Catalog of Spreader Types

Prepared as part of
"Comparison of Material Distribution Systems for Winter Maintenance"



research for winter highway maintenance

Thompson Engineering Company

Project 01531/CR12-05
December 2014

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www.clearroads.org

Comparison of Material Distribution Systems for Winter Maintenance – Phase I

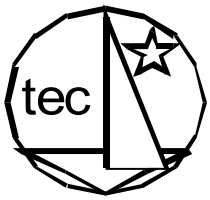
Catalog of Spreader Types

May 14, 2014

Prepared for:

Ashley Duran, Contract Administrator
Minnesota Department of Transportation
Consultant Services Section, Mail Stop 680
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Prepared by:



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Thursday, June 2, 2014

Ashley Duran, Contract Administrator
Minnesota Department of Transportation
Consultant Services Section, Mail Stop 680
395 John Ireland Boulevard
St. Paul, Minnesota 55155-1899

Dear Ashley Duran,

Please find attached the draft of the deliverable "Catalog of Spreader Types", part of the project "*Comparison of Material Distribution Systems for Winter Maintenance – Phase I*"

Please review as needed. Comments, suggestions, and recommendations received from the Clear Roads staff will be incorporated in the final version.

Please contact me if you require additional information. Thank you for your consideration.

Sincerely,

Gregory E. Thompson

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I. Executive Summary

There is a wide range of salt spreading equipment in use around the United States. There are commercially available systems, homemade systems and everything in between. For this reason, it is difficult for agencies to know which system or type of system is best suited to their needs. This report, "Catalog of Spreader Types" is designed to aid in that process. It is part three of a four-part study, "Comparison of Material Distribution Systems for Winter Maintenance – Phase I". The four parts are: Literature Search, Survey Analysis, Catalog of Spreader Types, and Field-testing Recommendations. The goal of this project is to identify as many solid material distribution systems as possible, develop a plan for field-testing them and present this information to the snow fighting professionals.

The goal for this "Catalog of Spreader Types" is to present the photographic information obtained from a survey and email solicitations. To do this photographs were obtained via an online survey, email solicitation and in a few cases from websites. Eighty-five photos were collected and sorted into eight categories. The categories are: tailgate spreaders; hopper spreaders (slide in); single purpose spreaders; pre-wetting systems; salt slurry generators; spinners, chutes, and boots; zero velocity spreaders; and controllers.

These photographs show the wide variety of systems in use by winter maintenance garages around the country. Commercially available systems are shown in the categories ***Tailgate Spreaders, Hopper Spreaders,*** *and* ***Single Purpose Spreaders***. Popular and effective add-ons are shown in ***Zero Velocity Spreaders*** *and* ***Controllers*** categories. Specific in-house modifications are illustrated in the categories ***Pre-wetting Systems*** *and* ***Spinners, Chutes and Boots.***

A point of contact is given for every photo in the catalog so that snow fighters can follow up with these professionals to get more information, more photos or advice on some specific piece of equipment.

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II. Introduction and Methodology

For the winter maintenance professional purchasing equipment and upgrading or modifying existing equipment can be a daunting task. There is a multitude of products to choose from both domestic and foreign and many different options with regards to performance, maintenance and price. This catalog along with the survey analysis and literature search already completed is meant to help the professional make an informed decision by becoming acquainted with options, and seeing what others are using and doing.

This report, "Catalog of Spreader Types" is the third task of the project "Comparison of Material Distribution Systems for Winter Maintenance – Phase I". The four tasks that make up this project are as follows:

- Literature Search
- Survey Analysis
- Catalog of Spreader Types
- Field Testing Recommendations

This report is a photographic catalog of different types of material distribution systems. Photos were gathered over an eight-month time period, June 2013 to February 2014. They were obtained in three ways:

1. Gathered as part of a survey professionals (an earlier step in this project)
2. Solicited in emails targeted to individuals and organizations
3. Collected from websites when a suitable photos were not received in either of the first two ways

The categories used to sort and group the photos were suggested by the Clear Roads committee and then modified to include some other categories given the content of the photos submitted. The categories are:

- Tailgate Spreaders
- Hopper Spreaders (slide in)
- Single Purpose Spreaders
- Pre-wetting Systems
- Salt Slurry Generators
- Spinners, Chutes, and Boots
- Zero Velocity Spreaders
- Controllers

More detailed subcategories can be found in the Table of Contents (page 3). The first three categories are ordered simplest (least expensive) to most complex (most expensive). The tailgate spreaders where the tailgate of a regular dump truck is replaced or modified and the lifting of the box moves the material to the exit point are

the least expensive type of system. The hopper spreader where the spreading unit slides into a regular truck represents the next level of cost and sophistication. The single purpose spreader trucks where the truck is only used for spreading material can have the most features but also have the highest price.

There is significant interest in how systems were/are modified from factory models. The areas where most modifications were observed in this study are in the pre-wetting systems and the spinners, chutes and boots categories. For a more detailed discussion of these modifications see the Survey Analysis Report.

The catalog gives a point of contact for every photo submitted/solicited. This is in an appendix, where names, emails and websites are provided to help the professional contact this source for more information.

With actual photos of spreading systems at use in the field this catalog is unique. It can be used in a number of different ways.

- A resource for professionals purchasing new spreader systems.
- A resource for professionals upgrading their equipment
- A resource for professionals that want to see ways to modify their systems in house to improve their bounce and scatter performance, their pre-wet system or some other feature.
- An educational tool for understanding the different types of spreaders

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III. Tailgate Spreaders

A. Dump style box feed (gravity feed)



Figure 1: Warren Tailgate spreader Model GS, http://www.pavementgroup.com/chip-spreaders/tailgate-spreader-model-gs/?chip-spreaders



Figure 2: Tenco side tipping body, Washington State DOT



Figure 3: Flink tailgate replacement spreader HD6, http://flinkco.com/pdf/hd8.pdf



Figure 4: Henderson dump body with drag chain, Illinois DOT



Figure 5: Dump style tailgate spreader, Shawano County Highway Department

B. Front Dump systems



Figure 6: Front dump systems, photo 1, Maine DOT



Figure 7: Front dump systems, photo 2, Maine DOT



Figure 8: Front dump systems, photo 3, Maine DOT

C. Tailgate mounted spreaders



Figure 9: Elkin Hi-Tech stainless steel trough spreader, Delaware DOT



Figure 10: Monroe tailgate spreader, Dane County Highway Department



Figure 11: Iowa truck with tailgate spreaders and dual spinners, Illinois DOT.

