Mn/DOT Snowplow Salt and Sander Controller

Calibration Guide

Credits

The development of this guide involved many Mn/DOT and local agency employees. We would like to recognize these individuals for contributing their time and knowledge to this project.

In addition to the list below, <u>all of the Mn/DOT and local agency persons who attended the Fall 2009 Training Sessions</u> held throughout Minnesota contributed to this guide through their suggestions and input.

- Central Office, Ms. Farideh Amiri
- Central Office, Mr. Bruce Holdhusen
- Central Office, Mr. Joseph Huneke
- Central Office, Mr. Andy Kubista
- Central Office, Ms. Sue Lodahl
- Central Office, Mr. Ryan Otte
- Central Office, Ms. Kathleen Schaefer
- Central Office, Ms. Linda Taylor
- Champion Industrial Equipment, Mr. Ray Durand
- City of Eden Prairie, Mr. Mike Schmidt
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- District 1, Ms. Wendy Frederickson
- District 1, Ms. Holly Johnson
- District 2, Mr. Anthony Bowe
- District 2, Mr. Gale Tiedemann
- District 3A, Mr. Richard Bordwell
- District 3A, Mr. Myron Rohloff
- District 3B , Mr. Mike Kiley
- District 3B , Mr. Mark Loxtercamp
- District 3B , Mr. Randy Reznicek
- District 4 , Mr. Thomas Deutschman
- District 4 , Mr. Kurt Holland
- District 4, Mr. Gregory Schultz
- District 6E, Ms. Shannon Wait
- District 6W , Mr. Ron Heim
- District 7 , Mr. Charles Larson
- District 8 , Mr. Dennis Marty
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Credits, Continued Next Page

Credits, Continued

- EVS, Mr. Gary Peterson
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- Hennepin County, Mr. Michael Scherber
- Metro District, Mr. Joel Dixon
- Metro District, Mr. Mark Fischbach
- Metro District, Mr. Steven Pavek
- Metro District, Mr. Gust Scharffbillig
- Metro District, Mr. William Utecht
- Metro District , Ms. Lynn Tschida

We would also like to thank the facilities and shops who hosted Fall 2009 Calibration Training sessions. They went out of their way by providing meeting rooms, trucks, extra persons to load trucks with material, coffee accommodations, etc. We thank the teams at these Mn/DOT facilities for hosting the sessions:

- Bemidji (Anthony Bowe)
- Fergus Falls (Thomas Deutschman, Kurt Holland, Gregory Schultz)
- Maryland Truck Station (Joel Dixon, Mark Fischbach, Steve Pavek, Bill Utecht)
- Richfield (Joel Dixon, Mark Fischbach, Steve Pavek, Bill Utecht)
- Rochester (Ron Heim, Shannon Wait)
- Saint James (Charles Larson)
- St. Cloud (Mike Kiley, Mark Loxtercamp, Randy Reznicek)
- Virginia (Wendy Frederickson, Holly Johnson)
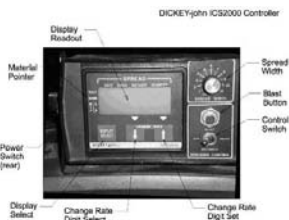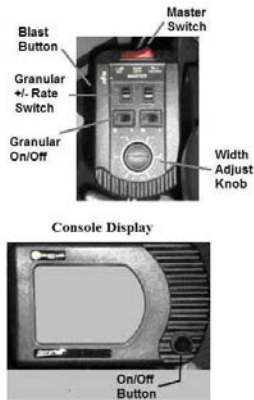- Willmar (Dennis Marty)

Writing: Gary Peterson, Paul Keranen and Rod Pletan of EVS, Inc.
Graphic Design: Sally Kim and Gary Peterson of EVS, Inc.

This report was prepared for the Minnesota Department of Transportation
by EVS, Inc.

Table of Contents

Introduction

The purpose of this guide book is to provide easy-to-use steps for calibrating snowplow sander controllers. It is an experience-based guide that captures tips and techniques learned by experienced calibrators.

The guide focuses on controller calibration. It does not include controller programming.

The layout of the guide is a short informational discussion followed by guidance for specific controllers. The end of the guide includes blank calibration forms, quick calibration sheets, and calculation worksheets.

The guide was prepared by EVS, Inc for Mn/DOT's Office of Maintenance.

For the latest downloadable and printable version of this guide, see the "Office of Maintenance - Maintenance Research" area of the Mn/DOT website.

General Approach to Calibration

No matter what kind of controller you will be calibrating there are several general concepts that are helpful. These concepts are based on lessons learned of experienced calibrators

- Safety
    - Know and use your governing safety regulations
    - Spinner dials to zero/off before starting
    - Always notify all persons outside truck before running auger/spinner
    - Heads-up when outside truck
- Take it slow
    - Especially when going through screens on the controller
    - Usually goes smoothly when we go through steps carefully and not too quickly
- Record constants as you calibrate
    - Helps mechanics when troubleshooting is required
    - Very easy to do (not very many constants to record)
- Simulate operating conditions during calibration
    - Fully warm up truck hydraulics
    - Keep auger loaded/primed during tests
    - Get truck RPM's up at key test points (i.e. running auger/spinner/...)
- Automatic controllers self-calibrate
    - We do not have to be concerned with calibrating different rates (100, 200, 300, etc). The controller will automatically calibrate for any/all rates.

Controller Classifications

Automatic controllers automatically adjust the application rate so that it always applies the same amount of material to the road no matter the truck speed. When the snowplow increases vehicle speed, the controller automatically increases the auger rotation speed so that application rate is maintained. When the vehicle slows down, the controller automatically reduces the auger rotation speed to the correct level to maintain the road application rate.

Manual sander controllers spin the auger at one set fixed speed. The material flow rate from the auger is fixed. At higher speeds less material is applied to the road, at slower speeds less material is applied. Typically manual sanders have about ten different fixed auger speeds that can be selected. Calibration for manual controllers means that we develop a table showing how much material is being applied to the road for a variety of vehicle speeds, for the different fixed auger settings.

Mn/DOT uses automatic controllers.

Open-Loop and Closed-Loop Controllers

All automatic controllers have a speed sensor that allows them to adjust the material application rate (auger speed) for changes in truck speed.

Open-loop systems adjust the auger control valve to a predetermined setting that is a function of truck speed.

