids • Prewetted dry material and liquid
Height From Road Surface	12” to 18”
Spread Rate Control	Ground speed (closed loop)
Typical Operating Speed	Dependent upon road, such as urban/rural/interstate
Operating Speed Variance	Hills, intersections, traffic, curves
Calibration Frequency	• At the start of the season • If operators notice discrepancies • When the system is repaired
Usage Data Retrieval	Electronic database via internet

System Operation and Assessment	
	Rating options for the following categories: poor, fair, good, Very good and excellent.
Operational Capacities	
Efficient Use of Manpower	Good
Flexibility to Change With Weather	Very good
Loading and Unloading Techniques	Good
Comments	None

Material Spreader System Descriptions
Flink Company

Agency: Pennsylvania Department of Transportation

Effectiveness	
All Winter Storm Conditions	Good
Before the Snow Falls	Good
After Some Snow Has Fallen	Good
During Freezing Rain	Good
Comments	None
Features and Functions	
Accurate Placement of Chemicals	Very good
Ease of Calibration	Good
Effective Use of Chemicals	Very good
Comments	None
	Rating options for the following category: very difficult, difficult, neutral, easy and very easy.
System Upgrade	
Ease of System Upgrade	Neutral
	Rating options for the following category: not at all satisfied, slightly satisfied, moderately satisfied, very satisfied and extremely satisfied.
Level of Satisfaction	
Bounce and Scatter	Moderately satisfied
Overall Satisfaction	Very satisfied

System Selection and Value	
Other Systems Considered	Not provided
Most Influential Features	Not provided
Change in Agency Requirements	No
Purchase Again	Yes
	Members described how the factors listed below contributed to the decision to purchase this spreader system.
System Features and Functions	Not provided
Pricing	Not provided
Equipment Compatibility	Not provided
Other Factors	Not provided

Material Spreader System Descriptions
Flink Company

Agency: Texas Department of Transportation 2

System Description	
Vendor, Model, Year	Flink
System Features	• Spreads a range of materials • Variable RPM control for different materials • Adjustable spreader dispersal pattern
Type of Use	This is the spreader we use most often.
Maintenance Costs	This is not tracked by our agency.
Documents or Images	Not provided

System Functionality	
Material Types Delivered	• Granular (sand, salt) • Prewetted solids • Prewetted dry material and liquid
Height From Road Surface	18” to 24”
Spread Rate Control	Manual
Typical Operating Speed	5 to 10 mph
Operating Speed Variance	Depending on traffic
Calibration Frequency	If operators notice discrepancies
Usage Data Retrieval	Manually

System Operation and Assessment	
	Rating options for the following categories: poor, fair, good, Very good and excellent.
Operational Capacities	
Efficient Use of Manpower	Good
Flexibility to Change With Weather	Good
Loading and Unloading Techniques	Fair
Comments	None
Effectiveness	
All Winter Storm Conditions	Good
Before the Snow Falls	Good
After Some Snow Has Fallen	Good
During Freezing Rain	Good
Comments	None

Material Spreader System Descriptions
Flink Company

Agency: Texas Department of Transportation 2

Features and Functions	
Accurate Placement of Chemicals	Good
Ease of Calibration	Good
Effective Use of Chemicals	Good
Comments	None
	Rating options for the following category: very difficult, difficult, neutral, easy and very easy.
System Upgrade	
Ease of System Upgrade	Neutral
	Rating options for the following category: not at all satisfied, slightly satisfied, moderately satisfied, very satisfied and extremely satisfied.
Level of Satisfaction	
Bounce and Scatter	Moderately satisfied
Overall Satisfaction	Moderately satisfied

System Selection and Value	
Other Systems Considered	Unknown
Most Influential Features	Price
Change in Agency Requirements	No
Purchase Again	Yes
	Members described how the factors listed below contributed to the decision to purchase this spreader system.
System Features and Functions	Not provided
Pricing	Competitive bidding
Equipment Compatibility	Not provided
Other Factors	Not provided

Material Spreader System Descriptions
Henderson Products

Agency: Delaware Department of Transportation

System Description	
Model	Henderson V-box with certified Cirus XDS controller
System Features	• Spreads a range of materials • Variable RPM control for different materials • Material spread varies with speed of vehicle • Adjustable spreader height above road surface
Type of Use	This is the spreader we use most often.
Maintenance Costs	Not provided
Documents or Images	Not provided

System Functionality	
Material Types Delivered	• Granular (sand, salt) • Liquid • Liquid combined with dry material
Height From Road Surface	Variable
Spread Rate Control	Ground speed (closed loop)
Typical Operating Speed	35 mph
Operating Speed Variance	Varies with traffic and road conditions; stop/start at intersections
Calibration Frequency	At the start of the season
Usage Data Retrieval	Manually using a USB drive/computer

System Operation and Assessment	
	Rating options for the following categories: poor, fair, good, Very good and excellent.
Operational Capacities	
Efficient Use of Manpower	Good
Flexibility to Change With Weather	Good
Loading and Unloading Techniques	Fair
Comments	Data produced is often highly variable and questionable.
Effectiveness	
All Winter Storm Conditions	Good
Before the Snow Falls	Good
After Some Snow Has Fallen	Good
During Freezing Rain	Good

Material Spreader System Descriptions
Henderson Products

Agency: Delaware Department of Transportation

Comments	None
Features and Functions	
Accurate Placement of Chemicals	Fair
Ease of Calibration	Fair
Effective Use of Chemicals	Fair
Comments	None
	Rating options for the following category: very difficult, difficult, neutral, easy and very easy.
System Upgrade	
Ease of System Upgrade	Not provided
	Rating options for the following category: not at all satisfied, slightly satisfied, moderately satisfied, very satisfied and extremely satisfied.
Level of Satisfaction	
Bounce and Scatter	Not at all satisfied
Overall Satisfaction	Slightly satisfied

System Selection and Value	
Other Systems Considered	Not provided
Most Influential Features	Not provided
Change in Agency Requirements	Not provided
Purchase Again	Not provided
	Members described how the factors listed below contributed to the decision to purchase this spreader system.
System Features and Functions	Not provided
Pricing	Not provided
Equipment Compatibility	Not provided
Other Factors	Not provided

Material Spreader System Descriptions
Henderson Products

Agency: Massachusetts Department of Transportation

System Description	
Vendor, Model, Year	Henderson spreader; Cirus SpreadSmart controller
System Features	• Spreads a range of materials • Variable RPM control for different materials • Material spread varies with speed of vehicle • Adjustable spreader dispersal pattern
Type of Use	This is the spreader we use most often.
Maintenance Costs	Calibration costs less than $200 each season per unit.
Documents or Images	Not provided

System Functionality	
Material Types Delivered	• Granular (sand, salt) • Prewetted solids • Liquid
Height From Road Surface	Our spec is 16” above roadway +/- 4” for spinner height.
Spread Rate Control	Ground speed (closed loop)
Typical Operating Speed	Below 25 mph
Operating Speed Variance	Maybe a slight bit faster on a mainline than a single-lane state road
Calibration Frequency	We try to calibrate all MassDOT spreaders annually. We rely on 90% + contracted spreaders which must be calibrated annually.
Usage Data Retrieval	We use a variety of methods: • Webtech/Geotab Fleetworks GPS/AVL platform • Cirus drive-by downloads • Contractors provide numbers post-event which should equal what we loaded, minus what they spun off at event's conclusion

System Operation and Assessment	
	Rating options for the following categories: poor, fair, good, Very good and excellent.
Operational Capacities	
Efficient Use of Manpower	Very good
Flexibility to Change With Weather	Very good
Loading and Unloading Techniques	Very good
Comments	The Cirus SpreadSmart is very easy to adapt to AVL material tracking—plug-and-play. No hoops to jump through like Certified Power's ATS box and FORCE America's data unlock keys and codes.

Material Spreader System Descriptions
Henderson Products

Agency: Massachusetts Department of Transportation

Effectiveness	
All Winter Storm Conditions	Very good
Before the Snow Falls	Very good
After Some Snow Has Fallen	Very good
During Freezing Rain	Very good
Comments	Very good
Features and Functions	
Accurate Placement of Chemicals	Very good
Ease of Calibration	Very good
Effective Use of Chemicals	Very good
Comments	None
	Rating options for the following category: very difficult, difficult, neutral, easy and very easy.
System Upgrade	
Ease of System Upgrade	Easy
	Rating options for the following category: not at all satisfied, slightly satisfied, moderately satisfied, very satisfied and extremely satisfied.
Level of Satisfaction	
Bounce and Scatter	Very satisfied
Overall Satisfaction	Very satisfied

System Selection and Value	
Other Systems Considered	None specified
Most Influential Features	Adaptability and ease of use
Change in Agency Requirements	Yes. Spinner height was mandated 16” +/- 4” (12” to 20”qualifies).
Purchase Again	Yes
	Members described how the factors listed below contributed to the decision to purchase this spreader system.
System Features and Functions	Drive-by downloads are beneficial
Pricing	Fair pricing
Equipment Compatibility	Very important—the capability to adapt aftermarket AVL.
Other Factors	Good regional support

Material Spreader System Descriptions
Henderson Products

Agency: Montana Department of Transportation

System Description	
Vendor, Model, Year	Henderson spreader; Cirus SpreadSmart controller
System Features	• Spreads a range of materials • Material spread varies with speed of vehicle • Adjustable spreader height above road surface • Adjustable spreader dispersal pattern
Type of Use	This is the spreader we use most often.
Maintenance Costs	Varies year to year
Documents or Images	Not provided

System Functionality	
Material Types Delivered	Granular (salt, sand)
Height From Road Surface	18”
Spread Rate Control	Ground speed (closed loop)
Typical Operating Speed	25 to 35 mph
Operating Speed Variance	Hills, curves, bridges, intersections, urban/rural areas, stop signs, road and weather conditions
Calibration Frequency	• Every time new material is used • At the start of the season • If the operators notice discrepancies • When a system is repaired
Usage Data Retrieval	Cirus Controls storms and season totals

System Operation and Assessment	
	Rating options for the following categories: poor, fair, good, Very good and excellent.
Operational Capacities	
Efficient Use of Manpower	Very good
Flexibility to Change With Weather	Very good
Loading and Unloading Techniques	Very good
Comments	None
Effectiveness	
All Winter Storm Conditions	Very good
Before the Snow Falls	Very good

Material Spreader System Descriptions
Henderson Products

Agency: Montana Department of Transportation

After Some Snow Has Fallen	Very good
During Freezing Rain	Very good
Features and Functions	
Accurate Placement of Chemicals	Very good
Ease of Calibration	Very good
Effective Use of Chemicals	Very good
Comments	None
	Rating options for the following category: very difficult, difficult, neutral, easy and very easy.
System Upgrade	
Ease of System Upgrade	Easy
	Rating options for the following category: not at all satisfied, slightly satisfied, moderately satisfied, very satisfied and extremely satisfied.
Level of Satisfaction	
Bounce and Scatter	Very satisfied
Overall Satisfaction	Very satisfied

System Selection and Value	
Other Systems Considered	FORCE America hydraulic controls
Most Influential Features	Not provided
Change in Agency Requirements	Not provided
Purchase Again	Not provided
	Members described how the factors listed below contributed to the decision to purchase this spreader system.
System Features and Functions	Simplicity of the system; operator-friendly; redundant system for operator and mechanics in all trucks since 2005
Pricing	$18,000 Cirus hydraulic controls $19,000 sander spreader
Equipment Compatibility	Excellent; have been replacing older systems with the current system.
Other Factors	None

Material Spreader System Descriptions
Henderson Products

Agency: Nevada Department of Transportation

System Description	
Vendor, Model, Year	Henderson
System Features	• Spreads a range of materials • Variable RPM control for different materials • Material spread varies with speed of vehicle • Adjustable spreader dispersal pattern
Type of Use	This is the spreader we use most often.
Maintenance Costs	Not provided
Documents or Images	Not provided

System Functionality	
Material Types Delivered	• Liquid • Liquid combined with dry material • Prewetted dry material and liquid
Height From Road Surface	Not provided
Spread Rate Control	Not provided
Typical Operating Speed	35 mph
Operating Speed Variance	The operator varies the operating speed.
Calibration Frequency	At the start of the season
Usage Data Retrieval	Not provided

System Operation and Assessment	
	Rating options for the following categories: poor, fair, good, Very good and excellent.
Operational Capacities	
Efficient Use of Manpower	Good
Flexibility to Change With Weather	Good
Loading and Unloading Techniques	Good
Comments	None
Effectiveness	
All Winter Storm Conditions	Fair
Before the Snow Falls	Fair
After Some Snow Has Fallen	Good
During Freezing Rain	Fair