D. Rear Cross Conveyor



Figure 12: Rear cross conveyor – belt driven, Michigan DOT



Figure 13: Rear cross conveyor – with chain, Michigan DOT



Figure 14: Rear cross conveyor – with chain (view 2), Michigan DOT

E. Rear Cross Auger



Figure 15: Meyer dump truck spreader with rear cross auger, photo 1, http://www.meyerproducts.com/spreaders/dumptrucktailgate.aspx



Figure 16: Meyer dump truck spreader with rear cross auger, photo 2, http://www.meyerproducts.com/spreaders/dumptrucktailgate.aspx

IV. Hopper Style Spreaders – V-shaped Truck Boxes (Slide In Box)



Figure 17: Fontaine hopper with a V-box spreader, Maine DOT



Figure 18: V-box inspection, South Carolina Department of Transportation



Figure 19: A set of Schmidt Stratos V-box systems, Maine DOT



Figure 20: Monroe DUZ-MOR Vbox spreaders with conveyor
http://monroetruck.com/Products.aspx?category=207&product=89



Figure 21: Henderson FSH 13, Montana DOT



Figure 22: Epoke spreader with poly tanks on the side, Illinois DOT



Figure 23: Henderson de-icing slide-in unit, New York State DOT



Figure 24: Kenworth T800 quad axle truck dual wing underbody and V-box spreader, Sheboygan County Transportation Department - Highway Division



Figure 25: Hi-Way Xzalt spreader at a trade show, Illinois DOT



Figure 26: V-box with pre-wetting, Michigan DOT

V. Single Purpose Spreaders

A. Radial/Radius Dump Body



Figure 27: Monroe's RDS radial body spreader, http://www.ttspec.com/TruckTrailerSpecialties/media/files/RDS-presentation-Monroe-trip-2012.pdf



Figure 28: Monroe RDS with 900 gallons of liquid capacity and modified spinner 90 gal/ton capability for pre-wetting, Iowa DOT



Figure 29: Radial body with pre-wet tanks, Minnesota DOT

B. Other single purpose spreaders



Figure 30: Epoke cab over truck design spreader, Illinois DOT



Figure 31: Econ spreader, http://www.econ.uk.com/product_subcat.php?choosesubcat=1

VI. Systems for Pre-wetting Salt



Figure 32: V-box spreader with pre-wet system, photo 1, Idaho Transportation Department



Figure 33: V-box spreader with pre-wet system, photo 2, from Idaho Transportation Department



Figure 34: Henderson pre-wet system, saddle tank and plumbing, photo 1, Virginia DOT



Figure 35: Henderson pre-wet system, unloading and cleanout couplers, photo 2, Virginia DOT



Figure 36: Henderson pre-wet system, tank overfill/airvent pipes in the spreader chute, photo 3, Virginia DOT