Closed-loop controllers also have a rear auger sensor that allows them to monitor the actual rate of the auger. These controllers adjust the control valve until the correct auger speed is achieved. The closed-loop controller is able to dynamically adjust the auger speed if/when the predetermined setting is not providing the correct auger rotation speed. Equipment wear, variable operating temperatures, and aging of equipment can impact the application rate. Therefore, the closed-loop system provides the advantage of being able to adjust the controller to accommodate for those conditions.

Most Mn/DOT sander controllers operate in closed-loop mode.

Note that open-loop systems are typically more difficult to calibrate. For this reason, shops generally prefer to first verify these controllers to determine if calibration is required.

When to Calibrate

The goal is to keep the sander controllers always well-calibrated. Shops use a number of different strategies to accomplish this.

No matter what strategy you use in your shop it is important to always verify or calibrate after truck repairs or modifications that can directly or indirectly impact the sander operation. This

includes major truck maintenance/repair, truck hydraulic fluids/filter replacement, controller system (controller box, auger, sensors, etc) maintenance.

No matter what strategy is used, calibration or verification should be done <u>at least annually</u> in addition to as-needed (after repairs as discussed above, etc).

Experience has shown that <u>new trucks should be calibrated</u> after being delivered to your shop.

When there is any change in salt or other materials used, then controllers should be re-calibrated.

Tips on when to perform specific calibrations

Calibration	When	Notes
Application Rate (Catch Test)	At least annually (i.e. during winter prep) and as noted above.	Some shops first do an application rate verification to determine if a sander controller needs calibrating
System Response Calibration / Hydraulic Adjust	Any time the controller is responding poorly for no apparent reason. For example, if the controller is sluggish when responding to changes in truck speed / application rate, or if the displayed application rate fluctuates by a large amount (i.e. greater than 5%) when driving at a steady speed.	Some shops also choose to do this test as part of scheduled (i.e. annual) calibration. Some shops do this calibration if the catch test is off. Note however, that manual tweaking of controller constants is often required after doing this calibration.
Ground Speed Calibration	Any time the controller speed MPH reading does not match truck speedometer closely	
Spinner Width Calibration	Any time the spinner is not spreading material to the desired width after running all of the other calibrations	

Verification

Some shops use a verification-first strategy. This strategy is discussed here.

For this strategy a verification test is done before calibrating (for each sander controller). If the verification passes, this means that the controller is well-calibrated and does not need calibration. If the verification fails, a calibration should be performed.

The verification test does not change any settings on the controller.

One approach is to take two "passes" (sometimes two separate teams). In the first pass, they "verify" (check) the entire truck fleet to identify trucks that need calibrating. In the second pass, they calibrate the smaller set of trucks identified as needing calibration.

Verification can be a good introduction to sander controllers for new persons on the calibration team.

Verification can be useful for cases where operators are not comfortable when changes are made to their truck. The verification test does not change the controller.

One important use for verification is for cases where specific sander controllers are difficult to calibrate. For example, sander controllers which are running in open loop mode (no rear auger sensor) are typically relatively difficult to calibrate. For these cases, shops prefer to use verification to minimize the number of the more difficult calibrations performed.

Another benefit of verification is for cases where an operator feels that her/his sander controller is not applying the correct amount of material (i.e. thinks it is applying "too little"). The operator is invited to observe a verification to prove the controller is working properly.

DICKEY-john Control Point Calibration

DICKEY-john Control Point Calibration

Contents

Controller Components

DICKEY-john Control Point Controller Components

Tip - Calibration Function Keys

F1 Operate

F2 Granular Application Rate

F3 Granular Configuration

F6 Calibration

F7 Ground Speed

F8 Spinner

F11 System Response
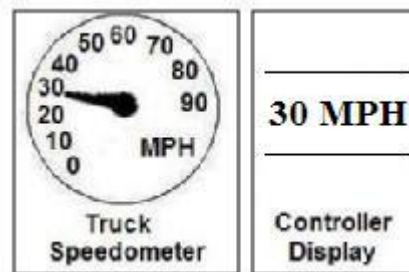
Getting Started
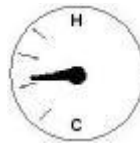
1	Start truck and turn PTO on. Note that PTO controls will vary by truck (see examples in figure).	
2	Fully warm up the truck hydraulics (also see next step). Drive the truck for at least 10 minutes.	
3	While warming up the truck compare the speed on the controller console to the truck speedometer reading (while driving at least 25 mph). These will usually match. In the case they do not match, see 'Ground Speed Calibration' section.	
4	Park the truck and let idle	
5	Apply the parking brake	
6	Load the truck with material	
7	Tie the spinner up (you may find with experience that some weighing methods do not require spinner up)	

8   Insure a complete salt shield is in place (if truck has one)

9   Turn spinner width adjust knob down to zero for safety

10   Ensure all persons are clear of truck and sander

11   Fill the auger by raising the truck box

12   Fill the auger by switching the spreader control to the "Unload" position for a few seconds

13   If the spinner is still 'creeping' (turning slowly) disconnect hydraulic hose temporarily (during calibration)

14   Verify that tailgate air release valve (end gate trip valve) is open (if truck has one)

Application Rate Verification

If you do not want to do a verification, skip to the next section - "**Entering Calibration Mode.**

When - Any time you want to check if the controller application rate is well-calibrated or needs calibration.

Note: This verification process assumes that 'Manual' mode is already enabled. If not, please ask mechanics on your team to enable manual mode. Programming will be required using F7 MANUAL ON' and 'MANUAL SPEED'.

1   Find <u>Test-Time</u> to run test using 'Calibration Verification' page at back of this guide (i.e. 60 seconds). This page will also show the expected weight. For this **example**, we'll use 400 lbs/mile, 60 seconds and therefore an **expected weight of 200 lbs**.

