RESEARCH

2009RIC08

Local Government Snowplow Salt and Sander Controller Calibration Guide

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16. Abstract (Limit: 200 words)

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.

It helps agencies calibrate their sander controllers so the correct amount of salt, sand or other solid material is applied to the road when treating roads during winter maintenance. It focuses on controllers commonly used by agencies.

It provides easy-to-use detailed calibration steps with step-by-step instructions. Each instruction step includes a picture to help with clarity. Also, "Quick Calibration Sheets" (one-pagers) are included with less detailed (quicker) instructions to assist calibrators who are already experienced. The guide also includes calibration forms, and a general discussion about calibration.

It covers both automatic and manual controllers. It suggests approaches for both open-loop and closed-loop automatic controllers. The primary automatic controller covered is the ForceAmerica unit. A general approach is given for calibrating any manual controller type.

The guide covers both calibration and verification. It also suggests "when to calibrate".

The guide includes quick calibration sheets, calculation worksheets, and blank calibration forms.

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December 18, 2009

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Local Government Snowplow Salt and Sander Controller

Calibration Guide

Credits

The development of this guide involved many 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, all of the local agency persons who attended the Fall 2009 Training Sessions held throughout Minnesota contributed to this guide through their suggestions and input.

- Champion Industrial Equipment, Mr. Ray Durand
- City of Cottage Grove, Ms. Jennifer Levitt
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- SRF Consulting Group, Mr. Mike Marti
- Stearns County, Mr. Dave Otte
- Stearns County, Mr. Dave Gill

Credits, Continued Next Page

Credits, Continued

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- Mn/DOT Fergus Falls (Thomas Deutschman, Kurt Holland, Gregory Schultz)
- Hennepin County (Tom Hagen, Dave Poppler, Michael Scherber)
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- Stearns County (Dave Otte, Dave Gill)

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 Local Road Research Board (LRRB) by EVS, Inc. EVS ENGINEERING | SURVEYING | ENVIRONMENTAL | PLANNING

Table of Contents

How to Use This Guide

Please first read the short introduction and discussion on the following pages. These will help you learn from agency experience about general calibration approaches, when to calibrate, and a "verification-first" approach option.

Calibration Guide Roadmap

If you have this Controller	Then see this section
Force America 5100	See 'ForceAmerica 5100' section (page 7)
Force America 5000 (GRS32 Head)	See 'Note 1' below
Any manual controllers	See "Manual Controllers" section (page 35)
DICKEY-john Controllers	See 'Note 1' below
Gresen GRS-32 Controller	See 'Note 1' below
Controllers not listed – If manual	See "Manual Controllers" section (page 35)
Controllers not listed – If automatic	See "Verification For Other Automatic Controllers" section (page 41)
Weighing Materials	Weighing Materials (page 44)
Forms	Forms (page 49)
Quick Calibration Sheets	Quick Sheets (page 57)

Notes:

1. Also see the "Office of Maintenance - Maintenance Research" area of the Mn/DOT website for calibration guidance on additional sander controllers not included in this guide

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 the Local Road Research Board (LRRB).

For the latest downloadable and printable version of this guide, see the LRRB web site.

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 <u>not</u> 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.

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.

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 at least annually in addition to as-needed (after repairs as discussed above, etc).

Experience has shown that new trucks should be calibrated 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
Min/Max, 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.