Figure 37: Henderson pre-wet system, spray nozzles, photo 4, Virginia DOT

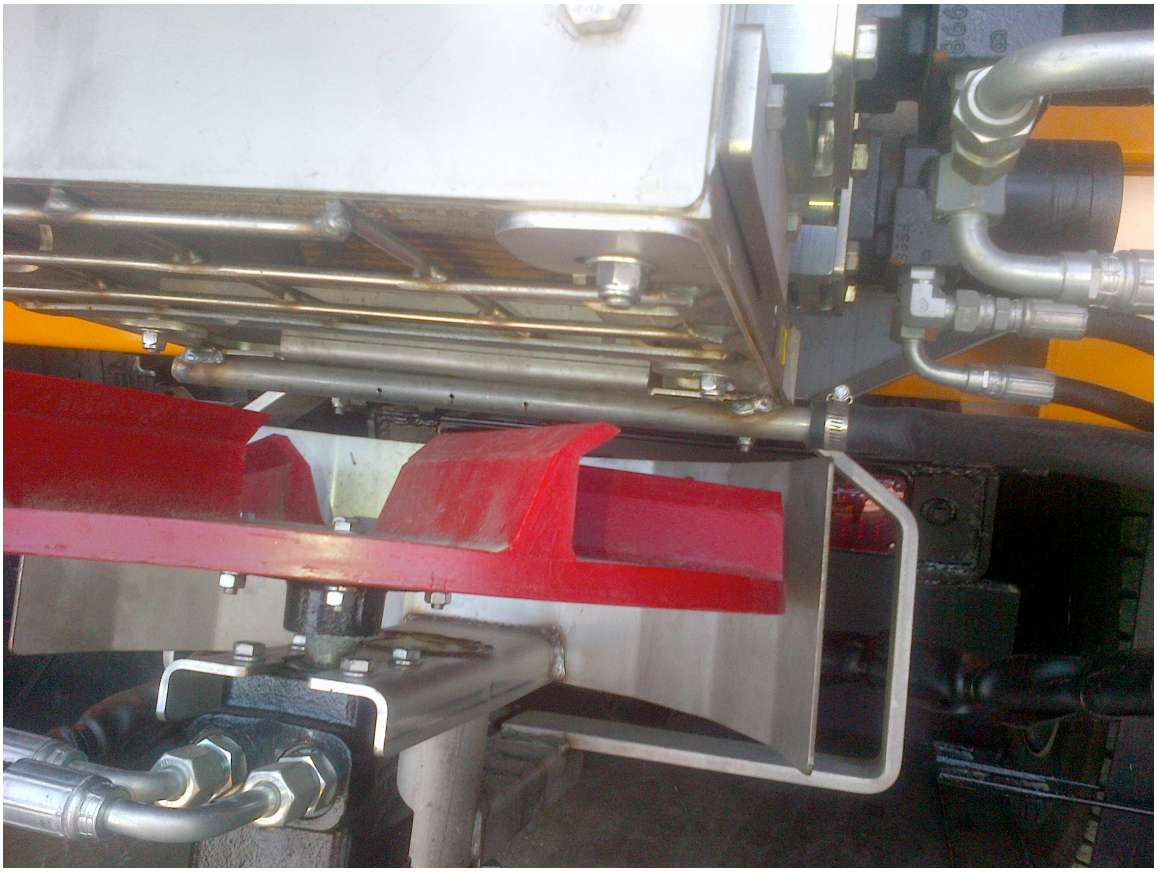


Figure 38: A pre-wetting mechanism, Illinois DOT

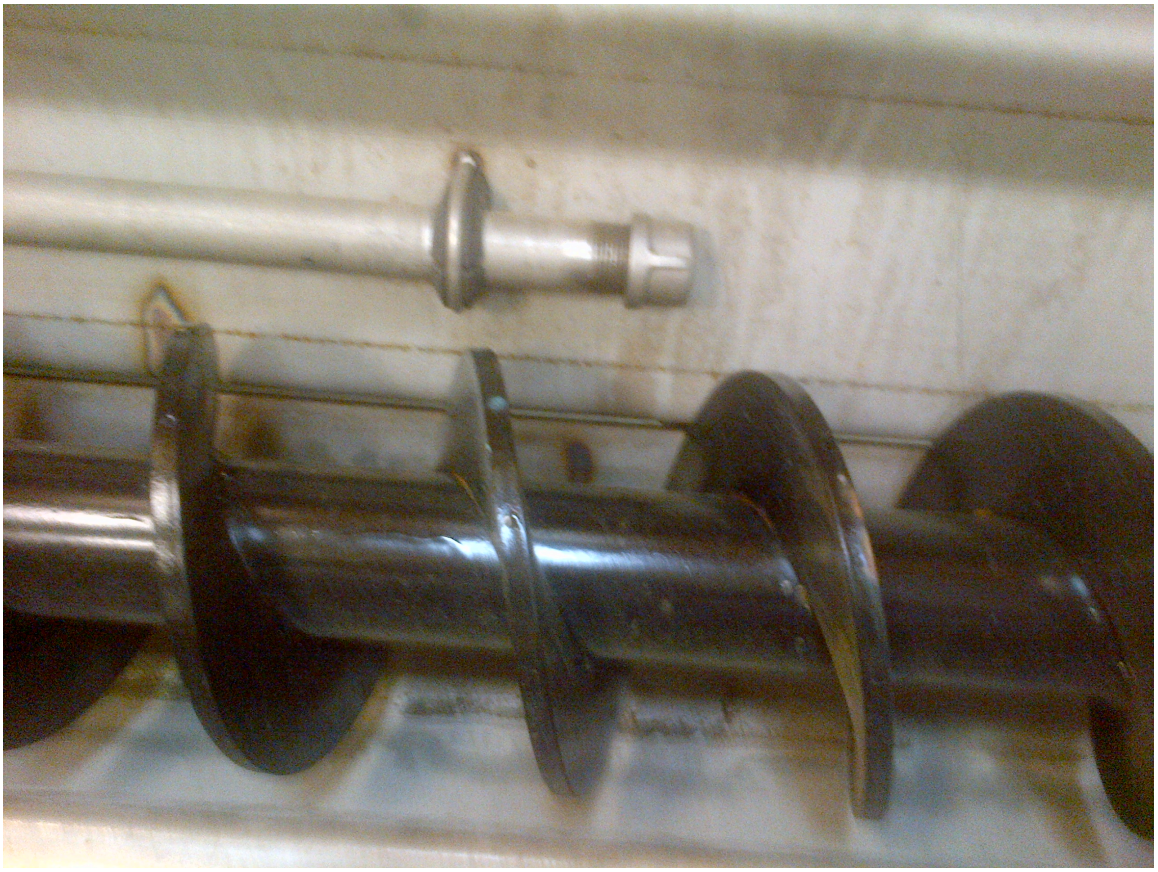


Figure 39: Pre-wet systems in the trough, photo 1, Illinios DOT



Figure 40: Pre-wet systems in the trough, photo 2, Illinois DOT



Figure 41: 80 gallon mid-mounted wetting system, Ohio DOT



Figure 42: Henderson spreader with stainless steel tanks, Illinois DOT



Figure 43: Pre-wetting system, photo 1, Dane County Highway Department



Figure 44: Pre-wetting system, photo 2, Dane County Highway Department



Figure 45: Pre-wetting system on a Swenson spreader, Delaware DOT



Figure 46: Iowa truck with pre-wetting tanks in the bed, Illinois DOT

VII. Salt Slurry Generators

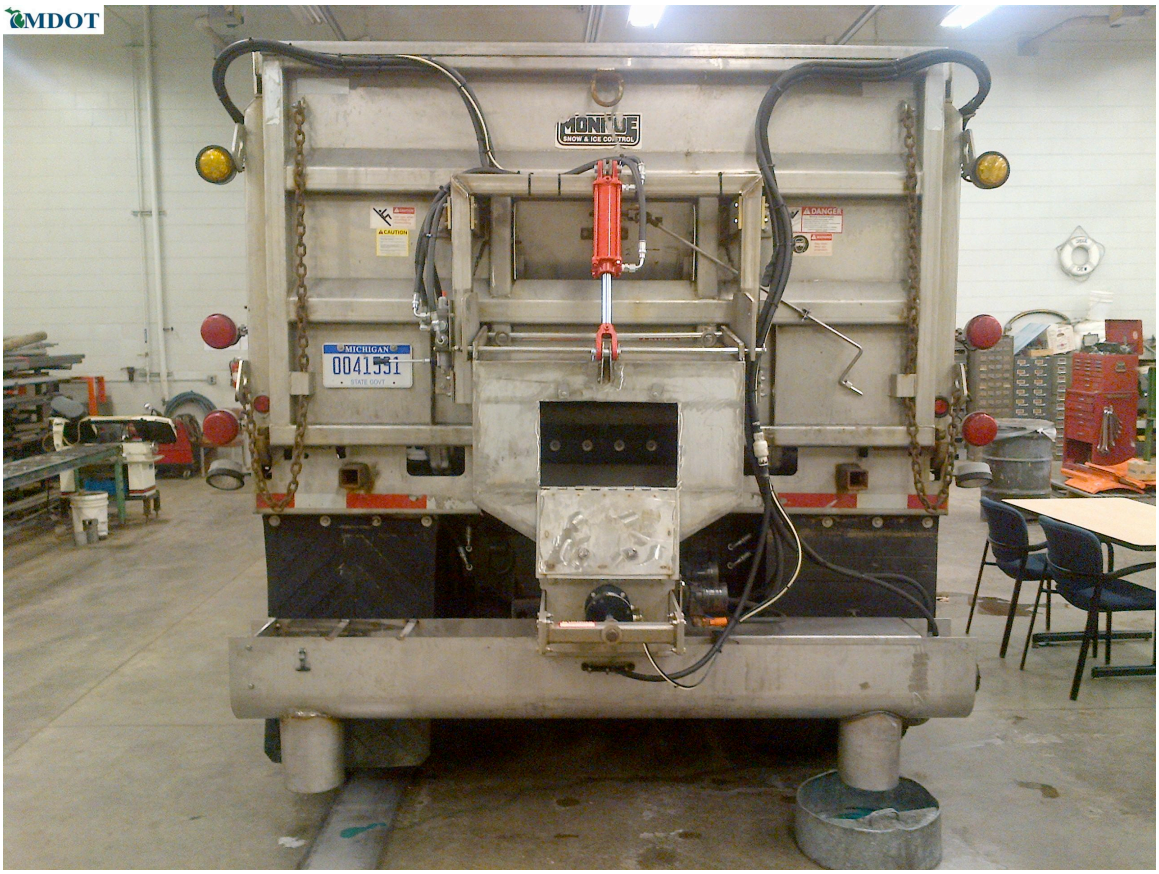


Figure 47: Slurry system, Michigan DOT



Figure 48: Slurry generator, Illinois DOT



Figure 49: Slurry generator, photo 2, Illinois DOT



Figure 50: Maine's Volvo truck with Monroe slurry maker, photo 1, http://www.maine.gov/mdot/tr/documents/pdf/report0905f.pdf