Material Spreader System Descriptions
Henderson Products

Agency: Nevada Department of Transportation

Comments	None
Features and Functions	
Accurate Placement of Chemicals	Fair
Ease of Calibration	Fair
Effective Use of Chemicals	Fair
Comments	None
	Rating options for the following category: very difficult, difficult, neutral, easy and very easy.
System Upgrade	
Ease of System Upgrade	Neutral
	Rating options for the following category: not at all satisfied, slightly satisfied, moderately satisfied, very satisfied and extremely satisfied.
Level of Satisfaction	
Bounce and Scatter	Moderately satisfied
Overall Satisfaction	Moderately satisfied

System Selection and Value	
Other Systems Considered	Not provided
Most Influential Features	Not provided
Change in Agency Requirements	No
Purchase Again	Yes
	Members described how the factors listed below contributed to the decision to purchase this spreader system.
System Features and Functions	Not provided
Pricing	Not provided
Equipment Compatibility	Not provided
Other Factors	None

Material Spreader System Descriptions
Henderson Products

Agency: New York State Department of Transportation

System Description	
Vendor, Model, Year	Henderson 1000; DICKEY-john Control Point controller
System Features	• Spreads a range of materials • Variable RPM control for different materials • Material spread varies with speed of vehicle • Adjustable spreader height above road surface • Adjustable spreader dispersal pattern
Type of Use	This is the spreader we use most often.
Maintenance Costs	Air/hydraulic prone to freezing
Documents or Images	Not provided

System Functionality	
Material Types Delivered	• Granular (sand, salt) • Prewetted solids • Liquid • Liquid combined with dry material • Prewetted dry material and liquid
Height From Road Surface	Varies; 6” to 18”
Spread Rate Control	Ground speed (closed loop)
Typical Operating Speed	35 mph maximum
Operating Speed Variance	• Traffic • Road conditions • Time of day
Calibration Frequency	• Every time new material is used • Monthly • At the start of the season • If operators notice discrepancies • When the system is repaired
Usage Data Retrieval	Manually transcribed to a snow and ice operator's report

System Operation and Assessment	
	Rating options for the following categories: poor, fair, good, Very good and excellent.
Operational Capacities	
Efficient Use of Manpower	Fair
Flexibility to Change With Weather	Fair
Loading and Unloading Techniques	Fair

Material Spreader System Descriptions
Henderson Products

Agency: New York State Department of Transportation

Comments	Air over hydraulic controls; prone to cold weather issues.
Effectiveness	
All Winter Storm Conditions	Fair
Before the Snow Falls	Fair
After Some Snow Has Fallen	Fair
During Freezing Rain	Fair
Comments	None
Features and Functions	
Accurate Placement of Chemicals	Fair
Ease of Calibration	Good
Effective Use of Chemicals	Fair
Comments	None
	Rating options for the following category: very difficult, difficult, neutral, easy and very easy.
System Upgrade	
Ease of System Upgrade	Difficult
	Rating options for the following category: not at all satisfied, slightly satisfied, moderately satisfied, very satisfied and extremely satisfied.
Level of Satisfaction	
Bounce and Scatter	Slightly satisfied
Overall Satisfaction	Slightly satisfied

System Selection and Value	
Other Systems Considered	Currently looking at other electric/hydraulic controls and spreaders.
Most Influential Features	Safety and training as well as durability will be weighted heaviest in end user survey.
Change in Agency Requirements	Yes. Need a spreader system that is AVL-compatible.
Purchase Again	No. We are phasing out of DICKEY-john.
	Members described how the factors listed below contributed to the decision to purchase this spreader system.
System Features and Functions	Met our specifications
Pricing	Low bid

Material Spreader System Descriptions
Henderson Products

Agency: New York State Department of Transportation

Equipment Compatibility	Purchased with the truck and plow as a package.
Other Factors	Safety and training as well as durability will be weighted heaviest in end user survey.

Material Spreader System Descriptions
Henderson Products

Agency: Utah Department of Transportation

System Description	
Model	Henderson spreader; FORCE America 5100, 5100EX, 6100 controllers
System Features	• Spreads a range of materials • Material spread varies with speed of vehicle
Type of Use	This is the spreader we use most often.
Maintenance Costs	Unknown
Documents or Images	Not provided

System Functionality	
Material Types Delivered	• Granular (sand, salt) • Prewetted solids • Liquid • Liquid combined with dry material • Prewetted dry material and liquid
Height From Road Surface	18”
Spread Rate Control	Ground speed (open loop)
Typical Operating Speed	30 mph
Operating Speed Variance	No
Calibration Frequency	At the start of the season
Usage Data Retrieval	At this point we do not have the ability to gather this data.

System Operation and Assessment	
	Rating options for the following categories: poor, fair, good, Very good and excellent.
Operational Capacities	
Efficient Use of Manpower	Very good
Flexibility to Change With Weather	Very good
Loading and Unloading Techniques	Very good
Comments	None
Effectiveness	
All Winter Storm Conditions	Very good
Before the Snow Falls	Very good
After Some Snow Has Fallen	Very good
During Freezing Rain	Not provided

Material Spreader System Descriptions
Henderson Products

Agency: Utah Department of Transportation

Comments	None
Features and Functions	
Accurate Placement of Chemicals	Very good
Ease of Calibration	Very good
Effective Use of Chemicals	Very good
Comments	None
	Rating options for the following category: very difficult, difficult, neutral, easy and very easy.
System Upgrade	
Ease of System Upgrade	Neutral
	Rating options for the following category: not at all satisfied, slightly satisfied, moderately satisfied, very satisfied and extremely satisfied.
Level of Satisfaction	
Bounce and Scatter	Very satisfied
Overall Satisfaction	Very satisfied

System Selection and Value	
Other Systems Considered	Not provided
Most Influential Features	Not provided
Change in Agency Requirements	No
Purchase Again	Yes
	Members described how the factors listed below contributed to the decision to purchase this spreader system.
System Features and Functions	Not provided
Pricing	Not provided
Equipment Compatibility	Not provided
Other Factors	None

Material Spreader System Descriptions
Henderson Products

Agency: Wisconsin Department of Transportation

System Description	
Vendor, Model, Year	Henderson, 2010
System Features	• Variable RPM control for different materials • Material spread varies with speed of vehicle • Adjustable spreader height above road surface • Adjustable spreader dispersal pattern • Other feature: Onboard prewetting system.
Type of Use	We frequently use this spreader.
Maintenance Costs	Not provided
Documents or Images	Not provided

System Functionality	
Material Types Delivered	• Granular (sand, salt) • Prewetted solids
Height From Road Surface	Not provided
Spread Rate Control	Ground speed (closed loop)
Typical Operating Speed	30 mph
Operating Speed Variance	No
Calibration Frequency	• Every time new material is used • At the start of the season • If operators notice discrepancies • When the system is repaired
Usage Data Retrieval	Not provided

System Operation and Assessment	
	Rating options for the following categories: poor, fair, good, Very good and excellent.
Operational Capacities	
Efficient Use of Manpower	Good
Flexibility to Change With Weather	Very good
Loading and Unloading Techniques	Good
Comments	None
Effectiveness	
All Winter Storm Conditions	Good
Before the Snow Falls	Very good

Material Spreader System Descriptions
Henderson Products

Agency: Wisconsin Department of Transportation

After Some Snow Has Fallen	Good
During Freezing Rain	Good
Comments	None
Features and Functions	
Accurate Placement of Chemicals	Very good
Ease of Calibration	Very good
Effective Use of Chemicals	Very good
Comments	None
	Rating options for the following category: very difficult, difficult, neutral, easy and very easy.
System Upgrade	
Ease of System Upgrade	Neutral
	Rating options for the following category: not at all satisfied, slightly satisfied, moderately satisfied, very satisfied and extremely satisfied.
Level of Satisfaction	
Bounce and Scatter	Very satisfied
Overall Satisfaction	Very satisfied

System Selection and Value	
Other Systems Considered	Not provided
Most Influential Features	Not provided
Change in Agency Requirements	No
Purchase Again	Yes
	Members described how the factors listed below contributed to the decision to purchase this spreader system.
System Features and Functions	Hopper-type truck body with conveyor feeding material to power-driven spinner-type spreader; computerized with onboard prewetting system (may include anti-icing spray bar)
Pricing	$18,925
Equipment Compatibility	Not provided
Other Factors	Not provided

Material Spreader System Descriptions
Henke Manufacturing

Agency: Texas Transportation Department 2

System Description	
Vendor, Model, Year	Henke
System Features	• Spreads a range of materials • Adjustable spreader height above road surface • Adjustable spreader dispersal pattern
Type of Use	This is the spreader we use most often.
Maintenance Costs	Not provided
Documents or Images	Not provided

System Functionality	
Material Types Delivered	• Granular (sand, salt) • Prewetted solids • Prewetted dry material and liquid
Height From Road Surface	18” to 24”
Spread Rate Control	Manual
Typical Operating Speed	5 to 10 mph
Operating Speed Variance	Traffic conditions
Calibration Frequency	If operators notice discrepancies
Usage Data Retrieval	Manually

System Operation and Assessment	
	Rating options for the following categories: poor, fair, good, Very good and excellent.
Operational Capacities	
Efficient Use of Manpower	Good
Flexibility to Change With Weather	Good
Loading and Unloading Techniques	Fair
Comments	None
Effectiveness	
All Winter Storm Conditions	Good
Before the Snow Falls	Good
After Some Snow Has Fallen	Good
During Freezing Rain	Good

Material Spreader System Descriptions
Henke Manufacturing

Agency: Texas Transportation Department 2

Comments	Not provided
Features and Functions	
Accurate Placement of Chemicals	Good
Ease of Calibration	Good
Effective Use of Chemicals	Good
Comments	None
	Rating options for the following category: very difficult, difficult, neutral, easy and very easy.
System Upgrade	
Ease of System Upgrade	Neutral
	Rating options for the following category: not at all satisfied, slightly satisfied, moderately satisfied, very satisfied and extremely satisfied.
Level of Satisfaction	
Bounce and Scatter	Moderately satisfied
Overall Satisfaction	Moderately satisfied

System Selection and Value	
Other Systems Considered	N/A
Most Influential Features	Price
Change in Agency Requirements	No
Purchase Again	Yes
	Members described how the factors listed below contributed to the decision to purchase this spreader system.
System Features and Functions	Not provided
Pricing	Competitive bidding
Equipment Compatibility	Not provided
Other Factors	Not provided

Material Spreader System Descriptions
Henke Manufacturing

Agency: Texas Department of Transportation 6

System Description	
Vendor, Model, Year	Henke HXC2000, 2018
System Features	• Spreads a range of materials • Variable RPM control for different materials • Material spread varies with speed of vehicle • Adjustable spreader dispersal pattern • Other feature: 304 stainless steel construction and a removable cartridge-style conveyor.
Type of Use	We frequently use this spreader.
Maintenance Costs	Costs are consistent with most spreader boxes. The savings come in the form of life expectancy.
Documents or Images	https://drive.google.com/file/d/1ghmcB-cc4_mxqXaq3vButkHyhKJtS5lY/view

System Functionality	
Material Types Delivered	• Granular (sand, salt) • Prewetted solids • Prewetted dry material and liquid
Height From Road Surface	24”
Spread Rate Control	Ground speed (closed loop)
Typical Operating Speed	Less than 25 mph
Operating Speed Variance	Situation and location dictate safe operating speeds.
Calibration Frequency	• At the start of the season • If operators notice discrepancies • When the system is repaired
Usage Data Retrieval	At this time, we do not track spreader usage.