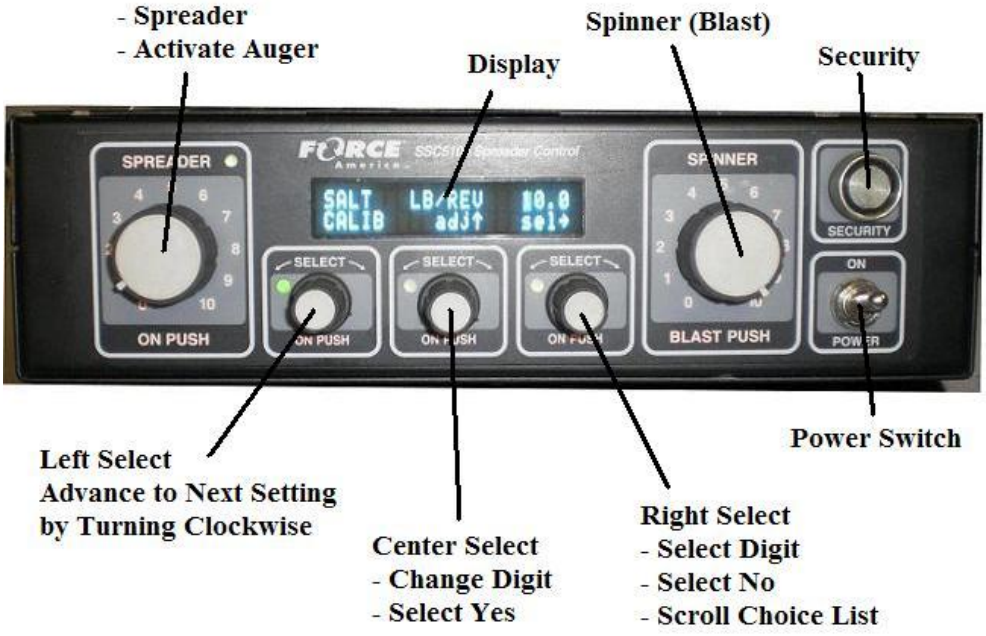
Another benefit of verification is for cases where an operator feels that her/his sander controller is not applying the correct amount of material (i.e. thinks it is applying "too little"). The operator is invited to observe a verification to prove the controller is working properly.

Force America 5100
Calibration

Force America 5100 Calibration

Contents

Controller Components

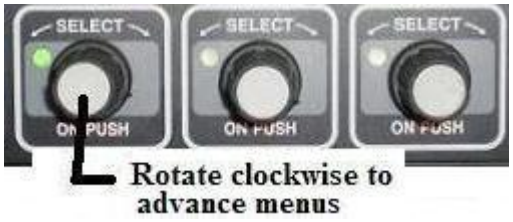


Tricks/Traps - General

Problem	Possible Solution
Menus not scrolling?	Is auger/spreader on?
Calibration data not saved?	Be sure to exit calibration with left select button **before** turning power switch off

Tips - Buttons

Advancing menus



Entering numbers

Selecting Yes or No

Scrolling a list

Entering calibration mode. Advance to 'calib' menu. Push left select button

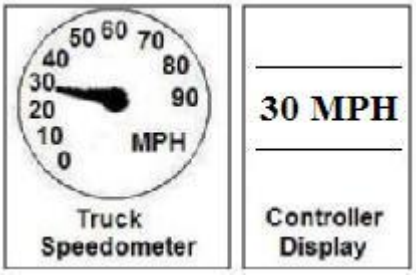
Exiting calibration mode **(and saving data)**

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' in vendor manual.



4 Park the truck and let idle

5 Turn on 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 Put the salt shield in place (if truck has one)

9 Prime the auger by tilting the truck box up and/or running the auger long enough so that it is filled

10 Turn spinner knob down to zero for safety

11 Turn spreader knob down to zero for safety

12 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.**

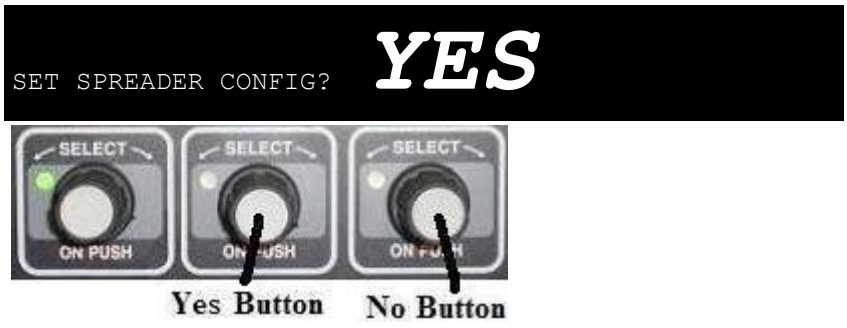
Also see 'Quick Sheets' in back of guide