Figure 51: Maine's Volvo truck with Monroe slurry maker, photo 2, http://www.maine.gov/mdot/tr/documents/pdf/report0905f.pdf

VIII. Spinners, Chutes and Boots

A. Spinners



Figure 52: Monroe spinner, Illinois DOT



Figure 53: Spinner, New York State DOT



Figure 54: Swenson modified spinner, photo 1, Maine DOT



Figure 55: Swenson modified spinner, photo 2, Maine DOT

B. Spinner with a skirt attached



Figure 56: Dual spinners, Iowa DOT



Figure 57: Dual spinners with skirts, Iowa DOT



Figure 58: Spinner with skirt, Iowa DOT



Figure 59: Spinner with skirt and tuxedo tail, Iowa DOT



Figure 60: Spinner with load monitor, Shawano County Highway Department

C. Drop chutes



Figure 61: Chute with flaps, Idaho DOT



Figure 62: Chute with flaps second photo, Idaho DOT



Figure 63: Triangle chute, Iowa DOT



Figure 64: Wide chute, Iowa DOT



Figure 65: Chute open (left) and closed (bypassed), Iowa DOT



Figure 66: Experimental chute with oscillation, Iowa DOT

D. Boot systems that lower the drop height

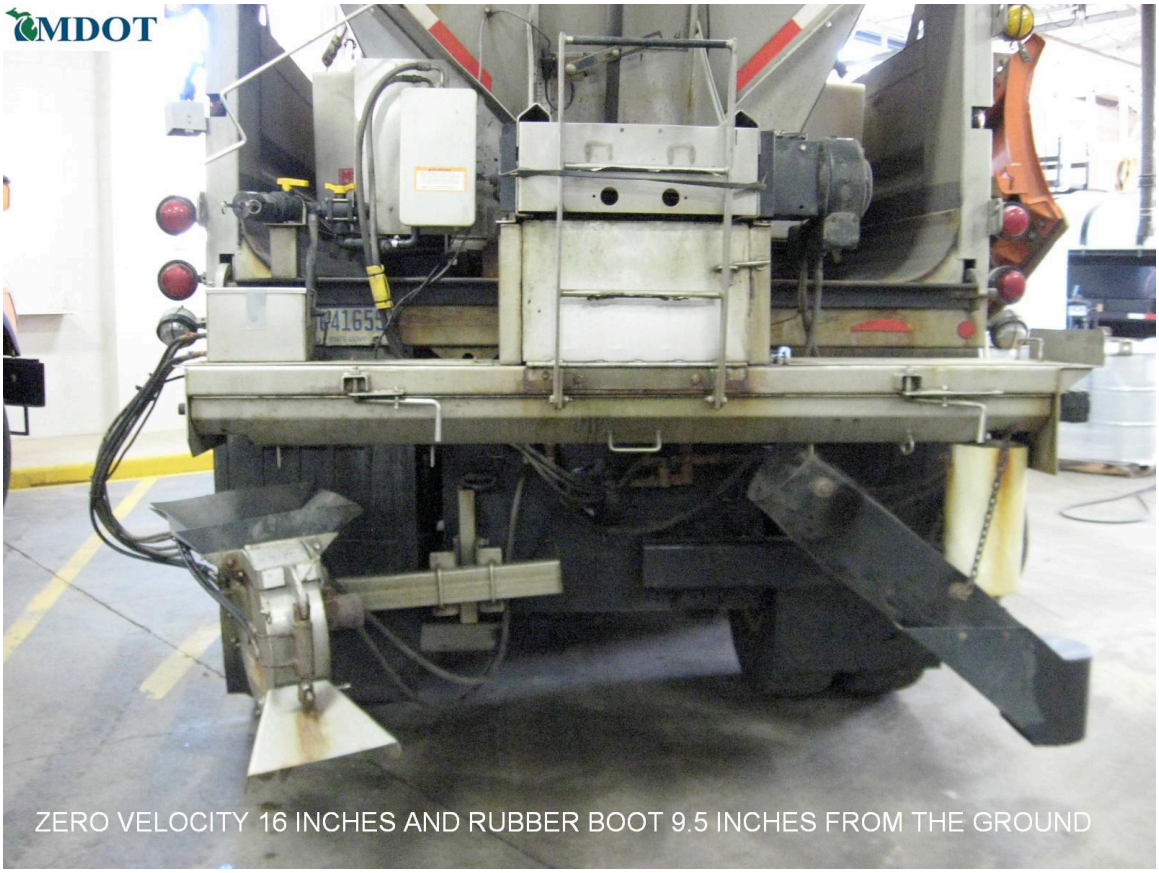


Figure 67: Zero Velocity 16 inches and rubber boot 9.5 inches from the ground, Michigan DOT