System Operation and Assessment	
	Rating options for the following categories: poor, fair, good, Very good and excellent.
Operational Capacities	
Efficient Use of Manpower	Very good
Flexibility to Change With Weather	Very good
Loading and Unloading Techniques	Very good
Comments	None

Material Spreader System Descriptions
Henke Manufacturing

Agency: Texas Department of Transportation 6

Effectiveness	
All Winter Storm Conditions	Very good
Before the Snow Falls	Excellent
After Some Snow Has Fallen	Very good
During Freezing Rain	Fair
Comments	If it rains before it freezes and the trucks are not covered, it can be difficult to disperse material.
Features and Functions	
Accurate Placement of Chemicals	Very good
Ease of Calibration	Very good
Effective Use of Chemicals	Very good
Comments	None
	Rating options for the following category: very difficult, difficult, neutral, easy and very easy.
System Upgrade	
Ease of System Upgrade	Neutral
	Rating options for the following category: not at all satisfied, slightly satisfied, moderately satisfied, very satisfied and extremely satisfied.
Level of Satisfaction	
Bounce and Scatter	Very satisfied
Overall Satisfaction	Very satisfied

System Selection and Value	
Other Systems Considered	Unknown
Most Influential Features	Stainless steel with the removable conveyor
Change in Agency Requirements	No
Purchase Again	Yes
	Members described how the factors listed below contributed to the decision to purchase this spreader system.
System Features and Functions	Stainless steel construction and removable conveyor system
Pricing	We opted for a slightly more expensive unit to get the stainless and other features we wanted. The cost difference was negligible.
Equipment Compatibility	Had to be compatible with 6/10 yd. trucks

Material Spreader System Descriptions
Monroe Truck Equipment

Agency: Connecticut Department of Transportation

System Description	
Vendor, Model, Year	Monroe DTS 120-88-27; Cirus Model EZ Spread controller
System Features	• Spreads a range of materials • Variable RPM control for different materials • Material spread varies with speed of vehicle • *Note*: RPM control is done through hydraulic pump, variable displacement type.
Type of Use	This is the spreader we use most often.
Maintenance Costs	Not provided
Documents or Images	Not provided

System Functionality	
Material Types Delivered	• Granular (sand, salt) • Liquid
Height From Road Surface	8” to 20”
Spread Rate Control	Ground speed (open loop)
Typical Operating Speed	20 to 30 mph
Operating Speed Variance	Varies; higher speeds create scatter
Calibration Frequency	• At the start of the season • If operator notices discrepancies
Usage Data Retrieval	N/A at this time

System Operation and Assessment	
	Rating options for the following categories: poor, fair, good, Very good and excellent.
Operational Capacities	
Efficient Use of Manpower	Very good
Flexibility to Change With Weather	Very good
Loading and Unloading Techniques	Good
Comments	None
Effectiveness	
All Winter Storm Conditions	Very good
Before the Snow Falls	Very good
After Some Snow Has Fallen	Very good
During Freezing Rain	Very good

Material Spreader System Descriptions
Monroe Truck Equipment

Agency: Connecticut Department of Transportation

Comments	None
Features and Functions	
Accurate Placement of Chemicals	Good
Ease of Calibration	Good
Effective Use of Chemicals	Very good
Comments	None
	Rating options for the following category: very difficult, difficult, neutral, easy and very easy.
System Upgrade	
Ease of System Upgrade	Neutral
	Rating options for the following category: not at all satisfied, slightly satisfied, moderately satisfied, very satisfied and extremely satisfied.
Level of Satisfaction	
Bounce and Scatter	Moderately satisfied
Overall Satisfaction	Moderately satisfied

System Selection and Value	
Other Systems Considered	Muncie, Rexroth, Cirus
Most Influential Features	Pricing and ease of use for operator/technician
Change in Agency Requirements	CTDOT is in the process of equipping snowplow trucks.
Purchase Again	Yes
	Members described how the factors listed below contributed to the decision to purchase this spreader system.
System Features and Functions	Ease of use for both operator and service tech; ability to gather proper data for pending integrated mobile observations (IMO) project
Pricing	Plays a part
Equipment Compatibility	Big factor
Other Factors	Not provided

Material Spreader System Descriptions
Monroe Truck Equipment

Agency: Kansas Department of Transportation

System Description	
Vendor, Model, Year	Monroe, 2019
System Features	• Spreads a range of materials • Material spread varies with speed of vehicle • Adjustable spreader dispersal pattern • Other feature: Dual auger V-box slip-in spreader.
Type of Use	This is the spreader we use most often.
Maintenance Costs	N/A
Documents or Images	Not provided

System Functionality	
Material Types Delivered	• Granular (sand, salt) • Prewetted solids • Liquid • Liquid combined with dry material
Height From Road Surface	Unknown
Spread Rate Control	Ground speed (closed loop)
Typical Operating Speed	25 mph
Operating Speed Variance	Based on road conditions and surrounding traffic speed and visibility
Calibration Frequency	• At the start of the season • If operators notice discrepancies
Usage Data Retrieval	We do not retrieve material usage from our trucks.

System Operation and Assessment	
	Rating options for the following categories: poor, fair, good, Very good and excellent.
Operational Capacities	
Efficient Use of Manpower	Excellent
Flexibility to Change With Weather	Excellent
Loading and Unloading Techniques	Good
Comments	Unloading can be slow with augers.
Effectiveness	
All Winter Storm Conditions	Excellent
Before the Snow Falls	Excellent

Material Spreader System Descriptions
Monroe Truck Equipment

Agency: Kansas Department of Transportation

After Some Snow Has Fallen	Excellent
During Freezing Rain	Excellent
Comments	None
Features and Functions	
Accurate Placement of Chemicals	Very good
Ease of Calibration	Very good
Effective Use of Chemicals	Very good
Comments	Effective use of chemicals is dependent on operator, not the spreader.
	Rating options for the following category: very difficult, difficult, neutral, easy and very easy.
System Upgrade	
Ease of System Upgrade	Neutral
	Rating options for the following category: not at all satisfied, slightly satisfied, moderately satisfied, very satisfied and extremely satisfied.
Level of Satisfaction	
Bounce and Scatter	Moderately satisfied
Overall Satisfaction	Very satisfied

System Selection and Value	
Other Systems Considered	Not provided
Most Influential Features	Ability to spread uniformly at a low application rate
Change in Agency Requirements	No
Purchase Again	Yes
	Members described how the factors listed below contributed to the decision to purchase this spreader system.
System Features and Functions	Met our specifications
Pricing	Low bid
Equipment Compatibility	Purchased with the truck and plow as a package
Other Factors	Not provided

Material Spreader System Descriptions
Monroe Truck Equipment

Agency: Montana Department of Transportation

System Description	
Vendor, Model, Year	Monroe spreader; Cirus SpreadSmart controller
System Features	• Spreads a range of materials • Material spread varies with speed of vehicle • Adjustable spreader height above road surface • Adjustable spreader dispersal pattern
Type of Use	This is the spreader we use most often.
Maintenance Costs	Varies year to year
Documents or Images	Not provided

System Functionality	
Material Types Delivered	Granular (salt, sand)
Height From Road Surface	18”
Spread Rate Control	Ground speed (closed loop)
Typical Operating Speed	25 to 35 mph
Operating Speed Variance	Hills, curves, bridges, intersections, urban/rural areas, stop signs, road and weather conditions
Calibration Frequency	• Every time new material is used • At the start of the season • If the operators notice discrepancies • When a system is repaired
Usage Data Retrieval	Cirus Controls storms and season totals

System Operation and Assessment	
	Rating options for the following categories: poor, fair, good, Very good and excellent.
Operational Capacities	
Efficient Use of Manpower	Very good
Flexibility to Change With Weather	Very good
Loading and Unloading Techniques	Very good
Comments	None
Effectiveness	
All Winter Storm Conditions	Very good
Before the Snow Falls	Very good

Material Spreader System Descriptions
Monroe Truck Equipment

Agency: Montana Department of Transportation

After Some Snow Has Fallen	Very good
During Freezing Rain	Very good
Features and Functions	
Accurate Placement of Chemicals	Very good
Ease of Calibration	Very good
Effective Use of Chemicals	Very good
Comments	None
	Rating options for the following category: very difficult, difficult, neutral, easy and very easy.
System Upgrade	
Ease of System Upgrade	Easy
	Rating options for the following category: not at all satisfied, slightly satisfied, moderately satisfied, very satisfied and extremely satisfied.
Level of Satisfaction	
Bounce and Scatter	Very satisfied
Overall Satisfaction	Very satisfied

System Selection and Value	
Other Systems Considered	FORCE America hydraulic controls
Most Influential Features	Not provided
Change in Agency Requirements	Not provided
Purchase Again	Not provided
	Members described how the factors listed below contributed to the decision to purchase this spreader system.
System Features and Functions	Simplicity of the system; operator-friendly; and redundant system for operator and mechanics in all trucks since 2005
Pricing	$18,000 Cirus hydraulic controls $19,000 sander spreader
Equipment Compatibility	Excellent; have been replacing older systems with the current system.
Other Factors	None

Material Spreader System Descriptions
Monroe Truck Equipment

Agency: South Dakota Department of Transportation

System Description	
Model	Monroe V-box spreader; FORCE America FA6100 Gen 5 controller installed on FY19/20 trucks

System Features	• Spreads a range of materials
	• Variable RPM control for different materials
	• Material spread varies with speed of vehicle
	• Adjustable spreader dispersal pattern
	Other features:
	  • This system allows us to prewet our salt as it spreads on the roadway and gives our drivers the option to direct apply liquid.
	  • 304 stainless steel slide-in units, changing to auger from chain-driven.
	  • Two 250-gallon saddle tanks for prewetting.

Type of Use	This is the spreader we use most often.
Maintenance Costs	Maintenance costs are minimal.
Documents or Images	https://forceamerica.com/industries/snow-and-ice-removal

System Functionality	
Material Types Delivered	• Granular (sand, salt) • Prewetted solids • Liquid • Liquid combined with dry material • Prewetted dry material and liquid
Height From Road Surface	24” +/-3” depending on tire and box height
Spread Rate Control	Ground speed (closed loop)
Typical Operating Speed	25 mph
Operating Speed Variance	On occasion the driver can spread up to 30 mph. This depends on wind speed and direction.
Calibration Frequency	• At the start of the season • If operators notice discrepancies • When the system is repaired
Usage Data Retrieval	• High-resolution 10” color LCD: Displays information-rich graphical spreader data along with up to three camera feeds eliminating the need for multiple displays within the cab. • CAN bus central processing: Provides high-level diagnostics and eliminates bulky harnessing. • Connectivity: Plug-and-play with a single connector to a trailer system, spreader body or other slide-in attachments.

Material Spreader System Descriptions
Monroe Truck Equipment

Agency: South Dakota Department of Transportation

System Operation and Assessment	
	Rating options for the following categories: poor, fair, good, Very good and excellent.
Operational Capacities	
Efficient Use of Manpower	Excellent
Flexibility to Change With Weather	Excellent
Loading and Unloading Techniques	Very good
Comments	None
Effectiveness	
All Winter Storm Conditions	Excellent
Before the Snow Falls	Excellent
After Some Snow Has Fallen	Excellent
During Freezing Rain	Excellent
Comments	We have found that by utilizing dual augers versus chain-driven with adjustable gate, the dual augers' spread is more uniform. Our salt usage is more accurate with the auger versus chain due to proper gate height setting.
Features and Functions	
Accurate Placement of Chemicals	Excellent
Ease of Calibration	Excellent
Effective Use of Chemicals	Excellent
Comments	None
	Rating options for the following category: very difficult, difficult, neutral, easy and very easy.
System Upgrade	
Ease of System Upgrade	Very easy
	Rating options for the following category: not at all satisfied, slightly satisfied, moderately satisfied, very satisfied and extremely satisfied.
Level of Satisfaction	
Bounce and Scatter	Extremely satisfied
Overall Satisfaction	Extremely satisfied

Material Spreader System Descriptions
Monroe Truck Equipment

Agency: South Dakota Department of Transportation

System Selection and Value	
Other Systems Considered	Only other systems we use are the older FORCE America 3100 and 5100. We chose the 6100 due to newer and more options available and it was an easier install with our current fleet.
Most Influential Features	Not provided
Change in Agency Requirements	No
Purchase Again	Yes
	Members described how the factors listed below contributed to the decision to purchase this spreader system.
System Features and Functions	• Material application modes: granular and prewet direct, simultaneous granular, prewet and direct skip sanding • Adjustable gate and two-position gate • Directional spinner/spread pattern control • Tow Plow position and application control • Aux power mode with selectable ramp time • Distance measurement • Individually customizable material settings, including LBS/MI set rates and selectable number of set rates • Real-time vehicle health monitoring and response systems • Real-time material usage and GPS tracking with PreCise MRM website • Firmware upgrades and calibration settings • Import and export through USB flash drive • Over 100 more fully configurable features • Pressure sensor readings
Pricing	Not provided
Equipment Compatibility	Not provided
Other Factors	Not provided

Material Spreader System Descriptions
Monroe Truck Equipment

Agency: Wisconsin Department of Transportation

System Description	
Vendor, Model, Year	Monroe, 2010
System Features	• Spreads a range of materials • Variable RPM control for different materials • Material spread varies with speed of vehicle • Adjustable spreader dispersal pattern • Other feature: Onboard prewetting system and anti-icing spray bar.
Type of Use	This is the spreader we use most often.
Maintenance Costs	Not provided
Documents or Images	Not provided

System Functionality	
Material Types Delivered	• Granular (sand, salt) • Prewetted solids
Height From Road Surface	Not provided
Spread Rate Control	Not provided
Typical Operating Speed	30 mph
Operating Speed Variance	No
Calibration Frequency	• At the start of the season • If operators notice discrepancies • When the system is repaired
Usage Data Retrieval	Computer in the truck

System Operation and Assessment	
	Rating options for the following categories: poor, fair, good, Very good and excellent.
Operational Capacities	
Efficient Use of Manpower	Very good
Flexibility to Change With Weather	Very good
Loading and Unloading Techniques	Very good
Comments	None
Effectiveness	
All Winter Storm Conditions	Very good
Before the Snow Falls	Excellent