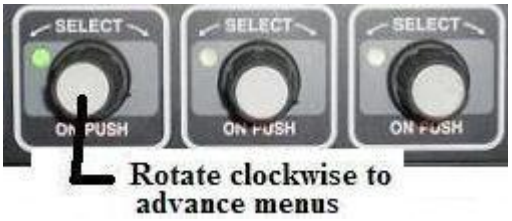
When - Any time you want to check if the controller is well-calibrated or needs calibration

Find **Test-Time** to run test using 'Calibration Verification' page at back of this guide (i.e. 60 seconds). For example, for 500 lbs/mile at 60 seconds, our expected weight would be **250 pounds** (1/2 mile in 60 seconds at 30 MPH).

Perform the steps outlined above in the ***Getting Started*** section before proceeding including **safety (spinner dial to zero)**, **warming up truck hydraulics** and **priming/filling auger**.

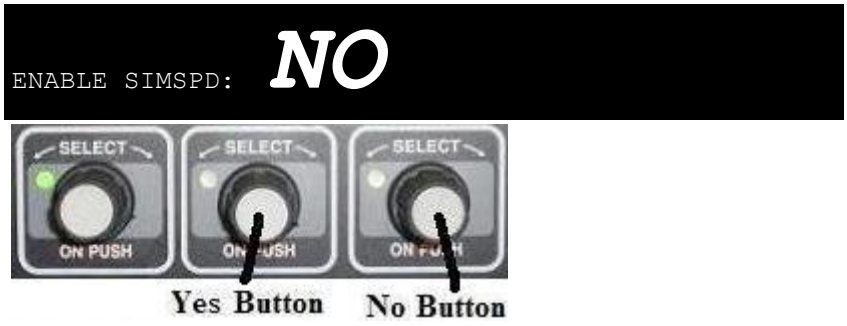
Enter Calibrate Mode (See "Entering Calibrate Mode' section)

Advance to the SET SPREADER CONFIG screen	
Choose yes	

Advance to the ENABLE SIMSPD screen	**ENABLE SIMSPD:** 
Choose yes	ENABLE SIMSPD: **YES** 
Exit calibration mode	
In operation mode, **select desired application rate** – i.e. 500 pounds/mile using Spreader Dial	
Advance to simspd menu	**simspd** 

Activate simspd by **pressing the left** select button	**SIMSPD** 
Advance to simset menu	**simset** 
Activate simset by **pressing the left** select button	**SIMSET** 
Enter speed to simulate (i.e. 30 MPH) by **rotating left button**	**30** 

Finish simset by **pushing left select button**	
Ensure all persons are clear of truck and sander	
Position container to catch material. Also see 'Weighing Material' Section.	
Increase truck engine speed to about 1500 RPM	
Notify spotter that we are ready to dump	
Start watch and **press** SPREADER knob	
Wait for spotter to signal us to stop while material is dumped into container	

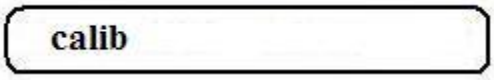
After time has elapsed on watch (i.e. 60 seconds), **press** SPREADER knob to stop **auger**	
Decrease truck engine speed to idle	
Compare actual dumped weight versus expected weight and record % difference	
How 'close' the actual measured weight is to the expected weight depends on the experience of 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.	
Note: Go back into calibrate mode and disable simpspd (see steps above)	

Entering Calibrate Mode

1 Turn on the controller power switch. Wait while the unit does a short self test

2 Rotate the left select knob clockwise until 'calib' is shown on the display

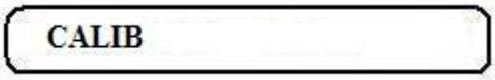
3 **calib** should show on the display



4 Push the left select knob to go into calibrate mode

5 The display will now show the 'Access Code' prompt. Enter the access code (**password**) and <u>rotate left select knob when done</u>.