E. Y-Chute



Figure 68: Swenson spreader with Y-chute, Michigan DOT



Figure 69: Y-chute, Indiana DOT,
http://docs.lib.purdue.edu/cgi/viewcontent.cgi?article=1566&context=jtrp

F. Other modified systems



Figure 70: WYDOT sander frame with skirt, Wyoming DOT

IX. Zero velocity spreaders

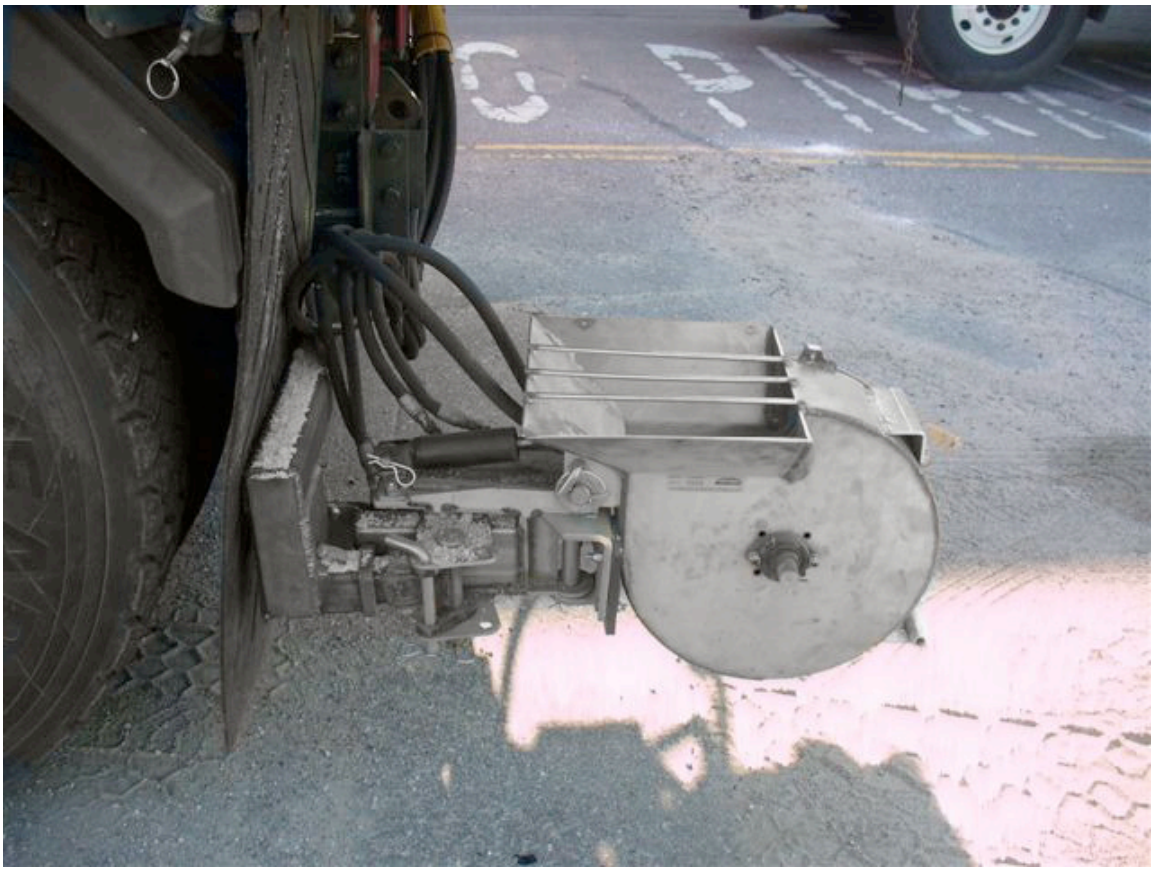


Figure 71: Henderson HTS-55, from
http://www.hendersonproducts.com/images/brochures/HP-192_HTS-55.pdf