2   Perform the steps outlined above in the "*Getting Started"* section before proceeding

3   Turn Master Switch off

4   For this test we need to be in **'MANUAL' mode** as shown to right. If the main operation screen shows MANUAL mode, **skip to step 10.** Otherwise, continue.
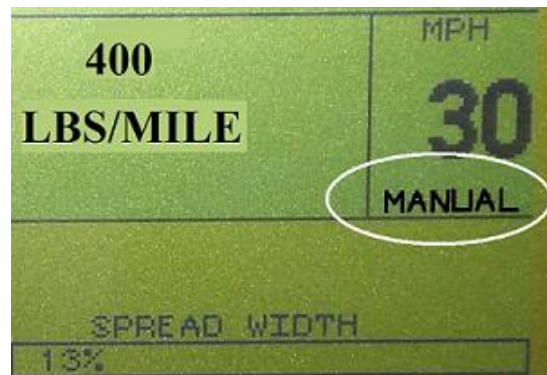
5   **Hold console button down until it beeps** (about a half-second). The 'Material Select' screen displays (may have to toggle console button)

Console Button
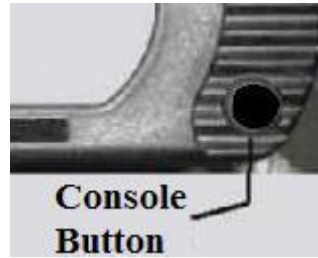
6   The 'Material Select' menu should now display with the text 'Manual On   NO' as shown to the right.

MATERIAL SELECT
...
MANUAL ON   NO
PRESS BLAST
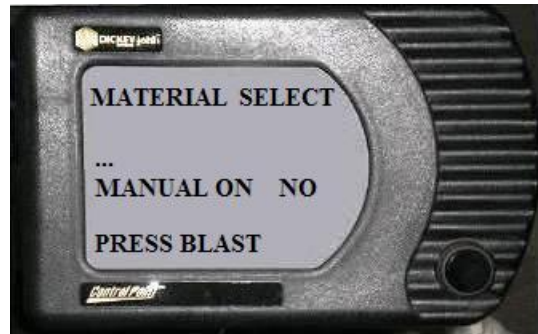
7   Press **Blast button**.
(note that if blast does not work here see "Note" at start of this section)

Blast Button
Granular +/- Rate Switch
MASTER
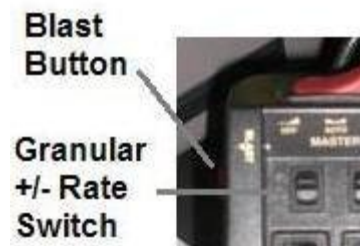
8   Manual mode should now be on.

MATERIAL SELECT
...
MANUAL ON   YES
PRESS BLAST

9	You should now be in **'MANUAL' mode** as shown to right.	
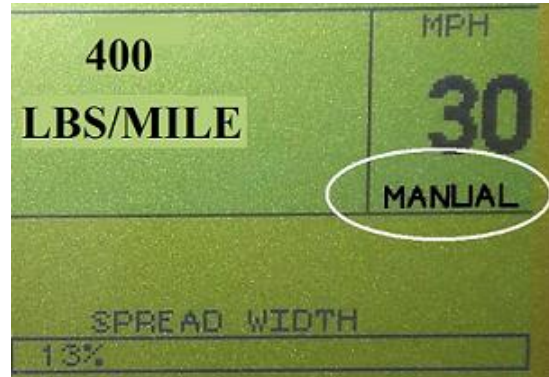
10	Assure that the **'Spreader Control' is off**	

11	Ensure **all persons are clear** of truck and sander	

12	Make sure auger is full. If not, fill by raising the truck box and running the auger for a few seconds to fill it.	

13	Position container to catch material (also see 'Weighing Material' section of guide)	

14	Increase truck engine speed to about **1500 RPM**	

15   Notify spotter that we are ready to dump

16   When spotter signals to **start**, turn **Master Switch to 'Auto'** to start the auger. Spotter starts watch.

17   Note: After **Test-Time** (i.e. 60 seconds) has elapsed, spotter will signal us to stop

18   When spotter signals to **stop**, set the **Master Switch to Off** to stop auger
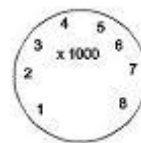
19   Decrease truck engine speed to idle
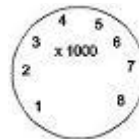
20   **Compare** actual dumped weight versus expected weight and record % difference

How 'close' the actual measured weight is to the expected weight depends on the experience of your office. Many shops use 10% as 'closeness criteria'.

If the verification comparison was close enough, then the controller's application rate is well-calibrated and does not need to be re-calibrated. If it is not close enough, then the controller needs to be calibrated.

Entering Calibration Mode

1	Turn controller master switch to off.	
2	Plug in a keyboard to controller (the keyboard is what enables calibration mode)	Keyboard Connector
3	Press the controller console button to turn controller on.	On/Off Button

Record Current Settings

1   Note: It is a good idea to keep a record of the current calibration and previous calibration to help mechanics troubleshoot if required. See blank forms in back of guide. It is also suggested that records be archived in office archives to demonstrate in future that calibrations were completed, if necessary.

2   Note: Calibration values are helpful to mechanics when troubleshooting is required.

3   **Press F3** key to view current controller constants

4   Select type (i.e. **press 1, 2, 3 or 4 key**)

5   Display screen shows constants

6   Record all constants shown on screen

Application Rate Calibration - Catch Test

1   **When** - This test should be done or checked **at least annually and after truck hydraulic repairs or modifications.**

2   Note: The 'catch test' is the primary calibration test. The test makes sure the controller dispenses material at the rate that is requested during operation (we do **not** worry about actual rates (100, 200, etc) during this test. However, when done, the controller will properly dispense material for **any and all rates** that can be requested by the operator.

3   **Press F6** to begin

4   Calibration Menu opens

5   **Press 1 key** for granular

6   Granular Calibration Menu opens

7	**Press 1, 2, 3 or 4** key to select material	
8	Run Menu opens. Do **not** press 'R' yet.	
9	Position container to catch material (also see 'Weighing Material' section of guide)	
10	Ensure all persons are clear of truck and sander	
11	Assure that auger is still full. If not, fill it by raising the box and running the auger for a few seconds.	
12	Increase truck engine speed to about **1500 RPM**	

13	Press R to run test (this will start auger)	
14	Fill container until sufficiently full (200 pounds minimum)	
15	Press S to stop	
16	Decrease truck engine speed to idle	
17	Weigh material	
18	**Keyboard-enter** total weight	
19	**Press Enter** key	

20	Spreader constant shows on display	CON 9999

21 **Press 'D'** key

22 To improve accuracy, repeat this test one or two more times and keyboard-enter the average of the constants. Another way to improve accuracy is to do a verification (see 'Verification' section)

23 Note: The new constants will be **recorded later** at the end of the calibration

24 Repeat for all granular material types used (salt, sand, etc)

Ending Calibration

1 **Press F3** key to view new controller constants

2 Select type (i.e. **press 1, 2, 3 or 4** key)

3 Display screen shows constants

CONFIGURATION

SPR CON   80.0
CAL GT HGT   7.4
DRV FREQ   100
....