Material Spreader System Descriptions
Monroe Truck Equipment

Agency: Wisconsin Department of Transportation

After Some Snow Has Fallen	Very good
During Freezing Rain	Good
Comments	None
Features and Functions	
Accurate Placement of Chemicals	Very good
Ease of Calibration	Very good
Effective Use of Chemicals	Very good
Comments	None
	Rating options for the following category: very difficult, difficult, neutral, easy and very easy.
System Upgrade	
Ease of System Upgrade	Neutral
	Rating options for the following category: not at all satisfied, slightly satisfied, moderately satisfied, very satisfied and extremely satisfied.
Level of Satisfaction	
Bounce and Scatter	Very satisfied
Overall Satisfaction	Very satisfied

System Selection and Value	
Other Systems Considered	Not provided
Most Influential Features	Not provided
Change in Agency Requirements	No
Purchase Again	Yes
	Members described how the factors listed below contributed to the decision to purchase this spreader system.
System Features and Functions	Hopper-type truck body with conveyor feeding material to power-driven spinner-type spreader; computerized, with onboard prewetting system (may include anti-icing spray bar)
Pricing	$7,250
Equipment Compatibility	Not provided
Other Factors	None

Material Spreader System Descriptions
Multiple Vendors

Agency: Minnesota Department of Transportation

System Description	
Vendor, Model, Year	Monroe, Falls, Swenson (Survey responses for this respondent appear under *Multiple Vendors*.)
System Features	• Spreads a range of materials • Variable RPM control for different materials • Material spread varies with speed of vehicle • Adjustable spreader height above road surface • Adjustable spreader dispersal pattern • Other feature: We are adding a liquid into the spread of salt.
Type of Use	This is the spreader we use most often.
Maintenance Costs	Hoses are the most common but occasionally we have to replace some motors.
Documents or Images	Not provided

System Functionality

Material Types Delivered	• Granular (sand, salt) • Prewetted solids • Liquid • Liquid combined with dry material • Prewetted dry material and liquid
Height From Road Surface	8” to 20”
Spread Rate Control	Ground speed (closed loop)
Typical Operating Speed	Under 30 mph
Operating Speed Variance	Ramps, stop light areas, highway, in town
Calibration Frequency	• At the start of the season • If operators notice discrepancies
Usage Data Retrieval	Force 6100, DICKEY-john

System Operation and Assessment	
	Rating options for the following categories: poor, fair, good, Very good and excellent.
Operational Capacities	
Efficient Use of Manpower	Very good
Flexibility to Change With Weather	Very good
Loading and Unloading Techniques	Very good
Comments	None

Material Spreader System Descriptions
Multiple Vendors

Agency: Minnesota Department of Transportation

Effectiveness	
All Winter Storm Conditions	Very good
Before the Snow Falls	Very good
After Some Snow Has Fallen	Very good
During Freezing Rain	Very good
Comments	None
Features and Functions	
Accurate Placement of Chemicals	Very good
Ease of Calibration	Very good
Effective Use of Chemicals	Very good
Comments	None
	Rating options for the following category: very difficult, difficult, neutral, easy and very easy.
System Upgrade	
Ease of System Upgrade	Very easy
	Rating options for the following category: not at all satisfied, slightly satisfied, moderately satisfied, very satisfied and extremely satisfied.
Level of Satisfaction	
Bounce and Scatter	Very satisfied
Overall Satisfaction	Very satisfied

System Selection and Value	
Other Systems Considered	We have the option of a couple when we order the trucks.
Most Influential Features	There are different factors that come into consideration when ordering the spreader.
Change in Agency Requirements	When we change the configuration of the truck the spreader is often changed.
Purchase Again	Yes
	Members described how the factors listed below contributed to the decision to purchase this spreader system.
System Features and Functions	Not provided
Pricing	Not provided
Equipment Compatibility	Not provided

Material Spreader System Descriptions
Schmidt (Aebi Schmidt Group)

Agency: Maine Department of Transportation

System Description	
Vendor, Model, Year	Schmidt Stratos
System Features	• Spreads a range of materials • Variable RPM control for different materials • Material spread varies with speed of vehicle • Adjustable spreader dispersal pattern • Other feature: High liquid capacity and prewetting rates.
Type of Use	We frequently use this spreader.
Maintenance Costs	$1,000 year, compared to about $3,000 for our other spreaders
Documents or Images	Not provided

System Functionality	
Material Types Delivered	• Granular (sand, salt) • Prewetted solids • Liquid • Liquid combined with dry material • Prewetted dry material and liquid
Height From Road Surface	About 12”
Spread Rate Control	Ground speed (closed loop)
Typical Operating Speed	25 to 30 mph
Operating Speed Variance	Type of road and traffic conditions
Calibration Frequency	• At the start of the season. • If operators notice discrepancies. • When the system is repaired.
Usage Data Retrieval	Onboard spreader controls

System Operation and Assessment	
	Rating options for the following categories: poor, fair, good, Very good and excellent.
Operational Capacities	
Efficient Use of Manpower	Very good
Flexibility to Change With Weather	Very good
Loading and Unloading Techniques	Good
Comments	None

Material Spreader System Descriptions
Schmidt (Aebi Schmidt Group)

Agency: Maine Department of Transportation

Effectiveness	
All Winter Storm Conditions	Very good
Before the Snow Falls	Very good
After Some Snow Has Fallen	Very good
During Freezing Rain	Very good
Comments	None
Features and Functions	
Accurate Placement of Chemicals	Very good
Ease of Calibration	Very good
Effective Use of Chemicals	Very good
Comments	None
	Rating options for the following category: very difficult, difficult, neutral, easy and very easy.
System Upgrade	
Ease of System Upgrade	Easy
	Rating options for the following category: not at all satisfied, slightly satisfied, moderately satisfied, very satisfied and extremely satisfied.
Level of Satisfaction	
Bounce and Scatter	Very satisfied
Overall Satisfaction	Very satisfied

System Selection and Value	
Other Systems Considered	Henderson, Swenson
Most Influential Features	Reliability over time; bought some in 2004 and they're still like new
Change in Agency Requirements	No
Purchase Again	Yes
	Members described how the factors listed below contributed to the decision to purchase this spreader system.
System Features and Functions	Spread patterns and prewet rate; effectiveness
Pricing	Not provided
Equipment Compatibility	Not provided
Other Factors	Reliability

Material Spreader System Descriptions
Swenson Products

Agency: Idaho Transportation Department 1

System Description	
Vendor, Model, Year	Swenson; built to agency specifications
System Features	• Spreads a range of materials • Variable RPM control for different materials • Material spread varies with speed of vehicle • Adjustable spreader height above road surface • Adjustable dispersal pattern • Custom specification: Dual auger V-box spreader with liquid prewet tanks, prewet distribution lance above augers, standard spinner distribution chute.
Type of Use	This is the spreader we use most often.
Maintenance Costs	Moderate to low so far
Documents or Images	Not provided

System Functionality	
Material Types Delivered	• Granular (sand, salt) • Prewetted solids • Liquid combined with dry material • Prewetted dry material and liquid
Height From Road Surface	Approximately 12”
Spread Rate Control	Ground speed (closed loop)
Typical Operating Speed	Procedure manual requires maximum speed of 35 mph, but we know some are going faster.
Operating Speed Variance	Varies because of driver error
Calibration Frequency	• At the start of the season • If operators notice discrepancies • When the system is repaired • Some areas will verify calibration monthly
Usage Data Retrieval	AVL through the spreader controller and downloaded via WiFi

System Operation and Assessment	
	Rating options for the following categories: poor, fair, good, Very good and excellent.
Operational Capacities	
Efficient Use of Manpower	Very good
Flexibility to Change With Weather	Very good
Loading and Unloading Techniques	Good
Comments	None

Material Spreader System Descriptions
Swenson Products

Agency: Idaho Transportation Department 1

Effectiveness	
All Winter Storm Conditions	Excellent
Before the Snow Falls	Good
After Some Snow Has Fallen	Excellent
During Freezing Rain	Good
Comments	None
Features and Functions	
Accurate Placement of Chemicals	Very good
Ease of Calibration	Very good
Effective Use of Chemicals	Very good
Comments	None
	Rating options for the following category: very difficult, difficult, neutral, easy and very easy.
System Upgrade	
Ease of System Upgrade	Neutral
	Rating options for the following category: not at all satisfied, slightly satisfied, moderately satisfied, very satisfied and extremely satisfied.
Level of Satisfaction	
Bounce and Scatter	Very satisfied
Overall Satisfaction	Very satisfied

System Selection and Value	
Other Systems Considered	Henderson and Monroe
Most Influential Features	We specified the features.
Change in Agency Requirements	No
Purchase Again	Yes
	Members described how the factors listed below contributed to the decision to purchase this spreader system.
System Features and Functions	We specified the features.
Pricing	Bid was awarded on pricing and compliance to specifications.
Equipment Compatibility	None
Other Factors	Not provided

Material Spreader System Descriptions
Swenson Products

Agency: Idaho Transportation Department 2

System Description	
Vendor, Model, Year	Swenson; built to agency specifications, including slide-in deicing tank and distribution system
System Features	• Spreads a range of materials • Variable RPM control for different materials • Material spread varies with speed of vehicle • Adjustable spreader height above road surface • Adjustable spreader dispersal pattern • Special features: We used a tiered deicing boom system that is comprised of two booms for each lane, low speed, moderate speed and both for high-speed spreading.
Type of Use	We frequently use this spreader.
Maintenance Costs	Minimal. Most issues are either electrical or flow meter faults.
Documents or Images	Not provided

System Functionality	
Material Types Delivered	Liquid
Height From Road Surface	Approximately 12”
Spread Rate Control	Ground speed (closed loop)
Typical Operating Speed	Typically around 35 mph with capability for full ground speed up to 50 mph
Operating Speed Variance	Traffic has the most effect.
Calibration Frequency	• If operators notice discrepancies • When the system is repaired
Usage Data Retrieval	Same V-box-through-spreader controller and downloaded via WiFi connectivity.

System Operation and Assessment	
	Rating options for the following categories: poor, fair, good, Very good and excellent.
Operational Capacities	
Efficient Use of Manpower	Excellent
Flexibility to Change With Weather	Excellent
Loading and Unloading Techniques	Excellent
Comments	None
Effectiveness	
All Winter Storm Conditions	Excellent
Before the Snow Falls	Excellent

Material Spreader System Descriptions
Swenson Products

Agency: Idaho Transportation Department 2

After Some Snow Has Fallen	Excellent
During Freezing Rain	Excellent
Comments	None
Features and Functions	
Accurate Placement of Chemicals	Excellent
Ease of Calibration	Excellent
Effective Use of Chemicals	Excellent
Comments	None
	Rating options for the following category: very difficult, difficult, neutral, easy and very easy.
System Upgrade	
Ease of System Upgrade	Neutral
	Rating options for the following category: not at all satisfied, slightly satisfied, moderately satisfied, very satisfied and extremely satisfied.
Level of Satisfaction	
Bounce and Scatter	N/A; liquid only
Overall Satisfaction	Extremely satisfied

System Selection and Value	
Other Systems Considered	Henderson and Monroe provided bid solicitations.
Most Influential Features	None; minimum specifications
Change in Agency Requirements	No
Purchase Again	Yes
	Members described how the factors listed below contributed to the decision to purchase this spreader system.
System Features and Functions	All bid responses had to meet minimum requirements.
Pricing	Low bid meeting specifications was selected.
Equipment Compatibility	Not provided
Other Factors	Not provided

Material Spreader System Descriptions
Swenson Products

Agency: Maine Department of Transportation

System Description	
Vendor, Model, Year	Swenson (older, 30+ year systems)
System Features	• Variable RPM control for different materials • Material spread varies with speed of vehicle • Adjustable spreader dispersal pattern Other features: Many have been modified from chain to belt; some have different chutes for a windrow drop or a spread pattern. These are fairly old systems, 30+ years.
Type of Use	We frequently use this spreader.
Maintenance Costs	Not provided
Documents or Images	See Appendix C, Material Spreaders, Maine Department of Transportation, September 2011.

System Functionality	
Material Types Delivered	• Granular (sand, salt) • Prewetted solids
Height From Road Surface	Varies, about 12”
Spread Rate Control	Some are closed loop; others are open
Typical Operating Speed	25 mph
Operating Speed Variance	No
Calibration Frequency	• At the start of the season • If operators notice discrepancies • When the system is repaired
Usage Data Retrieval	Computer in the truck

System Operation and Assessment	
	Rating options for the following categories: poor, fair, good, Very good and excellent.
Operational Capacities	
Efficient Use of Manpower	Fair
Flexibility to Change With Weather	Fair
Loading and Unloading Techniques	Fair
Comments	None
Effectiveness	
All Winter Storm Conditions	Good
Before the Snow Falls	Poor

Material Spreader System Descriptions
Swenson Products

Agency: Maine Department of Transportation

After Some Snow Has Fallen	Good
During Freezing Rain	Good
Comments	None
Features and Functions	
Accurate Placement of Chemicals	Good
Ease of Calibration	Good
Effective Use of Chemicals	Good
Comments	None
	Rating options for the following category: very difficult, difficult, neutral, easy and very easy.
System Upgrade	
Ease of System Upgrade	Neutral
	Rating options for the following category: not at all satisfied, slightly satisfied, moderately satisfied, very satisfied and extremely satisfied.
Level of Satisfaction	
Bounce and Scatter	Moderately satisfied
Overall Satisfaction	Moderately satisfied

System Selection and Value	
Other Systems Considered	Not sure. It was decades ago.
Most Influential Features	Not provided
Change in Agency Requirements	Yes. Prewetting has become more important and we prefer belts when they work properly.
Purchase Again	There's better, more modern equipment these days.
	Members described how the factors listed below contributed to the decision to purchase this spreader system.
System Features and Functions	Not provided
Pricing	Not provided
Equipment Compatibility	Not provided
Other Factors	None
Other Comments	We also have some spreaders we built ourselves, but they are essentially the same as the Swenson spreader.