6 Capitalized **CALIB** should show on the display

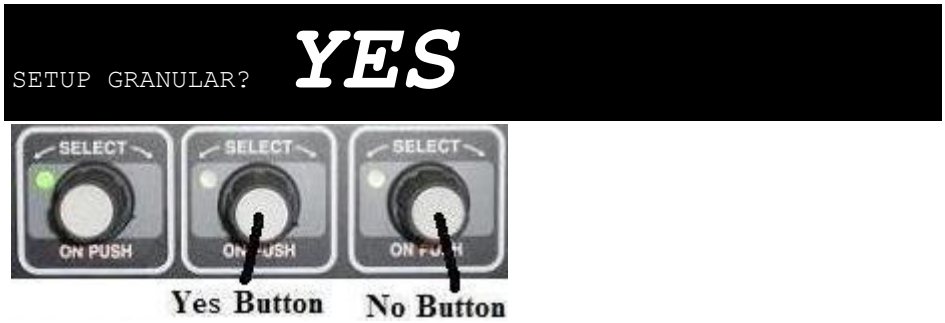


Selecting Material and Controller Types

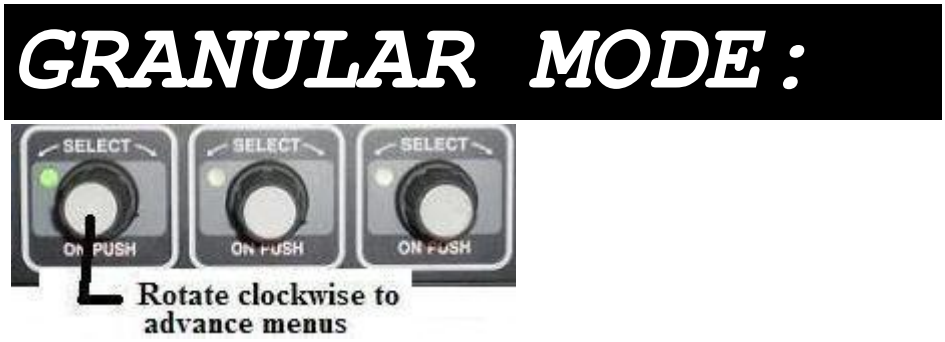
This calibration procedure assumes that this is a re-calibration (initial controller setup is complete)

1 Advance to the granular screen

2 Choose yes



3 Advance to the granular mode screen



4 Choose closed loop (assumption: controller is in closed loop mode)

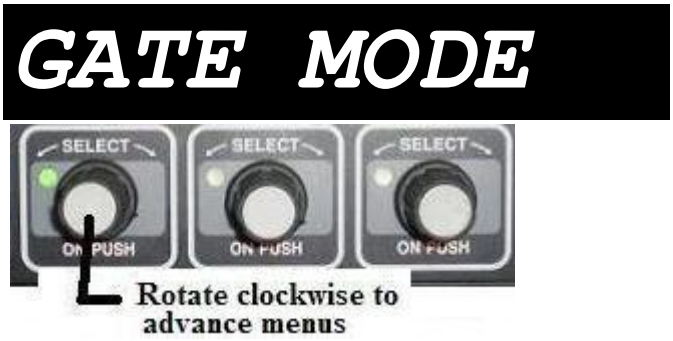
Application Rate Calibration (Catch Test)

Also see ‘Quick Sheets’in back of guide

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

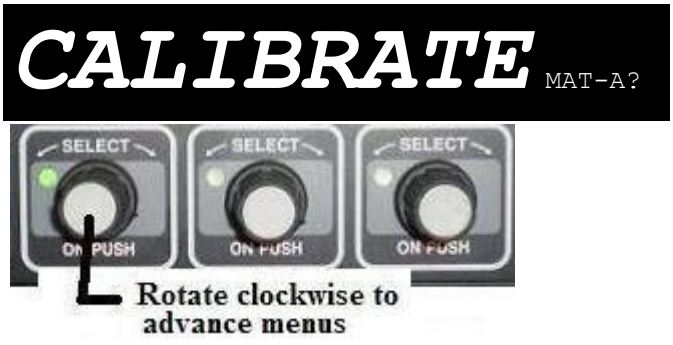
Note: The 'catch test' is the primary calibration test. The test makes sure the controller dispenses material at the rate that is requested during operation (we do not worry about actual rates (100 200 etc) during this test. However when done the controller will properly dispense material for any and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