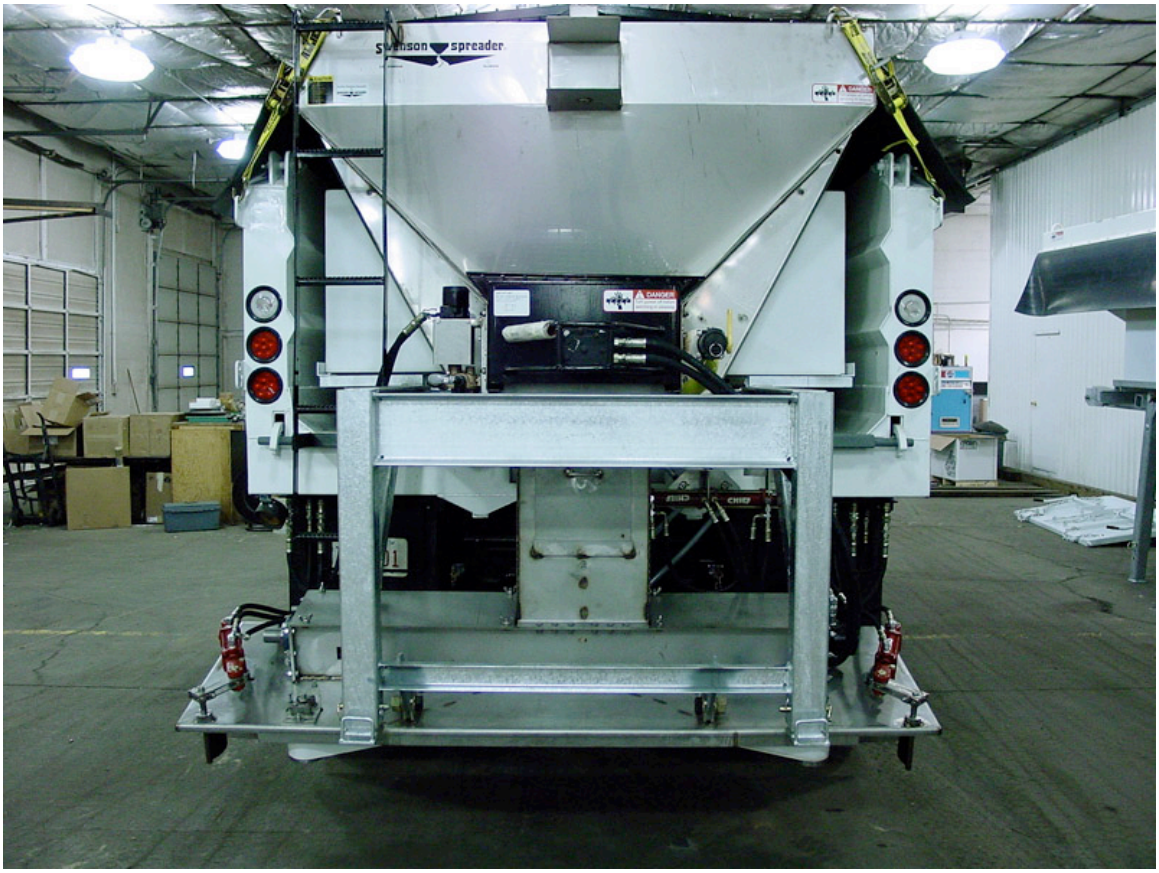


Figure 72: Pengwyn zero velocity system, from http://www.pengwyn.com/zerovelocity.html

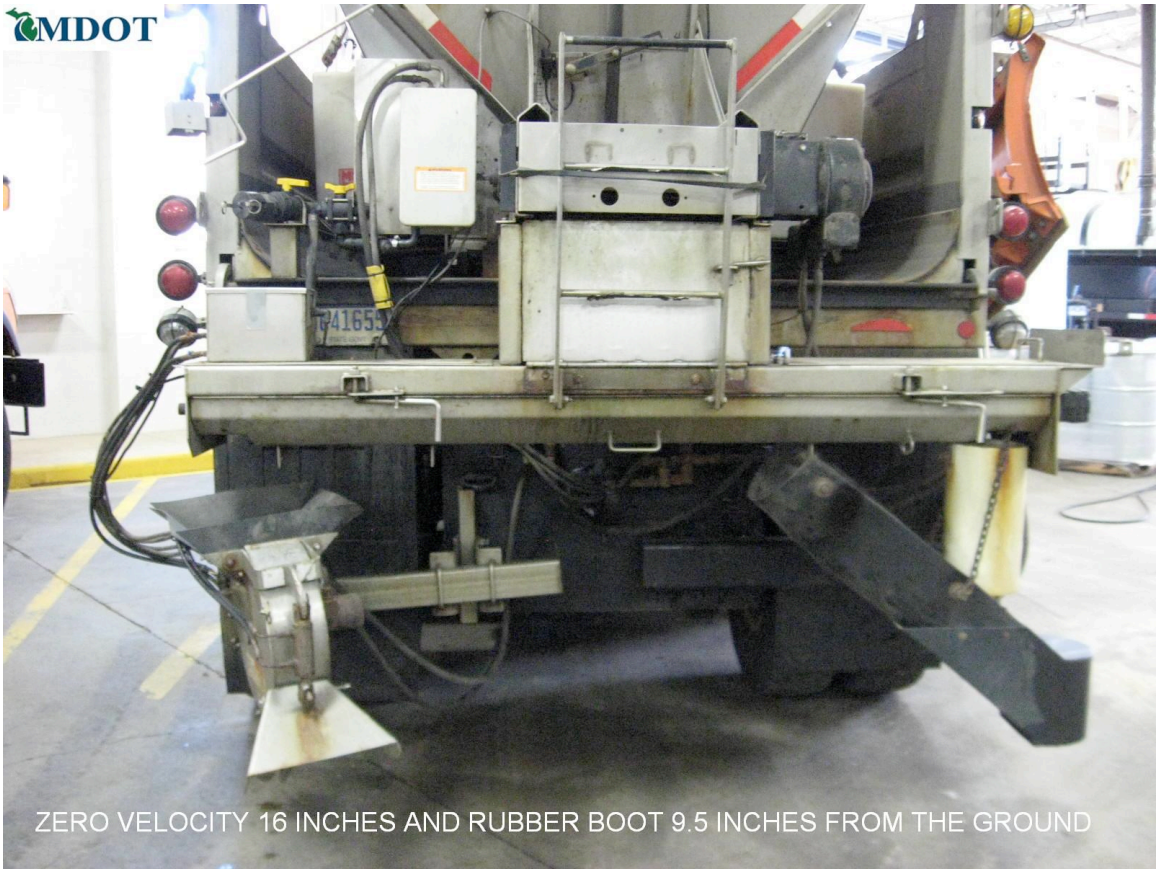


Figure 73: Zero velocity 16 inches and rubber boot 9.5 inches from the ground, Michigan DOT



Figure 74: Monroe zero velocity spreader, Illinois DOT



Figure 75: Monroe zero velocity unit at 20mph, Iowa DOT

X. Controllers



Figure 76: Cirus Controller, SC Department of Transportation



Figure 77: Cirus Controller, Delaware DOT



Figure 78: Component Tech Controller, Delaware DOT



Figure 79: Inside of the cab, Michigan DOT



Figure 80: Dickey John control point controller, New York State DOT



Figure 81: NS 200 spread controller, Washington State DOT



Figure 82: Parker IZAN controller, Washington State DOT



Figure 83: Dickey John control point controller, Washington State DOT



Figure 84: Force America 5100 Electronic controller, Washington State DOT



Figure 85: Force America controller, Dane County Highway Department

XI. Conclusion

Eight-five different photographs of material spreading systems were presented in this catalog. These photographs illustrate a significant cross section of the systems in use by snow fighting professionals in the United States.