4 Record all constants shown on screen

5 **Press F1** key to return controller to 'Operate' mode

6 Unplug keyboard

System Response Calibration

1	**When** - The system response test should be done **any time the controller is responding poorly** for no apparent reason (see next 'Note'). Some shops also choose to do this test as part of scheduled (i.e. annual) calibration. Some shops do this calibration if the catch test is off. Note however, that manual tweaking of controller constants is often required after doing this calibration.
2	Note: The purpose of this test is to improve the 'system response' of the controller. This calibration is needed if the controller is **sluggish** when responding to changes in truck speed / application rate, or if the displayed application rate fluctuates by a large amount (i.e. greater than 5%) when driving at a steady speed.
3	Note: This test does **not** impact the 'catch test'
4	Make sure spinner will spin (if it is tied up). If not, let spinner down
5	Ensure all persons are clear of truck and sander
6	Assure that auger is full of material. If not, fill it by raising the box and running the auger for a few seconds. Having the auger full for this test helps to calibrate and confirm the integrity of the system under real time (loaded) conditions.
7	Press F11 to begin

8	System Response Menu Opens	
9	Select type (i.e. press 1 key for granular)	
10	Increase truck engine speed to about 1500 RPM	
11	Press R key to run	
12	Screen shows status. Wait until screen shows done.	

13	Screen shows final status	
14	Decrease truck engine speed to idle	
15	Press C key to continue	
16	System Response Menu Re-Opens (or Press F11)	
17	Select 4 key for spinner	
18	Increase truck engine speed to about 1500 RPM	

19	Press R key to run	

19   Press R key to run

20   **After display screen prompts**, turn spinner width adjust knob wide open (as high as possible)

Width Adjust Knob

21   Press D key to finish this calibration **(after display prompts at bottom of screen)**

22   Decrease truck engine speed to idle

23   Turn spinner width adjust knob back down to zero

24   Note: You may need to fine-tune the constants after this calibration. For example, if the spinner spins too fast, decrease the 'PWM SAT' level (some shops use a maximum of 50 for the 'PWM SAT' level). Use the F8 function key to access and edit these constants. Also see vendor manual.

Ground Speed Calibration

1	**When** - Any time the controller speed MPH reading does not match truck speedometer closely
2	Note: First ask the mechanics to check speed sensor and controller (i.e. wiring)
3	Press F7 to begin

| 4 | Ground Speed menu opens |

| 5 | Press 1 for Calibration |

| 6 | Ground Speed Calibration display opens |

7	Drive to start of known one mile course. Approach start marker at 5 mph.	
8	At course start marker press S to start	
9	Drive course at close to normal operating speed	
10	Slow down as approaching stop marker, and press S when passing the stop marker	
11	Read Ground Speed Constant from display	CON 9999
12	Repeat this procedure two times or more and use average to improve accuracy	
13	Record ground speed constant in calibration records	

Spinner Width Calibration

1   **When** - Any time the spinner is not spreading material to the desired width

2   Note - First run the 'System Response' Calibration, which also can impact spreader width

3   Note - The purpose of this calibration is to ensure that material is spread to the desired width

4   Load the vehicle with material

5   Press F6 to begin

6   Calibration Menu Opens

7   Press 3 for Spinner Width

8   Press 1, 2, 3 or 4 key to select material

| 9 | Set the Width Adjust Knob to 0 | |

| 10 | Ensure all persons are clear of truck and sander | ⚠️ |

| 11 | Press R key to run | |

| 12 | Measure the spread width | |
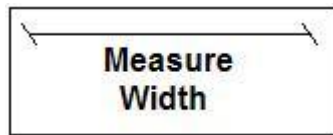
Measure Width

| 13 | Keyboard-enter the measured value |

| 14 | Repeat for spinner widths of 20, 40, 60, 80 and 100 |

| 15 | Press S when done | |

DICKEY-john ICS 2000 Calibration

DICKEY-john ICS 2000 Calibration

Contents

Controller Components

DICKEY-john ICS2000 Controller
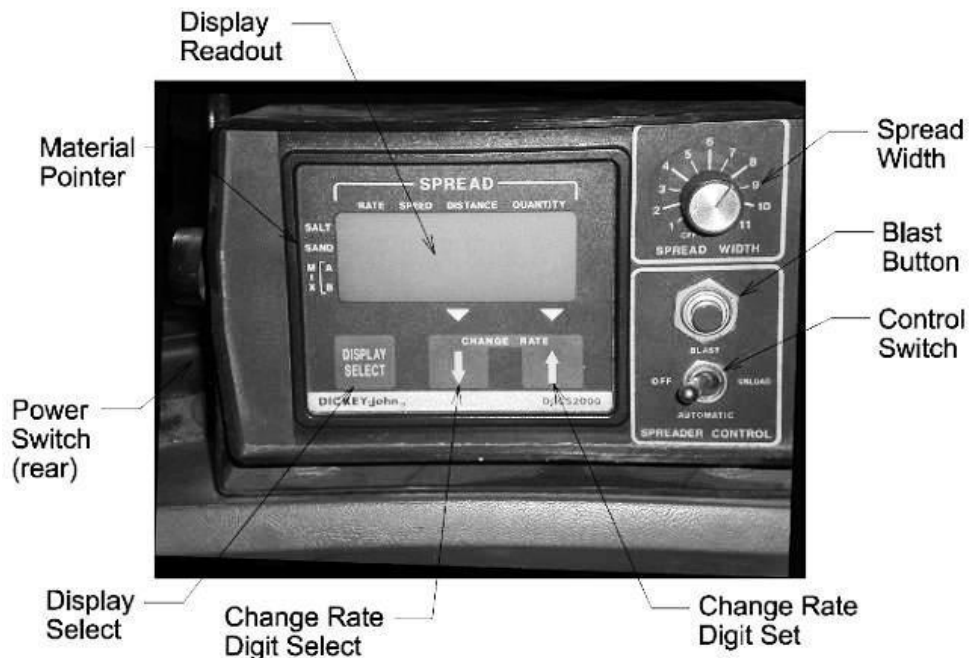
Note – On some screens the 'Display Select' is hidden but in position shown above