Material Spreader System Descriptions
Swenson Products

Agency: Montana Department of Transportation

System Description	
Vendor, Model, Year	Swenson spreader; Cirus SpreadSmart controller
System Features	• Spreads a range of materials • Material spread varies with speed of vehicle • Adjustable spreader height above road surface • Adjustable spreader dispersal pattern
Type of Use	This is the spreader we use most often.
Maintenance Costs	Varies year to year
Documents or Images	Not provided

System Functionality	
Material Types Delivered	Granular (salt, sand)
Height From Road Surface	18”
Spread Rate Control	Ground speed (closed loop)
Typical Operating Speed	25 to 35 mph
Operating Speed Variance	Hills, curves, bridges, intersections, urban/rural areas, stop signs, road and weather conditions
Calibration Frequency	• Every time new material is used • At the start of the season • If the operators notice discrepancies • When a system is repaired
Usage Data Retrieval	Cirus Controls storms and season totals

System Operation and Assessment	
	Rating options for the following categories: poor, fair, good, Very good and excellent.
Operational Capacities	
Efficient Use of Manpower	Very good
Flexibility to Change With Weather	Very good
Loading and Unloading Techniques	Very good
Comments	None
Effectiveness	
All Winter Storm Conditions	Very good
Before the Snow Falls	Very good
After Some Snow Has Fallen	Very good

Material Spreader System Descriptions
Swenson Products

Agency: Montana Department of Transportation

During Freezing Rain	Very good
Comments	None
Features and Functions	
Accurate Placement of Chemicals	Very good
Ease of Calibration	Very good
Effective Use of Chemicals	Very good
Comments	None
	Rating options for the following category: very difficult, difficult, neutral, easy and very easy.
System Upgrade	
Ease of System Upgrade	Easy
	Rating options for the following category: not at all satisfied, slightly satisfied, moderately satisfied, very satisfied and extremely satisfied.
Level of Satisfaction	
Bounce and Scatter	Very satisfied
Overall Satisfaction	Very satisfied

System Selection and Value	
Other Systems Considered	FORCE America hydraulic controls
Most Influential Features	Not provided
Change in Agency Requirements	Not provided
Purchase Again	Not provided
	Members described how the factors listed below contributed to the decision to purchase this spreader system.
System Features and Functions	Simplicity of the system; operator-friendly; redundant system for operator and mechanics in all trucks since 2005
Pricing	$18,000 Cirus hydraulic controls $19,000 sander spreader
Equipment Compatibility	Excellent; have been replacing older systems with the current system.
Other Factors	None

Material Spreader System Descriptions
Swenson Products

Agency: Texas Department of Transportation 1

System Description	
Vendor, Model, Year	Swenson, EV-100 box spreaders
System Features	• Spreads a range of materials • Variable RPM control for different materials • Material spread varies with speed of vehicle • Adjustable spreader dispersal pattern
Type of Use	This is the spreader we use most often.
Maintenance Costs	Minimal cost when cleaned and preventive maintenance is conducted after each use
Documents or Images	Not provided

System Functionality	
Material Types Delivered	• Granular (sand, salt) • Liquid
Height From Road Surface	30” to 36”
Spread Rate Control	Ground speed (open loop)
Typical Operating Speed	10 to 15 mph
Operating Speed Variance	No
Calibration Frequency	At the start of the season
Usage Data Retrieval	Our spreaders are not equipped with this feature.

System Operation and Assessment	
	Rating options for the following categories: poor, fair, good, Very good and excellent.
Operational Capacities	
Efficient Use of Manpower	Good
Flexibility to Change With Weather	Good
Loading and Unloading Techniques	Good
Comments	With V-boxes we do not have to raise the equipment dump when attached to an end spreader; safer operation.
Effectiveness	
All Winter Storm Conditions	Good
Before the Snow Falls	Good
After Some Snow Has Fallen	Good
During Freezing Rain	Good
Comments	Material loads and spreads much easier when dry.

Material Spreader System Descriptions
Swenson Products

Agency: Texas Department of Transportation 1

Features and Functions	
Accurate Placement of Chemicals	Good
Ease of Calibration	Good
Effective Use of Chemicals	Good
Comments	None
	Rating options for the following category: very difficult, difficult, neutral, easy and very easy.
System Upgrade	
Ease of System Upgrade	Easy
	Rating options for the following category: not at all satisfied, slightly satisfied, moderately satisfied, very satisfied and extremely satisfied.
Level of Satisfaction	
Bounce and Scatter	Very satisfied
Overall Satisfaction	Very satisfied

System Selection and Value	
Other Systems Considered	N/A
Most Influential Features	Only have one system
Change in Agency Requirements	No
Purchase Again	Yes
	Members described how the factors listed below contributed to the decision to purchase this spreader system.
System Features and Functions	Satisfied with features and functions; has a standardized model that fits our equipment fleet.
Pricing	Pricing is compatible with similar product.
Equipment Compatibility	Works well with our fleet
Other Factors	None

Material Spreader System Descriptions
Swenson Products

Agency: Texas Department of Transportation 2

System Description	
Vendor, Model, Year	Swenson
System Features	• Spreads a range of materials • Adjustable spreader height above road surface • Adjustable spreader dispersal pattern
Type of Use	This is the spreader we use most often.
Maintenance Costs	Not tracked
Documents or Images	Not provided

System Functionality	
Material Types Delivered	• Granular (sand, salt) • Prewetted solids • Prewetted dry material and liquid
Height From Road Surface	18” to 24”
Spread Rate Control	Manual
Typical Operating Speed	5 to 10 mph
Operating Speed Variance	Traffic conditions
Calibration Frequency	If operators notice discrepancies
Usage Data Retrieval	Manually

System Operation and Assessment	
	Rating options for the following categories: poor, fair, good, Very good and excellent.
Operational Capacities	
Efficient Use of Manpower	Good
Flexibility to Change With Weather	Good
Loading and Unloading Techniques	Fair
Comments	None
Effectiveness	
All Winter Storm Conditions	Good
Before the Snow Falls	Good
After Some Snow Has Fallen	Good
During Freezing Rain	Good
Comments	None

Material Spreader System Descriptions
Swenson Products

Agency: Texas Department of Transportation 2

Features and Functions	
Accurate Placement of Chemicals	Good
Ease of Calibration	Good
Effective Use of Chemicals	Good
Comments	None
	Rating options for the following category: very difficult, difficult, neutral, easy and very easy.
System Upgrade	
Ease of System Upgrade	Neutral
	Rating options for the following category: not at all satisfied, slightly satisfied, moderately satisfied, very satisfied and extremely satisfied.
Level of Satisfaction	
Bounce and Scatter	Moderately satisfied
Overall Satisfaction	Moderately satisfied

System Selection and Value	
Other Systems Considered	N/A
Most Influential Features	Pricing
Change in Agency Requirements	No
Purchase Again	Yes
	Members described how the factors listed below contributed to the decision to purchase this spreader system.
System Features and Functions	Not provided
Pricing	Competitive bidding
Equipment Compatibility	Not provided
Other Factors	None

Material Spreader System Descriptions
Swenson Products

Agency: Texas Department of Transportation 3

System Description	
Vendor, Model, Year	Swenson
System Features	• Spreads a range of materials • Variable RPM control for different materials • Material spread varies with speed of vehicle • Adjustable spreader height above road surface • Adjustable spreader dispersal pattern • Other feature: Vibrator.
Type of Use	We frequently use this spreader.
Maintenance Costs	Not provided
Documents or Images	Not provided

System Functionality	
Material Types Delivered	Granular (sand, salt)
Height From Road Surface	24” to 36”
Spread Rate Control	Manual
Typical Operating Speed	Not provided
Operating Speed Variance	No
Calibration Frequency	At the start of the season
Usage Data Retrieval	Daily Activity Report (DAR)

System Operation and Assessment	
	Rating options for the following categories: poor, fair, good, Very good and excellent.
Operational Capacities	
Efficient Use of Manpower	Very good
Flexibility to Change With Weather	Fair
Loading and Unloading Techniques	Good
Comments	None
Effectiveness	
All Winter Storm Conditions	Very good
Before the Snow Falls	Very good
After Some Snow Has Fallen	Very good
During Freezing Rain	Good
Comments	None

Material Spreader System Descriptions
Swenson Products

Agency: Texas Department of Transportation 3

Features and Functions	
Accurate Placement of Chemicals	Very good
Ease of Calibration	Good
Effective Use of Chemicals	Very good
Comments	None
	Rating options for the following category: very difficult, difficult, neutral, easy and very easy.
System Upgrade	
Ease of System Upgrade	Neutral
	Rating options for the following category: not at all satisfied, slightly satisfied, moderately satisfied, very satisfied and extremely satisfied.
Level of Satisfaction	
Bounce and Scatter	Very satisfied
Overall Satisfaction	Very satisfied

System Selection and Value	
Other Systems Considered	Not provided
Most Influential Features	Only have one system
Change in Agency Requirements	No
Purchase Again	Yes
	Members described how the factors listed below contributed to the decision to purchase this spreader system.
System Features and Functions	Not provided
Pricing	Not provided
Equipment Compatibility	Not provided
Other Factors	None

Material Spreader System Descriptions
Swenson Products

Agency: Texas Department of Transportation 4

System Description	
Vendor, Model, Year	Swenson Model #00001-501-83
System Features	• Spreads a range of materials • Variable RPM control for different materials • Material spread varies with speed of vehicle • Adjustable spreader height above road surface • Adjustable spreader dispersal pattern
Type of Use	This is the spreader we use most often.
Maintenance Costs	$1,000 to $1,200 per year
Documents or Images	Not provided

System Functionality	
Material Types Delivered	Granular (sand, salt)
Height From Road Surface	28” to 30”
Spread Rate Control	Ground speed plus gate opening
Typical Operating Speed	30 to 35 mph
Operating Speed Variance	Not provided
Calibration Frequency	• At the start of the season • If operators notice discrepancies
Usage Data Retrieval	Manually by user

System Operation and Assessment	
	Rating options for the following categories: poor, fair, good, Very good and excellent.
Operational Capacities	
Efficient Use of Manpower	Very good
Flexibility to Change With Weather	Very good
Loading and Unloading Techniques	Very good
Comments	None
Effectiveness	
All Winter Storm Conditions	Good
Before the Snow Falls	Very good
After Some Snow Has Fallen	Very good
During Freezing Rain	Not provided
Comments	None

Material Spreader System Descriptions
Swenson Products

Agency: Texas Department of Transportation 4

Features and Functions	
Accurate Placement of Chemicals	Very good
Ease of Calibration	Very good
Effective Use of Chemicals	Very good
Comments	None
	Rating options for the following category: very difficult, difficult, neutral, easy and very easy.
System Upgrade	
Ease of System Upgrade	Easy
	Rating options for the following category: not at all satisfied, slightly satisfied, moderately satisfied, very satisfied and extremely satisfied.
Level of Satisfaction	
Bounce and Scatter	Very satisfied
Overall Satisfaction	Very satisfied

System Selection and Value	
Other Systems Considered	Swenson tailgate spreaders
Most Influential Features	Safety; newer pieces of equipment.
Change in Agency Requirements	No
Purchase Again	Yes
	Members described how the factors listed below contributed to the decision to purchase this spreader system.
System Features and Functions	Two motors with spinners
Pricing	$6,000 to $8,000 each
Equipment Compatibility	Good
Other Factors	None

Material Spreader System Descriptions
Swenson Products

Agency: Texas Department of Transportation 5

System Description	
Vendor, Model, Year	Swenson PEV 100-12, 2020
System Features	• Spreads a range of materials • Material spread varies with speed of vehicle • Adjustable spreader dispersal pattern
Type of Use	This is the spreader we use most often.
Maintenance Costs	Unknown
Documents or Images	Not provided

System Functionality	
Material Types Delivered	• Granular (sand, salt) • Prewetted solids
Height From Road Surface	18”
Spread Rate Control	Ground speed (open loop)
Typical Operating Speed	20 to 25 mph
Operating Speed Variance	Type of vehicle, traffic and weather conditions
Calibration Frequency	At the start of the season
Usage Data Retrieval	Not provided