1 Advance to the **GATE MODE** (for tail gate type)

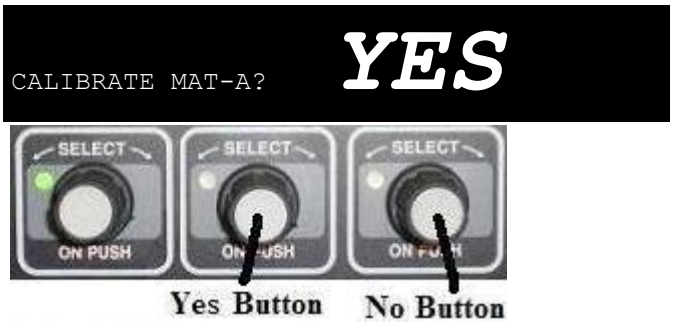


2 Choose 'NONE' (these steps assume a tail gate)

3 Advance to the **CALIBRATE** screen (this may be MAT-A, Salt, etc)

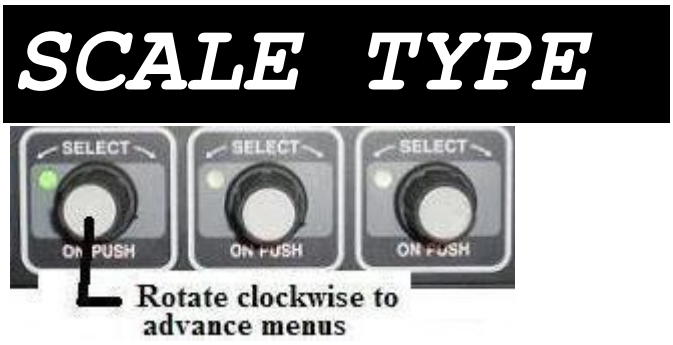


4 Choose yes for material 'A' (i.e. salt)



The next step assumes a portable scale. Steps for a truck scale are similar

5 Advance to the **SCALE TYPE** screen



6 Choose portable

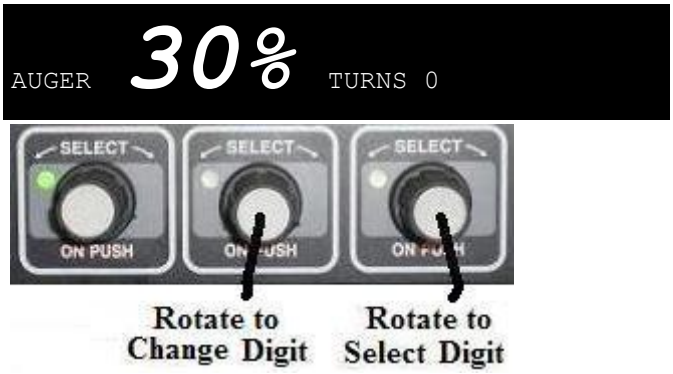
7 Position container to catch material.

8 Ensure all persons are clear of truck and sander

Note: It is suggested that about 200 pounds or more of total material be dumped

9 Advance to the **AUGER** screen

10 Increase discharge rate so auger will fill container in reasonable amount of time. Try 30% to start. Any number here that turns the auger is okay here.



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

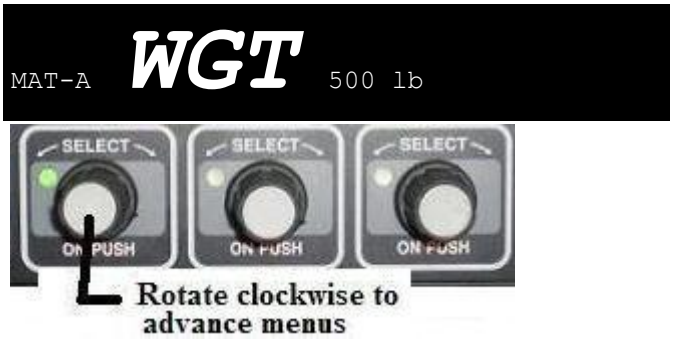
12 <u>Activate</u> auger by pressing SPREADER knob