See Me First - Controller Mode

If your truck i.e. does not have properly working rear sensors and is running in manual open-loop mode, then do a 'Verification' (See "Application Rate Verification" section). If re-calibration is required for open-loop mode, programming will be required by a team member who knows the programming side of the controller (often a mechanic on your team)

Tip - How to Enter Number into Controller

Note: Use "Digit Select" and "Digit Set" buttons to enter or change a number

1   Press the left change rate button to select the digit to change

2   Press the right change rate button to change the digit

3   Press Display Select when done to accept the number.

Tip - Selecting Yes/No in Controller

1	The display readout message should read YES or NO	
2	Press change rate arrows to toggle Yes/No	
3	Press Display Select when done to accept the value	

Tip - Exiting Calibration Mode

1	This can be done anytime when in calibrate mode	
2	Press and hold the **'Display Select'** button for approximately three **(3) seconds**	

Getting Started
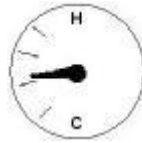
1	Start truck and turn PTO on. Note that PTO controls will vary by truck (see examples in figure).	
2	Fully warm up the truck hydraulics (also see next step). Drive the truck for at least 10 minutes.	
3	Verify that the ground speed sensor is calibrated. While warming up the truck compare the speed on the controller console to the truck speedometer reading (while driving at least 25 mph). These will usually match. In the case they do not match, see 'Ground Speed Calibration' section.	
4	Park the truck and let idle	
5	Apply the parking brake	
6	Load the truck with material	
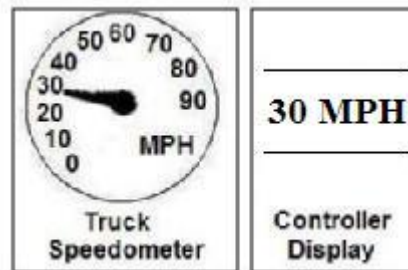
| 7 | Tie the spinner up (you may find with experience that some weighing methods do not require spinner up) | |

8   Insure a complete salt shield is in place (if truck has one)

| 9 | Prime the auger by raising the truck box | |

| 10 | Fill the auger by switching the spreader control to the "Unload" position for a few seconds | |

| 11 | Turn spinner width adjust knob down to zero for safety | |

12   If the spinner is still 'creeping' (turning slowly) disconnect hydraulic hose temporarily (during calibration)

13	Verify that tailgate air release valve (end gate trip valve) is open	
14	Turn spreader control switch to off.	
15	Turn on controller power switch	
16	Start new calibration record sheet (record will help mechanics if troubleshooting is required)	

Application Rate Verification

If you do not want to do a verification, skip to the next section - "**Entering Calibration Mode.**

1   **When** - Any time you want to check if the controller is well-calibrated or needs calibration.

2   Note: This verification process assumes that MANUAL mode is already enabled. If not, see steps above in section on 'Selecting Material Types' and set MANUAL to yes.

3   Perform the steps outlined above in the *Getting Started* section before proceeding

4   If in calibrate mode, exit calibration mode by holding display select button for at least three seconds

5   Assure that the 'Spreader Control' is **Off**

6   The Display Pointer should be at the "Rate" position as shown (if not see how to move pointer in steps below)

7	Use the change rate arrows to set the **desired Spread Rate** (pounds/mile) (i.e. 400 lbs/mile)	
8	Press the **Display Select** button **four times** to go to the manual change speed screen	
9	The Display Pointer should now point to both rate and speed and **MANUAL** should be shown on the right edge.	
10	Use the change rate arrows to set the **desired speed (MPH)** (i.e. 30 lbs/mile)	
11	Find **Test-Time** to run test using 'Calibration Verification' at back of this guide (i.e. 60 seconds)	
12	Ensure all persons are clear of truck and sander	
13	Make sure auger is full. If not, fill by raising the truck box and running the auger for a few seconds to fill it.	

14 Position container to catch material (also see 'Weighing Material' section of guide)

15 Increase truck engine speed to about **1500 RPM**

16 Verify that the sander lever is on (if truck has one). This is the 1st lever next to the driver's seat

17 Notify spotter that we are ready to dump

18 When spotter signals to **start**, set the 'Spreader Control' to **Automatic** and start the stopwatch

19 Note: After **Test-Time** (i.e. 60 seconds) has elapsed, spotter will signal us to stop

20 When spotter signals to **stop**, set the 'Spreader Control' to **Off**

21	Decrease truck engine speed to idle	

21   Decrease truck engine speed to idle
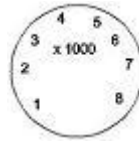
22   **Compare** actual dumped weight versus expected weight and record % difference

23   How 'close' the actual measured weight is to the expected weight depends on the experience of your office. Many shops use +/- 10% as 'closeness criteria'.

24   If the verification comparison was close enough, then the controller's application rate is well-calibrated and does not need to be re-calibrated. If it is not close enough, then this calibration is needed.

Entering Calibration Mode

1	Press and hold the 'Display Select' button for approximately three **(3) seconds**	DISPLAY SELECT
2	The message **'CALIBRATE'** and program will appear on display readout. Verify the arrow is pointing to 'calibrate'.	RATE SPEED DISTANCE QUANTITY **CALIBRATE**
3	**Press left** change rate button to continue	CHA↓
4	**Enter password** number	CHANGE RATE ↓ ↑ Select Digit Change Digit
5	**Press** the **'Display Select'** button to continue (the 'id. no.' can be skipped)	DISPLAY SELECT
6	If number is incorrect, controller will return to Operate Mode	

Selecting Material Types

<div style="border: 1px solid black;">

Description

If you are **not changing any material types** to be available during operation, **you may skip to the next section**

The purpose is to select one or more material types/mixes that will be used in the sander

The Material Pointer is pointing to Salt

The display readout message is YES or NO

Select Yes or No

The Material Pointer is now on the next material (Sand)

Repeat (choose Yes/No) for Sand, Mix A, and Mix B

After finishing Mix B, the word 'MANUAL' will display on the right side of the display

Leave this setting as-is. This determines if manual mode is available in operate mode and does not impact calibration

</div>

Press the 'Display Select' button to continue

DISPLAY SELECT

Application Rate Calibration - Catch Test

1   **When** - This test should be done or checked **at least annually and after truck hydraulic repairs or modifications.**

2   Note: The 'catch test' is the primary calibration test. The test makes sure the controller dispenses material at the rate that is requested during operation (we do **not** worry about actual rates (100, 200, etc) during this test. However, when done, the controller will properly dispense material for **any and all rates** that can be requested by the operator.