System Operation and Assessment	
	Rating options for the following categories: poor, fair, good, Very good and excellent.
Operational Capacities	
Efficient Use of Manpower	Good
Flexibility to Change With Weather	Good
Loading and Unloading Techniques	Fair
Comments	None
Effectiveness	
All Winter Storm Conditions	Good
Before the Snow Falls	Good
After Some Snow Has Fallen	Good
During Freezing Rain	Good
Comments	None

Material Spreader System Descriptions
Swenson Products

Agency: Texas Department of Transportation 5

Features and Functions	
Accurate Placement of Chemicals	Good
Ease of Calibration	Fair
Effective Use of Chemicals	Good
Comments	None
	Rating options for the following category: very difficult, difficult, neutral, easy and very easy.
System Upgrade	
Ease of System Upgrade	Difficult
	Rating options for the following category: not at all satisfied, slightly satisfied, moderately satisfied, very satisfied and extremely satisfied.
Level of Satisfaction	
Bounce and Scatter	Moderately satisfied
Overall Satisfaction	Moderately satisfied

System Selection and Value	
Other Systems Considered	Monroe, Henderson, Swenson and Flink
Most Influential Features	Price
Change in Agency Requirements	No
Purchase Again	Yes
	Members described how the factors listed below contributed to the decision to purchase this spreader system.
System Features and Functions	Not provided
Pricing	Our agency goes with the lowest bid.
Equipment Compatibility	Not provided
Other Factors	None

Material Spreader System Descriptions
Swenson Products

Agency: Texas Department of Transportation 6

System Description	
Vendor, Model, Year	Swenson EV 100
System Features	• Spreads a range of materials • Variable RPM control for different materials • Material spread varies with speed of vehicle • Adjustable spreader dispersal pattern • Other feature: Stainless steel with built-in leg stands.
Type of Use	We frequently use this spreader.
Maintenance Costs	Costs are fairly consistent with other V-boxes. Cost savings come in the form of longer life expectancy.
Documents or Images	https://www.swensonproducts.com/products/large-spreaders/ev100-stock-v-box-spreader/documents/253-ev-select-sell-sheet/file

System Functionality	
Material Types Delivered	• Granular (sand, salt) • Prewetted solids • Prewetted dry material and liquid
Height From Road Surface	24”
Spread Rate Control	Ground speed (closed loop)
Typical Operating Speed	< 25 mph
Operating Speed Variance	Varies based on location and conditions
Calibration Frequency	• At the start of the season • If operators notice discrepancies • When the system is repaired
Usage Data Retrieval	At this time, we are not tracking spreader usage.

System Operation and Assessment	
	Rating options for the following categories: poor, fair, good, Very good and excellent.
Operational Capacities	
Efficient Use of Manpower	Very good
Flexibility to Change With Weather	Very good
Loading and Unloading Techniques	Very good
Comments	None
Effectiveness	
All Winter Storm Conditions	Very good

Material Spreader System Descriptions
Swenson Products

Agency: Texas Department of Transportation 6

Before the Snow Falls	Excellent
After Some Snow Has Fallen	Very good
During Freezing Rain	Fair
Comments	If it rains before it freezes and the trucks are exposed, the material can be hard to disperse.

Features and Functions	
Accurate Placement of Chemicals	Very good
Ease of Calibration	Very good
Effective Use of Chemicals	Very good
Comments	None
	Rating options for the following category: very difficult, difficult, neutral, easy and very easy.
System Upgrade	
Ease of System Upgrade	Neutral
	Rating options for the following category: not at all satisfied, slightly satisfied, moderately satisfied, very satisfied and extremely satisfied.
Level of Satisfaction	
Bounce and Scatter	Very satisfied
Overall Satisfaction	Very satisfied

System Selection and Value	
Other Systems Considered	Swenson standard steel painted V-boxes
Most Influential Features	Having stainless steel construction
Change in Agency Requirements	No
Purchase Again	Yes
	Members described how the factors listed below contributed to the decision to purchase this spreader system.
System Features and Functions	Stainless with attached leg stands
Pricing	Slightly more expensive than painted V-boxes
Equipment Compatibility	Must be compatible with our 6/10 yd trucks
Other Factors	None

Material Spreader System Descriptions
Viking-Cives Midwest Inc.

Agency: Vermont Agency of Transportation

System Description	
Vendor, Model, Year	Viking-Cives ProLine (used 2010 to present)

System Features	• Spreads a range of materials
	• Variable RPM control for different materials
	• Material spread varies with speed of vehicle
	• Adjustable spreader dispersal pattern
	• Other features:
	  ○ Integrated with our pavement sensors and AVL systems; can be programmed to do more than we use them for.
	  ○ Can be programmed to spray liquids at the spinner or off a boom system.
	  ○ Can apply granular by the pound and liquids by gallon per mile at variable speeds simultaneously.

Type of Use	We only apply materials used (granular or liquids) via a spreader control system.
Maintenance Costs	Not provided
Documents or Images	Not provided

System Functionality	
Material Types Delivered	• Granular (sand, salt) • Prewetted solids • Liquid • Liquid combined with dry material • Prewetted dry material and liquid • We use them in the off seasons for shoulder work dispensing gravel and (screened) pavement grindings.
Height From Road Surface	6” to 8”, the closer the better
Spread Rate Control	Ground speed (closed loop)
Typical Operating Speed	25 mph maximum for prewetted granular; 35 mph for liquids only
Operating Speed Variance	Yes. Terrain, traffic and weather conditions all can have an effect on operating speeds. Icy roads especially, the only time manual mode should be permitted outside a rate sensor failure.
Calibration Frequency	• Every time new material is used • At the start of the season • If operators notice discrepancies • When the system is repaired
Usage Data Retrieval	We have two ways of retrieving our data: • Onboard system tallies daily usage and seasonal totals. • Through our AVL tracking system—real time or by preselected time frame throughout the season.

Material Spreader System Descriptions
Viking-Cives Midwest Inc.

Agency: Vermont Agency of Transportation

System Operation and Assessment	
	Rating options for the following categories: poor, fair, good, Very good and excellent.
Operational Capacities	
Efficient Use of Manpower	Excellent
Flexibility to Change With Weather	Excellent Good
Loading and Unloading Techniques	Excellent Good
Comments	None
Effectiveness	
All Winter Storm Conditions	Excellent
Before the Snow Falls	Excellent
After Some Snow Has Fallen	Excellent
During Freezing Rain	Excellent
Comments	None
Features and Functions	
Accurate Placement of Chemicals	Excellent
Ease of Calibration	Good
Effective Use of Chemicals	Excellent
Comments	Some units have presented challenges during calibration (software and operator maintenance issues).
	Rating options for the following category: very difficult, difficult, neutral, easy and very easy.
System Upgrade	
Ease of System Upgrade	Neutral
	Rating options for the following category: not at all satisfied, slightly satisfied, moderately satisfied, very satisfied and extremely satisfied.
Level of Satisfaction	
Bounce and Scatter	Extremely satisfied. We only apply granular with liquids to reduce bounce and scatter at the rate of 7 to 15 gallons per ton at the spinner/chute.
Overall Satisfaction	Extremely satisfied

Material Spreader System Descriptions
Viking-Cives Midwest Inc.

Agency: Vermont Agency of Transportation

System Selection and Value	
Other Systems Considered	Certified Power and DICKEY-john
Most Influential Features	Not provided
Change in Agency Requirements	No
Purchase Again	Yes
	Members described how the factors listed below contributed to the decision to purchase this spreader system.
System Features and Functions	Has to be compatible to our liquids program and satisfy the operational requirement of our snow and ice control plan
Pricing	Written into our specification for bidding new plow units
Equipment Compatibility	AVL system
Other Factors	None

MaineDOT

Material Spreaders

9/13/2011

Table of Contents

About our Material Spreaders

General Information

MaineDOT has over 400 vehicles equipped with some type of granular/liquid material spreading apparatus. Of these, just over 200 are hopper units, 200 are front dumping patrol trucks, and a couple dozen others are either Henderson bodies or specialty hoppers manufactured by Schmidt Stratos.

With very few exceptions, the hoppers have an 8 cubic yard capacity and are installed on dual axle, 10 wheel dump trucks (wheelers). Most of these hoppers also have liquid tanks attached that are capable of carrying 120 gallons each, with a total truck capacity of 240 gallons. Some of the newer or modified units have larger capacity tanks to accommodate greater liquid application rates with the granular salt or even the capability for DLA (Direct Liquid Applications). This is discussed in more detail in the Truck Mounted Liquid Systems section of this manual.

Most of the hoppers use a chain driven system to deliver material to the rear of the hopper. However, MaineDOT has been utilizing more belt driven systems in its newer and modified units because these systems deliver a more uniform application of material, eliminating the skipping action common with chain systems.

The front dumping patrol trucks have a 5 yard body that can also be used for ditching, material transportation, patching and other operations that requires material be dumped out the rear of the truck. The body can be changed from rear dumping to front dumping simply by pulling the body latch pins and moving them to the front hinge point location. These latches are located at each side of the truck frame.

In most of the patrol trucks, a bed chain running perpendicular, and at the front of the dump body, carries granular material to the driver's side of the truck and drops it on a spinner located just in front of the rear wheels. In several instances, the passing lane of the Interstate for example, material is delivered to the passenger side of the vehicle. A plate covers the bed chain when the body is in the rear dumping position.

Henderson bodies are designed similar to a hopper, but remain permanently in place. In winter operations, material is discharged at the rear of the truck utilizing a belt driven system running along the bottom of the body. When transporting gravel, pavement, or other material, the body can be used either as a fully functional dumping body, or the belt system can be used to move material to the rear opening.

Another piece of equipment gaining popularity is the swap loader. These trucks have the capability to swap between several different types of bodies. Hoppers, dump bodies, water tanks, etc., are mounted on a frame and can be quickly removed and replaced using a hydraulic arm that pulls the frame up onto the truck body.

The Schmidt Stratos spreaders are currently located at the Region 4, Bangor maintenance facility. The spreaders are hopper systems with integrated legs for storage. What sets the Schmidt spreaders apart from our standard hoppers is the ability to apply significant amounts of liquid to the granular salt being discharged. A mixture of 70 percent granular material is typically applied with 30 percent liquids. This equates to approximately 58 gallons of liquid for every ton of granular salt applied. By comparison, our standard hopper systems apply a liquid application of between 6 and 10 gallons per ton of granular

salt. The additional liquid application is designed to further minimize bounce and scatter of the granular material and activate the salt more quickly.

The Schmidt spreader is widely used in Europe and was originally introduced to MaineDOT in 2004 as part of a Research project. This technology is described in more detail in the Truck Mounted Liquid Systems section of this manual.

Each of these spreading devices requires specific maintenance, adjustments and installation and removal procedures to operate properly and efficiently. Each device also presents its own set of potential hazards to be aware of during installation, removal and adjustment. You should always consider safety your top priority when completing these tasks.

Hoppers

MaineDOT has two primary techniques for hopper storage; the hopper stand system and the gantry system. The hopper stand design incorporates legs as part of the hopper and enables the hopper to simply stand in position; usually on a concrete or paved pad. The gantry system allows the hopper to hang using approved chains and inspected chain falls.

Hopper installation and removal is typically completed each fall and spring and with every 50 hour service.

Hazards to Consider/Avoid When Installing and Removing the Hopper

- This procedure should always be completed with a minimum of two persons.
- Communication between the driver and one spotter is critical to a safe and successful hopper installation.
- The operator will keep visual contact with the spotter at all times
- The immediate area around the hopper should be checked for all hazards (including overhead) and additional persons should not be allowed in this area until the installation is complete.
- No person is allowed under the hopper when the vehicle is in motion, or when the legs are not locked and in the down position (hopper stand system).
- Always wear the required PPE, including; hardhat, gloves, eye protection, face protection and proper foot protection (steel toed boots).
- Work with an experienced person until you are comfortable completing this process.

For the Gantry Systems….

- Check all chain falls and chains to assure they are in good working order.
- Verify the gantry structure is sound and in good shape (no dents, damage, etc.)
- Make sure the gantry has been inspected and rated for the weight of the hopper. A weight rating tag should be located on the gantry (see picture to right).

Gantry Weight Rating Tag

Hopper Installation – Hopper Stand System

1) The first step in the hopper installation procedure is to remove the tailgate and apron, if attached. The apron must be removed for proper installation of a hopper stand system. To achieve this, first move the truck to a designated area to have the lifting tailgate removed using a bucket loader if a tailgate stand is not available. Attach a properly rated lifting chain to the link on the top of the tailgate and apply enough upward pressure to allow the tailgate pins to be removed. After the pins have been removed, check to see that the spreader/tailgate chains have been detached. Lift the tailgate out of position and reinsert the pins into the tailgate. Store the tailgate in the designated storage area.