13 Dump material

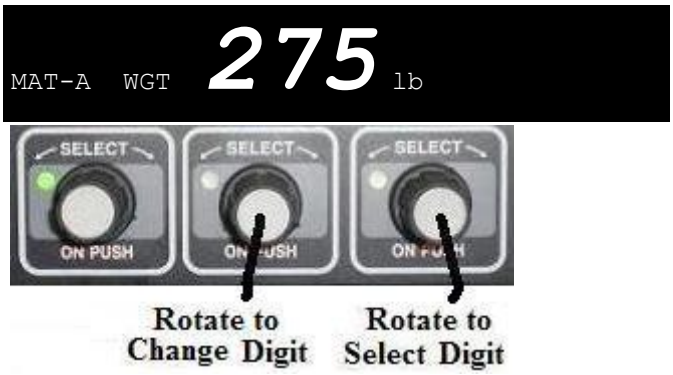
13 When container is sufficiently full, <u>deactivate</u> auger by pressing SPREADER knob

14 Decrease truck engine speed to idle

15 Advance to the **WGT** screen



16 Enter total weight dispensed (i.e. 275 pounds)



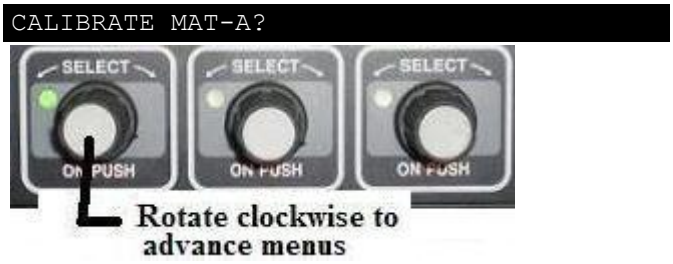
17 Advance to **CALC** screen. The controller will automatically calculate the pounds/revolution for us. This should match our calculation in the previous steps.

18 Choose yes

Display shows done prompt.
19 Press Right Select Knob to continue.

Record LB/REV value (may
20 have to **turn left select knob**)

If doing multiple material types, again advance to the
21 material calibration selection screen and choose the desired material to calibrate



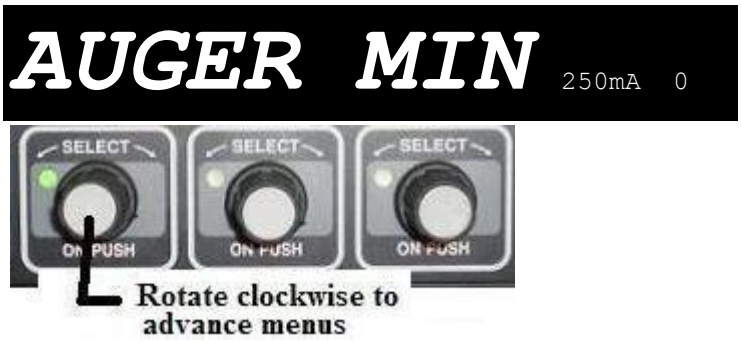
If done calibrating, to
22 **keep calibration changes** push the left select knob to exit calibrate mode

Determining the Auger Minimum Current

This procedure determines the minimum current required to begin movement of the auger motor

When - This test should be done any time the controller is responding poorly for no apparent reason or the catch test is failing. Some shops also choose to do this test as part of scheduled (i.e. annual) calibration.

1 Advance to auger min screen



Note: Far right number shows auger speed (auger rpm)

2 Verify that the constant (i.e. '250mA') is recorded on previous calibration data record

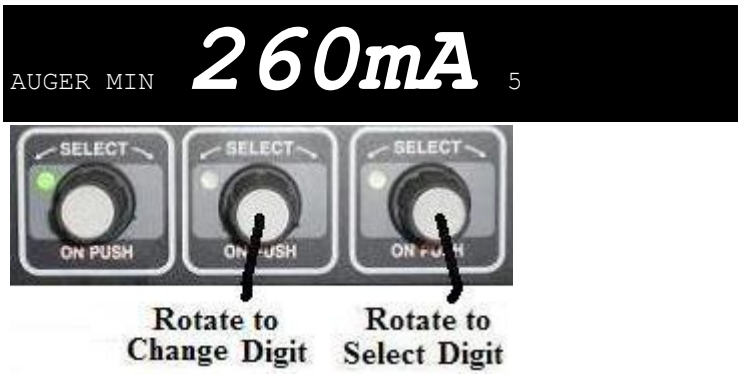
3 Ensure all persons are clear of truck and sander