3   The message **'SPr.AdJ'** should appear on display readout. If not **press 'Display Select'** button until it does appear
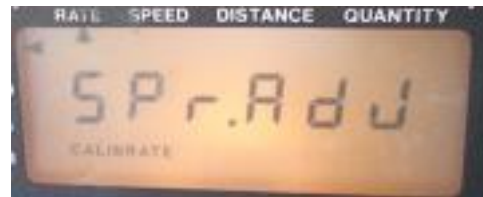
4   The Material Pointer should be pointing to your first selected material

5   Set 'SPREAD WIDTH' to Off

6   Increase **RPM's to 1500**

7   Ensure all persons are clear of truck and sander

| 8 | Assure that auger is still full. If not, prime it by raising the box and running the auger for a few seconds | |

9 **Press up arrow** until auger starts to spin (you may have to press arrow 2 to 20 times).

10 Spotter outside truck will tell us when auger is spinning fast enough to fill container in reasonable time. Proceed to next step.

11 **Press Display Select** to go to next step

12 Position container to catch material (also see 'Weighing Material' section of guide)

13 Ensure all persons are clear of truck and sander

14 Verify that the sander lever is on (if the truck has one)

15 **Press the left arrow below** the flashing **'Start'** message

16 Let the auger run until the container has a sufficient amount of material (200 pounds minimum recommended)

17 **Press the right arrow below** the **'Stop'** message

18 Decrease truck engine speed to idle
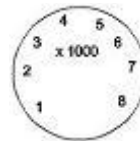
19 Verify that the sander lever is off (if the truck has one)

20 Weigh material

21 **Enter the weight** (pounds) into the controller

22 **Press Display Select**

23	The message 'SPr.Con' should appear on display readout	

24 **Press left change rate** button to continue

25	The controller now displays the new spreader constant 'SPr.Con' value	
26	Record this constant in the Calibration Data Records	

27 To improve accuracy, repeat this test one or two more times and enter the average of the constants. Another way to improve accuracy is to do a verification (see 'Verification' section)

28 If you use other material types, repeat these steps

29	Otherwise the display readout will show 'SPEEd' (see "Ground Speed Calibration" section)	

Hydraulic Adjust Calibration

1   **When** - The system response test should be done **any time the controller is responding poorly** for no apparent reason (see next 'Note'). Some shops also choose to this test as part of scheduled (i.e. annual) calibration. Some shops do this calibration if the catch test is off. Note however, that manual tweaking of controller constants is often required after doing this calibration.

2   Note: The purpose of this test is to improve the 'system response' of the controller. This calibration is needed if the controller is **sluggish** when responding to changes in truck speed / application rate, or if the displayed application rate fluctuates by a large amount (i.e. greater than 5%) when driving at a steady speed.

3   Note: This test does **not** impact the 'catch test'

4   Assure that auger is full of material. If not, prime it by raising the box and running the auger for a few seconds. Having the auger full for this test helps to calibrate and confirm the integrity of the system under real time conditions.

5   Press the display select button (possibly multiple times) until the message 'Hyd.AdJ' appears on the display

6   Switch the control Switch to Automatic position

7   Increase vehicle engine RPM to 1500 RPM
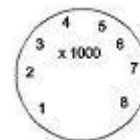
8	Again ensure truck is fully warmed up	
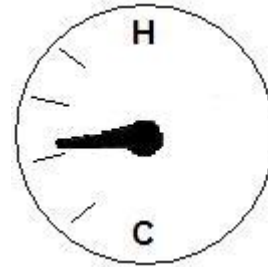
9	Press digit select button directly below flashing 'Start' message	

10	Keep engine RPM close to 1500 RPM throughout this procedure	
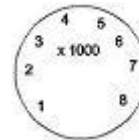
11   This procedure will take about 30 seconds

12   A square and changing number will appear in display

13	At end of procedure display will show 'donE'	

14	Decrease truck engine speed to idle	

15	Switch the 'Spreader Control' Switch to Off	

16	The number on the display is the Hydraulic Adjust constant	

17	Record this constant in the Calibration Data Records	
18	If system response is still **sluggish**, try **increasing the Hyd.Adj value**	
19	If application rate **fluctuates** as described above, try **decreasing the Hyd.Adj value**	
20	Press Display Select to continue	

Ground Speed Calibration

1   **When** - Any time the controller speed MPH reading does not match truck speedometer closely

2   Note: First ask the mechanics to check speed sensor and controller (i.e. wiring)

3   Note: Ensure that the controller is in calibrate mode as described in previous sections

4   Drive to a measured and marked one mile course (preferably on relatively level ground)

5   Set the controller so the display readout reads 'SPEEd' using Display Select button

6   Drive up to the start of the course at 5 MPH or faster
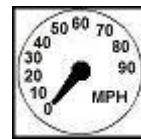
7   When at the course 'Start Marker', press the button below the flashing 'Start' message

8   The display should now be counting up from 0 and 'Stop' should be flashing

9   Drive the course at a common operating speed (i.e. 30 MPH)

10 When at the course 'Finish Marker', press the button below the flashing 'Stop' message

11	The display readout now shows the 'Speed Calibration Constant'	
12	Record this constant in the Calibration Data Records	

Weighing Material for Sander Calibration

Weighing Material for Sander Calibration

Options

Many different options are used to weight material ranging from pails to truck scales

All of these weighing methods have been found to produce ***good calibration results***

Tip - Dump a **minimum of 200 pounds** for **calibration**. For verification tests, dump a minimum of 100 pounds.

Tip - Do not stop and re-start the auger when catching material - run auger continuously during catch (even when using pails)

Truck Scale - Weigh truck, dump material during calibration. Weigh truck again. Difference of two weights is weight of material dumped.

⚠️ Never lift more weight than the maximum weight allowed by your governing safety regulations.

Tub – See Safety note above. Tub can be large enough to collect over 200 pounds. Tip the bucket over with a team of persons. Team up with enough persons so that the bucket can be easily tipped over.

Weight Box - Large box that automatically weighs material. Can collect approximately 500 pounds. **Requires a skid steer or fork lift** for positioning and emptying. Simple to use.