A wide range of different systems is illustrated in this catalog. Commercially available systems are shown in the categories ***Tailgate Spreaders, Hopper spreaders,*** *and* ***Single Purpose Spreaders***. Popular and effective add-ons are shown in the ***Zero Velocity Spreaders*** *and* ***Controllers*** sections. Specific in-house modifications are illustrated in the ***Pre-wetting Systems*** *and* ***Spinners, Chutes and Boots*** *sections (e.g. spinner with a skirt attached, drop chutes, boot systems that lower the drop height, other modified systems)****.***

A point of contact (appendix) is given for every system in this catalog in order that more information can be obtained about these particular systems.

XII. Appendix: Points of Contact

All eighty-five photos are listed here with their points of contact. They are listed in the same order as in the catalog above.

Tailgate Spreaders

Figure 1: Warren tailgate spreader model GS, http://www.pavementgroup.com/chip-spreaders/tailgate-spreader-model-gs/?chip-spreaders

Figure 2: Tenco side tipping body, from Joe Stinton, Washington State DOT. StintoJ@WSDOT.WA.Gov

Figure 3: Flink tailgate replacement spreader HD6, http://flinkco.com/pdf/hd8.pdf

Figure 4: Henderson dump body with drag chain, from Tim Peters, Illinois DOT. tim.peters@illinois.gov

Figure 5: Dump style tailgate spreader, from Mike Bohm and Casey Beyersdorf, Shawano County Highway Department
Casey.Beyersdorf@co.shawano.wi.us

Figure 6: Front dump systems, photo 1, from Brian Burne, Maine DOT
Brian.Burne@maine.gov

Figure 7: Front dump systems, photo 2, from Brian Burne, Maine DOT
Brian.Burne@maine.gov

Figure 8: Front dump systems, photo 3, from Brian Burne, Maine DOT
Brian.Burne@maine.gov

Figure 9: Elkin Hi-Tech stainless steel trough spreader, from Alastair Probert, Delaware DOT
alastair.probert@state.de.us

Figure 10: Monroe tailgate spreader, from Tim Yamriska, Dane County Highway Department
yamriska.tim@countyofdane.com

Figure 11: Iowa truck with tailgate spreaders and dual spinners, from Tim Peters, Illinois DOT
tim.peters@illinois.gov

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Figure 12: Rear cross conveyor – belt driven, from Mark Crouch and Matt Pratt, Michigan DOT
crouchm@michigan.gov and prattm@michigan.gov

Figure 13: Rear cross conveyor – with chain, from Mark Crouch and Matt Pratt, Michigan DOT
crouchm@michigan.gov and prattm@michigan.gov

Figure 14: Rear cross conveyor – with chain (view 2), from Mark Crouch and Matt Pratt, Michigan DOT
crouchm@michigan.gov and prattm@michigan.gov

Figure 15: Meyer dump truck spreader with rear cross auger, photo 1,
http://www.meyerproducts.com/spreaders/dumptrucktailgate.aspx

Figure 16: Meyer dump truck spreader with rear cross auger, photo 2,
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Hopper Style Spreaders - V-shaped truck boxes (slide in box)

Figure 17: Fontaine hopper with a V-Box spreader, from Brian Burne, Maine DOT
Brian.Burne@maine.gov

Figure 18: V-box inspection, from David Cook, South Carolina Department of Transportation
cookdb@scdot.org

Figure 19: A set of Schmidt Stratos V-box systems, from Brian Burne, Maine DOT
Brian.Burne@maine.gov

Figure 20: Monroe DUZ-MOR Vbox spreaders with conveyor
http://monroetruck.com/Products.aspx?category=207&product=89

Figure 21: Henderson FSH 13, from Justun Juelfs, Montana DOT
jjuelfs@mt.gov

Figure 22: Epoke spreader with poly tanks on the side, from Tim Peters, Illinois DOT
tim.peters@illinois.gov

Figure 23: Henderson De-icing Slide-in Unit, From Michael Lashmet, New York State DOT
michael.lashmet@dot.ny.gov

Figure 24: Kenworth T800 quad axle truck dual wing underbody and V-box spreader, from Bryan Olson, Sheboygan County Transportation Department - Highway Division bryan.olson@sheboygancounty.com

Figure 25: Hi-Way Xzalt spreader at a trade show, from Tim Peters, Illinois DOT tim.peters@illinois.gov

Figure 26: V-box with pre-wetting, from Mark Crouch and Matt Pratt, Michigan DOT. crouchm@michigan.gov
prattm@michigan.gov

Single Purpose Spreaders

Figure 27: Monroe's RDS radial body spreader http://www.ttspec.com/TruckTrailerSpecialties/media/files/RDS-presentation-Monroe-trip-2012.pdf

Figure 28: Monroe RDS with 900 gallons of liquid capacity and modified spinner 90 gal/ton capability for pre-wetting, from Bret Hodne, Iowa DOT bret.hodne@wdm.iowa.gov

Figure 29: Radial body with pre-wet tanks, from Tom Peters, Minnesota DOT tom.peters@state.mn.us

Figure 30: Epoke cab over truck design spreader, from Tim Peters, Illinois DOT tim.peters@illinois.gov

Figure 31: Econ spreader http://www.econ.uk.com/product_subcat.php?choosesubcat=1

Systems for Pre-wetting salt

Figure 32: V-box spreader with pre-wet system, photo 1, from Steve Spoor, Idaho Transportation Department steve.spoor@itd.idaho.gov

Figure 33: V-box spreader with pre-wet system, photo 2, from Steve Spoor, Idaho Transportation Department steve.spoor@itd.idaho.gov

Figure 34: Henderson pre-wet system, saddle tank and plumbing, photo 1, from Leon Prillaman, Virginia DOT Leon.Prillaman@vdot.virginia.gov

Figure 35: Henderson pre-wet system, unloading and cleanout couplers, photo 2, from Leon Prillaman, Virginia DOT
Leon.Prillaman@vdot.virginia.gov

Figure 36: Henderson pre-wet system, tank overfill/airvent pipes in the spreader chute, photo 3, from Leon Prillaman, Virginia DOT
Leon.Prillaman@vdot.virginia.gov

Figure 37: Henderson pre-wet system, spray nozzles, photo 4, from Leon Prillaman, Virginia DOT
Leon.Prillaman@vdot.virginia.gov

Figure 38: A pre-wetting mechanism, from Tim Peters, Illinois DOT
tim.peters@illinois.gov