2) During summer use, the body of the truck can become cluttered with gravel, pavement, miscellaneous tools and even an occasional bottle or can. Make certain the body is completely clean of all debris before installing the hopper.

3) Before positioning the truck for the installation, check the hopper for mechanical issues and grease the hopper if necessary or scheduled. Check the limiter strap for any cuts, tears or excessive wear.

4) Under the direction of the spotter, the operator will back slowly and squarely to the hopper.

5) The spotter will then direct the operator to raise the truck body so as to clear the rollers and slowly back up until the body is within a couple of inches of the front legs of the hopper stand unit. The spotter will then direct the operator to stop and secure the vehicle by putting the truck in neutral and applying the parking brake.

6) At this point, the spotter will indicate that he is going under the hopper to attach the limiter strap to the truck. The strap is designed to prevent the hopper from coming out of the body before the legs are down and locked. Check the strap to ensure it has been adjusted to the proper length. **Note: The legs of the hopper stand device are still in the down and locked position.**

7) With the spotter once again in view of the operator, he will direct the operator to lower the body of the truck until the front legs of the hopper stand unit just clear the ground.

8) The spotter will then unlock the front legs without going under the hopper.

9) The spotter will then direct the operator to back up slowly. The front legs will fold up as the hopper continues to roll into the truck body. **Note: Spotter should make certain the limiter strap does not get pinched or cut as the hopper is placed into the truck.**

10) At the direction of the spotter, the operator will continue to slowly back the truck while slowly lowering the body until the tailgate latch contacts the pins of the hopper stand and the spotter directs the operator to stop. The operator will secure the vehicle by putting the truck in neutral and applying the parking brake. **Note: The operator must maintain a dump angle that allows the hopper to roll into place. If this angle is too steep, the truck will actually push the hopper away. If it's too low, the back of the truck body will actually hit the hopper stand.**

11) With the hopper in the proper position, the spotter will close and lock the tailgate latch.

12) The spotter will then direct the operator to lower the body completely.

13) With the truck already secured, it is now safe for the operator to exit the vehicle and assist the spotter with unpinning, lifting and re-pinning the rear legs of the hopper stand unit.

14) Next, the operator and spotter will completely secure the hopper by fastening all the safety chains and latches provided. These should consist of two sets of safety chains; one on either side of the bottom rear corners and a chain and binder located on each of the front upper corners. **Note: When tightening the front binders use caution not to over tighten, as this can cause damage to the hopper.**

15) Connect all of the hydraulic fittings.

16) Connect all wiring for lighting, controller (Compu-Spread, Cirus, Schmidt), etc. **Note: Check the controller connector to assure a liberal amount of dialectic grease is present.**

17) Confirm all lighting is working properly.

18) Confirm the gate is positioned at the proper gate setting.

19) Confirm the bed chain or belt is working properly by running the truck in the “unload” mode.

20) Check for hydraulic leaks.

21) To complete the installation process, make one final and overall check of the hopper to confirm safety chains, hydraulic fittings and electrical connections are properly attached.

Hopper Installation – Gantry System

1) The first step in the hopper installation procedure is to remove the tailgate. To achieve this, first move the truck to a designated area to have the tailgate removed using a bucket loader if a tailgate stand is not available. Attach a properly rated lifting chain to the link on the top of the tailgate and apply enough upward pressure to allow the tailgate pins to be removed. After the pins have been removed, check to see that the spreader/tailgate chains have been detached. Lift the tailgate out of position and reinsert the pins into the tailgate. Store the tailgate in the designated storage area.

2) During summer use, the body of the truck can become cluttered with gravel, pavement, miscellaneous tools and even an occasional bottle or can. Make certain the body is completely clean of all debris before installing the hopper.

3) Before positioning the truck for the installation, check the hopper for mechanical issues and grease the hopper if necessary or scheduled.

4) Under the direction of the spotter, the operator will back slowly and squarely to the hopper.

5) With the truck body in the down position and at the direction of the spotter, the operator will slowly back under the hopper so as to allow the hopper to slide into the truck body. **Note: The spotter must check the hopper height to assure it will clear the truck body.**

6) The spotter will continue to direct the operator to back until the rear of the hopper latches into the tailgate latches. The operator will secure the vehicle by putting the truck in neutral and applying the parking brake. **Note: The spotter may need to adjust the two chain falls on either side at the rear of the hopper to insure proper fit into the tailgate latches.**

7) The spotter will close and lock the tailgate latch and hook the two safety chains located at either side of the rear of the hopper.

8) At this point, the spotter will release the chain falls from the back of the hopper and secure them to the side of the gantry.

9) The operator will raise the body until there is slack in the front chain that suspends the hopper in the gantry. The spotter will notify the operator that they are climbing between the cab and body to release the front chain. **Note: The chain should be hooked to the gantry so as to clear the hopper when driving away.**

10) After the spotter has climbed down and is in direct view of the operator, the operator will lower the body.

11) With the truck already secured, the operator can safely exit the cab and assist the spotter in hooking the two remaining chains and binders located at the front upper corners of the dump body. **Note: When tightening the front binders use caution not to over-tighten, as this can cause damage to the hopper.**

12) Connect all of the hydraulic fittings.

13) Connect all wiring for lighting, controller (Compu-Spread, Cirus, Schmidt), etc. **Note: Check the controller connector to assure a liberal amount of dialectic grease is present.**

14) Confirm all lighting is working properly.

15) Confirm the gate is positioned at the proper gate setting.

16) Confirm the bed chain or belt is working properly by running the truck in the “unload” mode.

17) Check for hydraulic leaks.

18) To complete the installation process, make one final and overall check of the hopper to confirm safety chains, hydraulic fittings and electrical connections are properly attached.

Hopper Removal (Hopper Stand System)

1) To begin the hopper removal procedure, position the vehicle at the appropriate stockpile location and completely empty the hopper of all granular material.

2) The liquid tanks should be completely emptied before removing the hopper. In no instance should the tanks be left partially full. A potential hazard exists when liquid in partially full tanks begins "sloshing" around during removal; causing the hopper to move quickly from the force of the moving liquid and potentially fall to the ground.
Note: Rubber gloves and face shield must be worn

3) Choose a firm, level landing place for unloading the hopper. Concrete or pavement is preferable.
Note: Extreme heat during summer storage can cause the hopper legs to sink into the pavement, requiring adjustment before the hopper can be inserted into the truck body. *Placing pieces of plywood under the legs can help prevent this from occuring

4) Move truck to the desired drop location. Under the direction of the spotter, the operator will slowly back up until the truck is positioned at the drop location. The spotter will direct the operator to secure the vehicle by putting the truck in neutral and applying the parking brake. **Note: It is now safe for the operator to exit the vehicle and assist the spotter.**

4A) For the Schmidt Stratos Spreader, the chute/spinner assembly must be raised when removing the hopper.

5) Next, the spotter and operator will unhook all hydraulic and electrical connections. **Note: Absorbent pads should be available to collect any leaked hydraulic fluid and hydraulic and electrical connections should be capped or plugged.**

6) The operator and spotter will remove the rear leg locking pins, lower the rear legs into position and re-insert the locking pins.

7) At this point, the operator and spotter will remove the safety chains and binders from the front of the hopper and safety chains from the rear of the hopper.

8) With the operator back in the vehicle and the spotter in full view, the operator will raise the dump until the rear legs make contact with the ground and stop the vehicle when directed by the spotter.

9) The spotter will then unlatch the tailgate.

10) The operator will raise the dump body until the rear of the hopper begins to come off the floor of the dump.

11) At the direction of the spotter, the operator will slowly pull forward, adjusting the dump angle as directed, to keep the frame of the hopper stand from rubbing against the floor of the dump body.

12) The operator will continue to pull forward until the hopper is positioned to allow the front legs of the hopper stand to drop. The spotter will direct the operator to stop and secure the vehicle by putting the vehicle in neutral and applying the parking brake.

13) The operator will exit the vehicle and assist the spotter with lowering the front legs into position and locking them into place.

14) The operator will re-enter the vehicle and with the spotter in full view, raise the body until the front legs have contacted the ground. The operator will stop and secure the vehicle.

15) The spotter will indicate to the operator that they are going under the hopper to unhook the limiter strap. **Note: The strap should be draped over the hopper stand in such a way that keeps the strap from contacting the ground.**

16) To complete the removal process, the spotter will perform a final check to confirm all fittings have been disconnected and then indicate to the operator that it is safe to move the vehicle away from the hopper.

17) Whenever possible, the hopper should be completely washed after removal. **Note: Wear all appropriate PPE.**

Hopper Stand Maintenance

There are several items that should be considered in keeping the Hopper Stand functioning smoothly and safely. The following items should be addressed each time the hopper is removed from the truck body:

- The hopper stand will be inspected for cracks, cracked welds, bent legs and pins, excessive corrosion or other deficiencies that can potentially cause the hopper stand to fail.

- If present, all grease fittings should be greased.

- A liberal amount of graphite shall be applied to the portion of the rear legs that slide into the hopper stand frame.

- Front leg pins and locks should receive a liberal application of chain and cable lube.

- Front, side and rear rollers should receive a liberal application of chain and cable lube.

- The limiter strap will be inspected for rips, cuts, frays, or other deficiencies that can potentially affect the straps integrity.

- Connections on the limiter strap must be checked and found to be secure and functional.

Hopper Removal (Gantry System)

1) To begin the hopper removal procedure, position the vehicle at the appropriate stockpile location and completely empty the hopper of all granular material.

2) The operator will then move the vehicle to the liquid storage area and completely empty the on-board liquid tanks. Proper PPE to include rubber gloves and face shield must be worn. **Note: Under no circumstance should a hopper be stored in a Gantry system with liquid remaining in the liquid tanks.**

3) Under the direction of the spotter, the operator will slowly back the truck under the desired gantry system. The spotter will take particular care to position the truck directly under the hook points to assure the hopper is lifted straight off the truck body. The spotter will direct the operator to secure the vehicle by putting the truck in neutral and applying the parking brake. **Note: It is now safe for the operator to exit the vehicle and assist the spotter.**

4) Next, the spotter and operator will unhook all hydraulic and electrical connections. **Note: Absorbent pads should be available to collect any leaked hydraulic fluid and hydraulic and electrical connections should be capped or plugged.**

5) At this point, the operator and spotter will remove the safety chains and binders from the front of the hopper and safety chains from the rear of the hopper.

6) The operator will re-enter the vehicle and raise the dump until the front of the hopper is high enough to hook the front chain located on the gantry system. The spotter will direct the operator to secure the vehicle.

7) The spotter will then notify the operator that he is going to climb between the cab and body of the vehicle to attach the front chain.

8) After the spotter has climbed down and is in direct view of the operator, the spotter will direct the operator to lower the front of the dump body. **Note: The spotter must check to assure the hopper has lifted slightly off the dump body floor.**

9) The spotter will then hook the chain falls located on the gantry to both sides of the rear of the hopper. **Note: The spotter will remove all slack from the chains by adjusting the chain falls.**

10) The spotter will then unlatch the tailgate.

11) The spotter will raise the hopper utilizing the chain falls until the rear of the hopper has lifted slightly off the dump body floor.

12) The spotter will then direct the operator to slowly pull forward until the tailgate latch clears. The spotter will direct the operator to stop and secure the vehicle by putting the truck in neutral and setting the parking brake.

13) The spotter will then raise the hopper using the chain falls, so it clears the truck body by several inches.

14) To complete the removal process, the spotter will perform a final check to confirm all fittings have been disconnected and then indicate to the operator that it is safe to move the vehicle away from the hopper.

15) Whenever possible, the hopper should be completely washed after removal. **Note: Wear all appropriate PPE.**

Hopper Maintenance

Maintenance of the hopper should be completed as part of every 50 hour service of the vehicle. When performing the 50 hour service during the summer, the driver should conduct a visual check of the hopper. If time allows, connect the hydraulic fittings and run the bed chain for 30 seconds to assure the hopper will perform when the winter season arrives.

Below is a list of items to perform as part of the hopper maintenance.

- Remove and thoroughly wash the hopper, making certain to wear all appropriate PPE.
- Complete a visual inspection of the hopper. Check all welds, bolts, etc.
- Check all hydraulic hoses and fittings.
- Check all electronic fittings.
- Grease all fittings. These are typically located on either side at the front, near the top of the hopper, at the rear of the hopper near the bed chain shaft and at the spinner.
- Check the bed chain or belt for proper tightness and alignment.

- Check the gear box for proper fluid level.

Front Dump Systems

MaineDOT Front Dump Systems can be quickly switched from rear dumping mode to winter maintenance, front dumping mode by removing the pins or locks from the rear hinge points and moving them to the front hinge point locations.

There are several hazard or safety considerations to be aware of when working with this system. These are discussed below.