Weight Box Meter - Zero meter before dumping. Read weight after dumping.

Bottomless Box - Take one 2" x 12" piece of lumber and cut into four pieces to make a square. If inside length of sides is 20-1/4", then weight of full box will be equal to four 5 gallon pails. (i.e. if full pail is 60 pounds, then we know full box is 240 pounds)

Bottomless Box - No Lifting - Box is bottomless, so no lifting is required. Easy to pull box off. Optionally add marks at i.e. 80% full, 90% full, etc.

Wheelbarrow Box on Scale - Can hold over 200 pounds

⚠️ Never lift more weight than the maximum weight allowed by your governing safety regulations.

Pails – See warning above. Also wear heavy work gloves. First determine material weight of full pail. In your salt/material stock pile, fill a 5 gallon pail with material and weigh with dairy or other scale. Subtract off empty weight of pail. Do three times to get an average (i.e. 60 pounds). You will only need to do this once for each material pile. Then to weigh dumped material from i.e. auger –fill three pails full and fourth partially full. Shovel spillage into partially full pail. Total weight is three pails + weight of partially full pail.
(i.e. 180 + 25 = 205 lbs).

⚠️ Never lift more weight than the maximum weight allowed by your governing safety regulations.

Dump onto ground - See warning above. Also wear heavy work gloves. Dump material onto ground and then shovel into pails and weigh each (remember to subtract off empty pail weight).

Other Method - Loader with scale

Forms

Calibration Verification (Check) Test
(Method 1: by Weighing Material)

This form is used to verify (check) if a snowplow sander controller is well-calibrated. It can be done to as a "proof" after a calibration, or to determine if a calibration is needed. *This calculation only needs to be done once (if using same rate, speed and time for other trucks)*

Use this form to determine <u>expected weight</u> if you plan to weigh material. Also see "*Verification by Filling a Container*" form.

Example: 400 lbs/mi 30 MPH	_400_ lb/mile _30_ MPH _1_ minutes	MPH/60 = _30_ / 60 = _0.5_ Expected Weight = Rate * (MPH/60) * Time Expected Weight = _400_ * _0.5_ * _1_ = _200_ lbs
	____ lb/mile ____ MPH ____ minutes	MPH/60 = ____ / 60 = ____ Expected Weight = Rate * (MPH/60) * Time Expected Weight = ____ * ____ * ____ = ____ lbs
	____ lb/mile ____ MPH ____ minutes	MPH/60 = ____ / 60 = ____ Expected Weight = Rate * (MPH/60) * Time Expected Weight = ____ * ____ * ____ = ____ lbs

Steps (as spotter during calibration)

1. Obtain weight from above, and enter on <u>calibration records</u> as "<u>Expected Value</u>"
2. Make note of *Test-Time* used from worksheet above
3. Make sure empty container is in position to catch material behind truck
4. When ready, **signal to calibrator**, to <u>start</u> dumping material
5. <u>Start stopwatch</u>
6. When *Test-Time* has elapsed, s**ignal to calibrator** to <u>stop</u> dumping material
7. Weigh material dumped and enter weight on <u>calibration records</u> as "<u>Measured Value</u>"

Note: For the verification/check test, try to dump 100 pounds or more of material.

Calibration Verification (Check) Test
(Method 2: by Filling a Container)

This form is used to verify (check) if a snowplow sander controller is well-calibrated. *This calculation only needs to be done once (if using same rate and, speed for other trucks).* Use this form to determine underlined expected time to fill a container. Also see *"Determining Weight of Container"* form. Also see *"Verification by Weighing Material"* form.

Example: 400 lb/mi, 30 MPH,	*400* pounds/mile *30* MPH *120* lb container	60/MPH = 60 / _*30*_ = _*2*_ Weight/Rate = _*120*_ / _*400*_ = _*0.3*_ Expected Time = 60 * _*2*_ * _*0.3*_ = *36* seconds
	_____ pounds/mile _____ MPH _____ lb container	60/MPH = 60 / _____ = _____ Weight/Rate = _____ / _____ = _____ Expected Time = 60 * _____ * _____ = _____ seconds
	_____ pounds/mile _____ MPH _____ lb container	60/MPH = 60 / _____ = _____ Weight/Rate = _____ / _____ = _____ Expected Time = 60 * _____ * _____ = _____ seconds

Steps (as spotter during calibration)

8. Record container weight from above as "Expected Value" (i.e. 120 lb)
9. Make note of *Test-Time* used from worksheet above **(i.e. 36 seconds)**
10. Make sure empty container is in position to catch material behind truck
11. When ready, **signal to calibrator**, to start dumping material
12. Start stopwatch
13. When *Test-Time* has elapsed, **signal to calibrator** to stop dumping material
14. Container should be about full. The % difference is the excess or shortage divided by the "expected" weight. For example if you are 7 pounds over, the % difference would be 7/120 = 6% difference (in our example).

Note: For the verification/check test, try to dump 100 pounds or more of material.

Salter and Sander Controller Verification Log Shop Location:

Date	Truck Id	(A) Expected Weight[1] (lbs)	(B) Actual Weight (lbs)	(A) Difference (lbs)	(D) % Difference	Notes
12/01/09	*Example*	*250*	*260*	*10*	*4%*	

Difference (C) = Actual Weight (B) – Expected Weight (A)

% Difference (D) = 100 * Difference (C) / Expected Weight (A)

Note 1 - Examples of Expected Weight
For 500 lbs/mile, 30 MPH, 60 seconds =250 pounds
For 400 lbs/mile, 30 MPH, 30 seconds = 100 pounds
For 200 lbs/mile, 30 MPH, 60 seconds = 100 pounds

Snowplow Sander Calibration Records
DICKEY-john Control Point

	Truck Id				
	Material				
	Date				
	By				
	SPRCON				
	DRV FREQ				
	PWM OFFSET				
	PWM SAT				
New Values	SYS RSPNS				
	VALV BOOST				
	AFILT				
	Verification (% Difference)				

% Difference = 100 * (Measured - Expected) / Expected

$1 \text{ ft}^3 = 7.4805 \text{ gal}$, $1 \text{ gal} = 0.13368 \text{ ft}^3$

Notes

Snowplow Sander Calibration Records
DICKEY-john ICS 2000

	Truck Id				
	Material				
New Values	Date				
	By				
	Spr.Con				
	Hyd.Adj				
	Verification (% Difference)				