4 Increase truck engine speed to about 1500 RPM

5 Activate auger by pressing SPREADER knob

6 Auger min displays

7 If auger is not running, slowly increase auger min until auger just starts rotating (auger rpm speed goes above zero -- the '5' in picture)



8 Slowly adjust auger min down until auger just stops rotating (auger rpm speed equals zero)

9 Deactivate auger by pressing SPREADER knob.

10 Record the constant in the calibration data records as the new

calibration auger min value (i.e. '240 mA' in example)

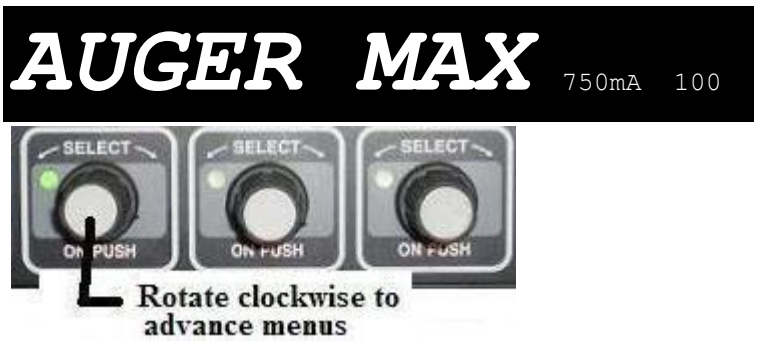
11 Decrease truck engine speed to idle

Determining the Auger Maximum Current

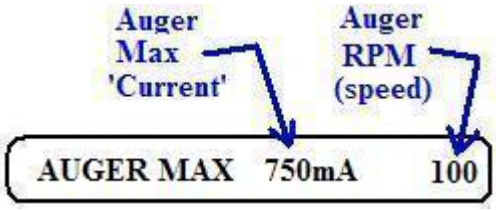
This procedure determines the current required to shift the valve to drive the auger motor at the maximum possible speed

When - This test should be done any time the controller is responding poorly for no apparent reason or the catch test is failing. Some shops also choose to do this test as part of scheduled (i.e. annual) calibration.

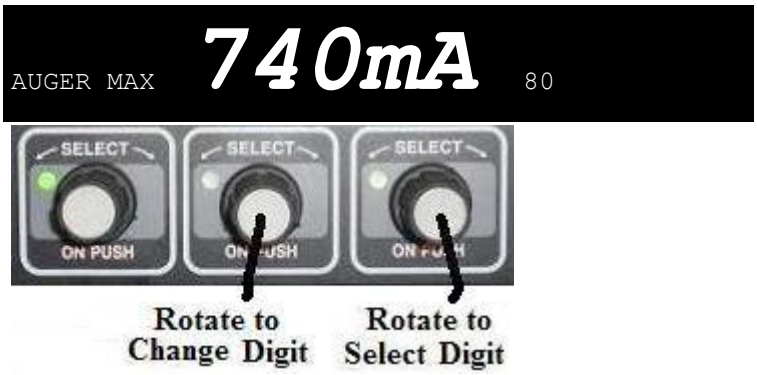
1 Advance to auger max screen



Note: Far right number shows auger RPM (speed)



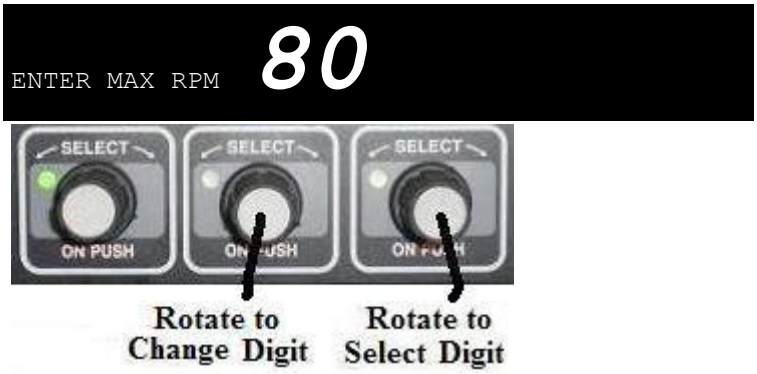
2 Verify these constants (i.e. '750mA' and 100) are recorded on previous calibration data record