Hazards to Consider/Avoid When Working with the Front Dump System

- The immediate area around the truck should be checked for all hazards (including overhead) and additional persons should not be allowed in this area until all changes are complete.
- Dump Props must always be in position when body is raised and maintenance, cleaning, greasing, etc. are being performed.
- When changing the dump position of the body, pins or locks must be switched on both sides of the truck.
- Always wear the required PPE, including; hardhat, gloves, eye protection, face protection and proper foot protection (steel toed boots).
- Work with an experienced person until you are comfortable completing these procedures.

Procedure for Changing from Rear Dump to Front Dump Position

1) When preparing for a winter storm event, check and completely clean the body of all tools, gravel material, pavement, etc.

2) Remove and properly store the bed chain plate cover.

3) Next, remove the pins or locks from the rear hinge point locations and move them to the front locations. **Note: Make certain this process is completed on both sides of the truck body.**

4) Install the chute, if not already in place.

5) If necessary, install the spinner.

6) Confirm the gate is positioned at the proper gate setting.

7) Confirm all lighting is working properly.

8) Before loading the truck with material, confirm the bed chain is working properly by running the truck in the "unload" mode.

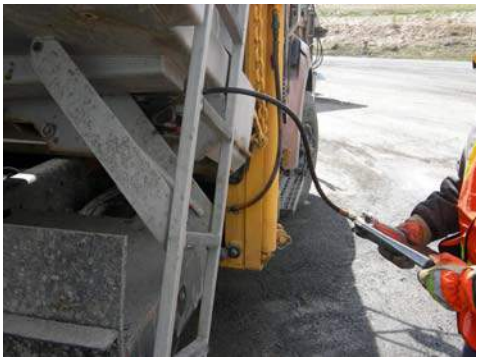
Front Dump Maintenance

Maintenance of the Front Dump should be completed as part of every 50 hour service of the vehicle. When performing the 50 hour service during the summer, the driver should conduct a visual check of the body and run the bed chain for 30 seconds to assure the equipment will be ready when the winter season arrives.

Below is a list of items to perform as part of the Front Dump maintenance.

- Lift dump body and place dump props into position

- Thoroughly wash the dump body, and the inside and outside of the frame and sub-frame, making certain to wear all appropriate PPE.



- Grease all fittings. These are typically located on each end of the idler sprocket shaft and on the drive shaft, opposite the gear box. Fittings may also be located at the rollers, if so equipped.

- Lubricate the dump scissors

- Next, complete a visual inspection of the body. Check all welds, bolts, etc.

- Check the bed chain or belt for proper tightness and alignment.

- As a final step, check the gear box for proper fluid level.

Henderson Body Systems

MaineDOT Henderson Body Systems are very similar to the hopper systems, except they remain permanently attached to the truck frame. For summer use, the belt running along the bottom of the body is typically covered with a plate and material is removed from the body by lifting the dump body. In winter conditions, the plate covering the belt is removed and a spinner assembly system is attached to the back of the truck.

There are several hazard or safety considerations to be aware of when working with this system. These are listed below.

Hazards to Consider/Avoid When Working with the Henderson System

- The immediate area around the truck should be checked for all hazards (including overhead) and additional persons should not be allowed in this area until all changes are complete.
- Dump Props must always be in position when body is raised and maintenance, cleaning, greasing, etc. are being performed.
- Always wear the required PPE, including; hardhat, gloves, eye protection, face protection and proper foot protection (steel toed boots).
- Work with an experienced person until you are comfortable completing these procedures.

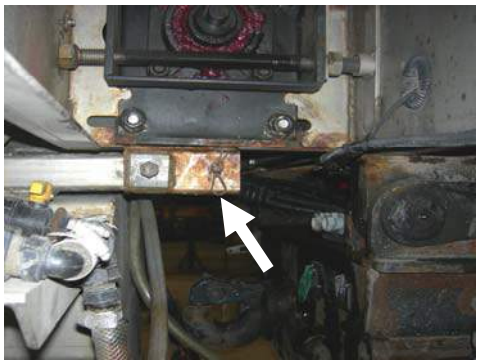
Preparing the Henderson Body System for Winter Maintenance Conditions

1) When preparing for a winter storm event, check and completely clean the body of all tools, gravel material, pavement, etc.

2) Remove and properly store the belt assembly plate cover.

3) The next step is to install the spinner assembly.

4) Once the two assembly arms have been inserted into the sleeves, insert the two locking pins. These are located at either side and under the truck body.



5) Next, connect all air fittings/couplings.

6) Connect all hydraulic fittings.

7) To complete the spinner assembly installation, connect the liquid/brine fittings

8) Next, confirm the gate is positioned at the proper gate setting.

9) Confirm all lighting is working properly.

10) Before loading the truck with material, confirm the bed chain is working properly by running the truck in the "unload" mode.

Henderson Body Maintenance

Maintenance of the Henderson Body should be completed as part of every 50 hour service of the vehicle. When performing the 50 hour service during the summer, the driver should conduct a visual check of the body and run the bed chain for 30 seconds to assure the equipment will be ready when the winter season arrives.

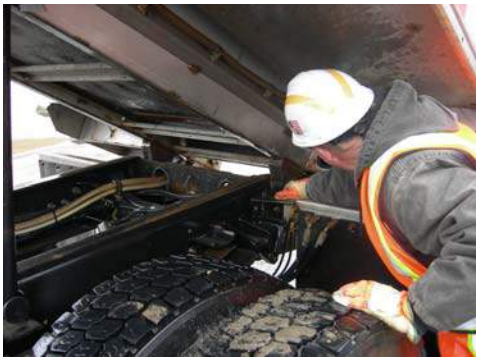
Below is a list of items to perform as part of the Henderson Body maintenance.

- Lift the dump body and place dump props into position

- Thoroughly wash the dump body, and the inside and outside of the frame and sub-frame, making certain to wear all appropriate PPE.

- Grease all fittings. These are typically located on each end of the idler sprocket shaft and on the drive shaft, opposite the gear box. Fittings may also be located at the rollers, if so equipped.

- Next, complete a visual inspection of the body. Check all welds, bolts, etc.



- To complete the maintenance procedure, check the bed chain or belt for proper tightness and alignment.

Swap Loader System

The Swap Loader system has a unique set of procedures for removing and installing the hopper attachment. Unlike the Stand Alone or Gantry system discussed previously, the Swap Loader has a mechanical arm used to lift the hopper onto and off of the truck body.

Hopper Installation – Swap Loader

1) To begin the installation process, check the hopper for mechanical issues and grease the hopper if necessary or scheduled. Also make certain that no equipment or tools have been placed in close proximity to the hopper that might become damaged during the loading process.

2) Under the direction of the spotter, the operator will then back slowly and squarely to the hopper.

3) Next, the operator will position the hook into the lifting point of the hopper frame and begin pulling the hopper onto the truck. This will pull the truck back and under the hopper as its being lifted.

4) With the hopper just off the ground, the spotter will direct the operator to apply the parking brake and complete the loading process.

5) With the hopper successfully loaded, the operator can safely exit the vehicle and assist the spotter.

6) The spotter will then plug in the electric winch.

7) Next, disconnect the safety chain. **Note: It may be necessary to adjust the chute assembly using the electric winch.**

8) The spotter will then operate the winch controls to lower the spinner/chute assembly. **Note: At no time will any person stand under the assembly during this procedure.**

9) The next step is to insert the spinner and chute assembly locking pin, located at the rear and to the right on the hopper.

10) The spotter and operator will then connect all hydraulic fittings.

11) Next, connect all wiring for lighting, controller (Compu-Spread, Cirus), etc. **Note: Check the controller connector to assure a liberal amount of dialectic grease is present.**

12) Confirm all lighting is working properly.

13) Confirm the gate is positioned at the proper gate setting.

14) Confirm the bed chain or belt is working properly by running the truck in the “unload” mode.

15) Check to make certain there are no hydraulic leaks.

16) To complete the installation process, make one final and overall check of the hopper to confirm all hydraulic fittings and electrical connections are properly attached.

Hopper Removal – Swap Loader

1) To begin the hopper removal procedure, position the vehicle at the appropriate stockpile location and completely empty the hopper of all granular material.

2) Next, position the vehicle at the storage tank area and completely empty the liquid storage tanks. Rubber gloves and face shield must be worn **Note: A potential spilling hazard exists if liquid is present in tanks during the hopper off-load. Shifting liquid can spill out from the over-fill tubes during removal.**

3) Select the drop location for the hopper. A firm, level surface is required.

4) Move truck to the desired drop location. Under the direction of the spotter, the operator will slowly back the truck into position. The spotter will direct the operator to secure the vehicle by putting the truck in neutral and applying the parking brake. **Note: It is now safe for the operator to exit the vehicle and assist the spotter.**

5) Next, the spotter and operator will disconnect all hydraulic fittings and electrical connections, except the electric winch connection.

6) The spotter will then remove the spinner and chute assembly locking pin, located at the rear and to the right on the hopper.

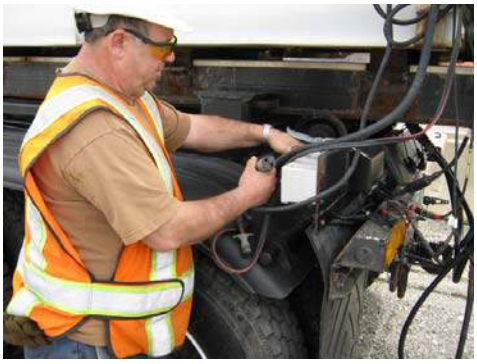
7) After an additional check to determine all hydraulic and electrical connectors (except the electrical winch) have been disconnected, the spotter will operate the winch controls to lift the spinner/chute assembly. **Note: At no time will any person stand under the assembly during this procedure.**

8) With the assembly in the full upright position, the spotter will then hook the safety chain to secure the spinner/chute assembly.

9) The spotter will then re-insert the spinner and chute assembly locking pin.

10) Next, the spotter will disconnect the electric winch connector. **Note: Before completing this step, make certain the winch cable is tight and lying firmly against the back of the chute assembly.**

11) Before unloading, complete one final check to make certain all fittings and connectors have been disconnected.



12) Next, the operator will re-enter the vehicle, making certain the truck is in neutral and the parking brake is applied.

13) With the spotter monitoring at a safe distance, it is now safe for the operator to begin the unloading process.

14) As the back of the hopper frame touches the ground, the spotter will direct the operator to release the parking brake. This will cause the truck to be pushed forward as the hopper is lowered.

15) With the hopper completely at rest on the ground, the operator will maneuver the hook away from the lifting point and fully retract the lifting arm into the transport position.

16) To complete the removal process, the hopper should be completely washed. **Note: Wear all appropriate PPE.**

Other Specialty Hoppers – Schmidt, Modified Units and Precision Placement System (PPS)

Schmidt and Modified Spreaders

The Schmidt Stratos spreaders and the Modified spreaders are similar to our standard hopper spreaders, with a few exceptions. They are equipped with higher capacity liquid tanks to accommodate higher liquid applications to the granular salt; they utilize a belt system to deliver salt to the rear of the hopper and they are designed to spread the salt using the material spinner, instead of concentrating the salt in a wind row.

The Schmidt Stratos is designed and used primarily in Europe and it incorporates a specially designed spinner to mix and distribute the treated salt. One additional feature of the Stratos is its ability to spread material in multiple lanes by rotating the spinner opening relative to the road alignment (see picture at left).

The Modified spreaders are so named because they are simply a standard spreader "modified" by Fleet Services to perform similarly to the European spreaders. These modifications include; four 135 gallon liquid tanks coupled together to provide a total capacity of 540 gallons and a belt over chain delivery system. The modified units also have modified chute/spinner systems to enhance material delivery.

Each of these spreaders is stored using a hopper stand system. The modified spreaders are installed and removed in the same manner as the standard hoppers, while the Stratos system has one additional requirement. The chute/spinner assembly must be raised when removing the spreader. This additional step is documented as step 4A in the Hopper Removal (Hopper Stand System) section.

Maintenance of the Hopper and Hopper Stand System for these spreaders is identical to that of the standard hopper system.

Consideration of the hazards associated with the installation and removal of these spreaders is also the same as the standard spreaders.

Precision Placement System (PPS)

Auger System

The Precision Placement System (PPS) is manufactured by the Swenson Spreader Company of Lindenwood, Illinois. It is designed to place salt in a windrow pattern at the centerline of the roadway. The PPS is an add-on to our standard hoppers that consists of an auger or chute and a high speed, shrouded spinner

Granular salt is moved from the center of the dump body (with either an auger or chute) to the centerline side of the truck and dropped onto the spinner. The speed of the spinner is directly proportional to the speed of the truck, only in the reverse direction, which negates the speed of the truck and drops the salt directly onto the pavement.

Chute System

Installation and removal of PPS equipped hoppers is the same as our standard hopper. **Caution must be used when installing or removing a hopper stand PPS system, so as to not allow the spinner to come in contact with the ground.**

Maintenance of the PPS system is also the same, except for additional grease fittings located on the auger and spinner mechanisms.

research for winter highway maintenance

Lead state:

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