% Difference = 100 * (Measured - Expected) / Expected

1 ft^3 = 7.4805 gal, 1 gal = 0.13368 ft^3

Notes

Troubleshooting During Calibration

	• **Make sure the PTO is on.**

Material Flow	• **If auger is not turning or turning too slowly**
	    ○ **Is auger jammed? If jammed, try reversing the auger (if you have this capability).**
	    ○ **Is sander lever engaged (older trucks)?**
	• **Is material tunneling/frozen/bridging? Try lifting and vibrating box.**
	• **Is the tailgate open? Is tailgate release air valve (usually left of seat) on?**
	• **Is the correct material selected on controller?**

Wiring	• **Hydraulic hose coupler connections – pull on them to make sure they are locked.** • **Check the electrical connection and wiring at the auger sensor and sander to make sure it is plugged in.** • **Check for hydraulic leaks. Is the auger motor in good condition? Are the bearings greased and in working condition?**
Controlle	• **Does screen flash "Manual"? If not, then a possible bad speed or auger sensor, notify mechanic.** • **Does screen show auger turn count (Control Point) during Catch Test? If not, then a possible bad speed or auger sensor, notify mechanic.**

Calibration

And

Verification

Quick Sheets

Control Point Application Rate Calibration Quick Sheet

Turn **spinner dial off** for safety

Fully **warm up** the **truck hydraulics**. Drive 10 minutes. Check MPH.

Turn parking brake on, let truck idle, ensure **all persons are clear**

Fill/Prime the auger by tilting box. If needed, also run auger.

Turn controller master switch to off.

Plug in a keyboard to controller

Press **F3 key**, select material and **record constants**

Press **F6** to begin, choose granular, then material

Position container

Ensure **all persons are clear** of truck and sander

Increase truck engine speed to about **1500 RPM**

Press R to run test (this will start auger)

Fill container until **sufficiently full** (min. 200 pounds)

Press S to stop

Keyboard-enter total weight and press Enter key

Record the new SPRCON constant, then press 'D' key.

Repeat this test **at least one more time** and keyboard-enter the average of the constants **or do a verification**

Repeat for all granular materials used (salt, sand, etc). Re-fill auger as needed.

Note: See step-by-step guidance in this guide for more detailed information

Control Point Application Rate Verification Quick Sheet

Turn **spinner dial off** for safety

Fully **warm up** the **truck hydraulics**. Drive 10 minutes. Check MPH.

Turn parking brake on, let truck idle, ensure **all persons are clear**

Fill/Prime the auger by tilting box. If needed, also run auger.

'Manual' mode must already be enabled (if not see detailed steps in guide).

Find <u>Test-Time</u>, i.e. 400 lbs/mile, **60 seconds**, **expected weight of 200 lbs**.

Turn Master Switch off

If the screen does <u>not</u> show MANUAL, see steps at bottom of this page

Ensure **all persons are clear** of truck and sander

Position container

Increase truck engine speed to about **1500 RPM**

Notify spotter that we are ready to dump

Turn **Master Switch to 'Auto' to start** . Spotter says 'go' and starts watch.

Note: After **Test-Time** (i.e. 60 seconds) has elapsed, spotter will signal us to stop

When spotter signals to **stop**, set the **Master Switch to off** to stop auger

Compare actual dumped weight versus expected weight and record % difference
Many shops use 10% as 'closeness criteria'.

Turning On Manual Mode (if necessary)

Hold console button down until it beeps

The 'Material Select' screen should show   MATERIAL SELECT

Press Blast button.

**ICS 2000
Application Rate
Calibration
Quick Sheet**

Advancing menus	DISPLAY SELECT

Entering a number	↓ Select Digit	↑ Change Digit

Turn **spinner dial off**

Fully **warm up** the **truck hydraulics**. Drive 10 minutes. Check MPH.

Turn parking brake on, let truck idle, ensure **all persons are clear**

Fill/Prime the auger by tilting box. If needed, also run auger.

Press 'Display Select' for 3 seconds (to enter calibration mode)

Press left down arrow to continue

Enter password, then **press 'Display Select'**

Advance to 'SPr.AdJ' screen using **'Display Select'** button

Increase **RPM's to 1500** and ensure all persons are clear

Press right up arrow 2 to 20 times until auger starts to spin

Press Display Select to go to next step

Position container to catch material and verify that sander is on (i.e sander lever, etc)

Ensure **all persons are clear** of truck and sander

Press the left arrow below the flashing 'Start' message

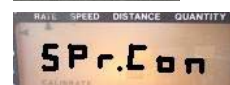Fill container until sufficiently full (200 pounds minimum)

Press the right arrow below the 'Stop' message

Enter the weight (pounds) and **press Display Select**

The message 'SPr.Con' should appear on display readout

Press left arrow to continue, and record new 'SPr.Con' constant

Repeat this test at least once and enter the average or do a verification

Repeat for all granular material types used (salt, sand, etc)
Note: See step-by-step guidance in this guide for more detailed information

ICS 2000 Application Rate Verification Quick Sheet

Turn **spinner dial off** for safety

Fully **warm up** the **truck hydraulics**. Drive 10 minutes. Check MPH.

Turn parking brake on, let truck idle, ensure **all persons are clear**

Fill/Prime the auger by tilting box. If needed, also run auger.

This assumes MANUAL mode is already enabled. If not, see detailed guide steps.
Find <u>Test-Time</u>, i.e. 400 lbs/mile, **60 seconds**, **expected weight of 200 lbs**.
In in calibration mode, hold 'Display Select' for three seconds to exit

Assure that the 'Spreader Control' is **Off**

Display Pointer should point to 'Rate' and your material

Set **desired Spread Rate** (i.e. 400 lbs/mile)

Press **Display Select four times**

MANUAL should be shown on the right edge

Set the desired speed (MPH) (i.e. 30 lbs/mile)

Ensure **all persons are clear** of truck and sander

Position container to catch material and verify that sander is on (i.e sander lever, etc)

Increase truck engine speed to about **1500 RPM**

Notify spotter that we are ready to dump

Start watch and set the 'Spreader Control' to **Automatic** and start the stopwatch

Spotter signals to **stop**, set the 'Spreader Control' to **Off**

Compare actual dumped weight versus expected weight and record % difference
Many shops use 10% as 'closeness criteria'