Figure 39: Pre-wet systems in the trough, photo 1, from Tim Peters, Illinois DOT
tim.peters@illinois.gov

Figure 40: Pre-wet systems in the trough, photo 2, from Tim Peters, Illinois DOT
tim.peters@illinois.gov

Figure 41: 80 gallon Mid-mounted wetting system, from Doug Burke, Ohio DOT
doug.burke@dot.state.oh.us

Figure 42: Henderson spreader with stainless steel tanks, from Tim Peters, Illinois DOT
tim.peters@illinois.gov

Figure 43: Pre-wetting system, photo 1, from Tim Yamriska, Dane County Highway Department
yamriska.tim@countyofdane.com

Figure 44: Pre-wetting system, photo 2, from Tim Yamriska, Dane County Highway Department
yamriska.tim@countyofdane.com

Figure 45: Pre-wetting System on a Swenson Spreader, from Alastair Probert, Delaware DOT
alastair.probert@state.de.us

Figure 46: Iowa truck with pre-wetting tanks in the bed, from Tim Peters, Illinois DOT
tim.peters@illinois.gov

Salt Slurry Generators

Figure 47: Slurry system, From Mark Crouch and Matt Pratt, Michigan DOT crouchm@michigan.gov and prattm@michigan.gov

Figure 48: Slurry generator, from Tim Peters, Illinois DOT tim.peters@illinois.gov

Figure 49: Slurry generator, photo 2, from Tim Peters, Illinois DOT tim.peters@illinois.gov

Figure 50: Maine's Volvo truck with Monroe slurry maker, photo 1, http://www.maine.gov/mdot/tr/documents/pdf/report0905f.pdf

Figure 51: Maine's Volvo truck with Monroe slurry maker, photo 2, http://www.maine.gov/mdot/tr/documents/pdf/report0905f.pdf

Spinners, Chutes and Boots

Figure 52: Monroe spinner, from Tim Peters, Illinois DOT tim.peters@illinois.gov

Figure 53: Spinner, from Michael Lashmet, New York State DOT michael.lashmet@dot.ny.gov

Figure 54: Swenson modified spinner, photo 1, from Brian Burne, Maine DOT Brian.Burne@maine.gov

Figure 55: Swenson modified spinner, photo 2, from Brian Burne, Maine DOT Brian.Burne@maine.gov

Figure 56: Dual spinners, from Tina Greenfield, Iowa DOT tina.greenfield@dot.iowa.gov

Figure 57: Dual spinners with skirts, from Tina Greenfield, Iowa DOT tina.greenfield@dot.iowa.gov

Figure 58: Spinner with skirt, from Tina Greenfield, Iowa DOT tina.greenfield@dot.iowa.gov

Figure 59: Spinner with skirt and tuxedo tail, from Tina Greenfield, Iowa DOT tina.greenfield@dot.iowa.gov

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Figure 60: Spinner with load monitor, from Mike Bohm and Casey Beyersdorf, Shawano County Highway Department
Casey.Beyersdorf@co.shawano.wi.us

Figure 61: Chute with Flaps, from Steve Spoor, Idaho DOT
steve.spoor@itd.idaho.gov

Figure 62: Chute with flaps second photo, from Steve Spoor, Idaho DOT
steve.spoor@itd.idaho.gov

Figure 63: Triangle chute, from Tina Greenfield, Iowa DOT
tina.greenfield@dot.iowa.gov

Figure 64: Wide chute, from Tina Greenfield, Iowa DOT
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Figure 65: Chute open (left) and closed (bypassed), from Tina Greenfield, Iowa DOT
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Figure 66: Experimental chute with oscillation, from Tina Greenfield, Iowa DOT
tina.greenfield@dot.iowa.gov

Figure 67: Zero Velocity 16 inches and Rubber Boot 9.5 inches from the ground, From Mark Crouch and Matt Pratt, Michigan DOT
crouchm@michigan.gov and prattm@michigan.gov

Figure 68: Swenson spreader with Y-Chute, From Mark Crouch and Matt Pratt, Michigan DOT
crouchm@michigan.gov and prattm@michigan.gov

Figure 69: Y-chute, from Indiana DOT
http://docs.lib.purdue.edu/cgi/viewcontent.cgi?article=1566&context=jtrp

Figure 70: WYDOT sander frame with skirt, from Cliff Spoonemore, Wyoming DOT
Cliff.Spoonemore@dot.state.wy.us

Zero Velocity Spreaders

Figure 71: Henderson HTS-55, from
http://www.hendersonproducts.com/images/brochures/HP-192_HTS-55.pdf

Figure 72: Pengwyn zero velocity system, from http://www.pengwyn.com/zerovelocity.html

Figure 73: Zero Velocity 16 inches and Rubber Boot 9.5 inches from the ground, from Mark Crouch and Matt Pratt, Michigan DOT.
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Figure 74: Monroe zero velocity spreader, from Tim Peters, Illinois DOT
tim.peters@illinois.gov

Figure 75: Monroe zero velocity unit at 20mph, from Tina Greenfield, Iowa DOT
tina.greenfield@dot.iowa.gov

Controllers

Figure 76: Cirus Controller, from David Cook, SC Department of Transportation
cookdb@scdot.org

Figure 77: Cirus Controller, from Alastair Probert, Delaware DOT
alastair.probert@state.de.us

Figure 78: Component Tech Controller, from Alastair Probert, Delaware DOT
alastair.probert@state.de.us

Figure 79: The Inside of the Cab, From Mark Crouch and Matt Pratt, Michigan DOT
crouchm@michigan.gov and prattm@michigan.gov

Figure 80: Dickey John control point controller, From Michael Lashmet, New York State DOT
michael.lashmet@dot.ny.gov

Figure 81: NS 200 Spread Controller, from Joe Stinton, Washington State DOT
StintoJ@WSDOT.WA.Gov

Figure 82: Parker IZAN controller, from Joe Stinton, Washington State DOT
StintoJ@WSDOT.WA.Gov

Figure 83: Dickey John control point controller, from Joe Stinton, Washington State DOT
StintoJ@WSDOT.WA.Gov

Figure 84: Force America 5100 Electronic controller, from Joe Stinton, Washington State DOT

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Figure 85: Force America controller, from Tim Yamriska, Dane County Highway Department.
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