3	Ensure all persons are clear of truck and sander	
4	Increase truck engine speed to about 1500 RPM	
5	Activate auger by pressing SPREADER knob	
6	Slowly adjust the auger max up and down until you find the point where the 'Auger-RPM' value does not further increase auger speed (RPM is '80' in picture)	
7	Record these constants (i.e. '740mA' and 80) in the calibration data records as the new auger max values	
8	Deactivate auger by pressing SPREADER knob	

9 Decrease truck engine speed to idle

10 Advance to 'Enter Max RPM' screen

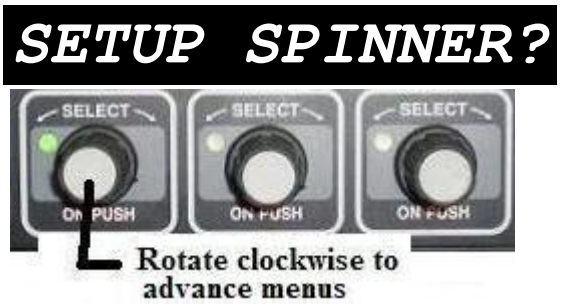
11 Enter Auger Max RPM value recorded in previous step (i.e. '80')



Note: Example RPM values are about 80 RPM for a 6" auger and about 180 RPM for a 9" auger (these may vary)

Setup Spinner

1 Advance to setup spinner screen



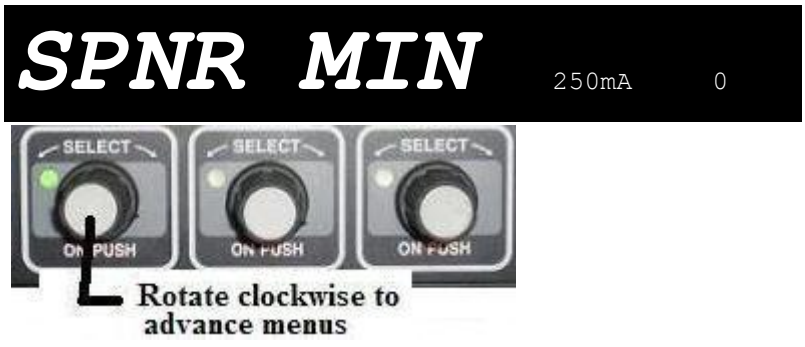
2 Choose yes

Spinner Min

1 **Note:** The spinner minimum current is the minimum current that will just begin movement of the spinner

2 **When** - This test should be done any time the controller is responding poorly for no apparent reason or the catch test is failing. Some shops also choose to do this test as part of scheduled (i.e. annual) calibration.

3 Advance to spinner min current screen

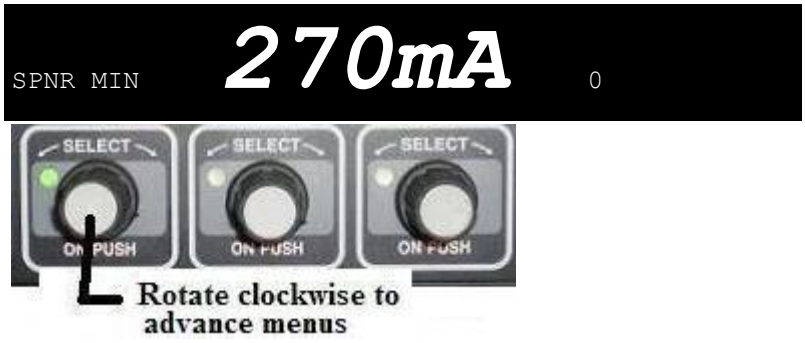


4 Ensure all persons are clear of truck and sander

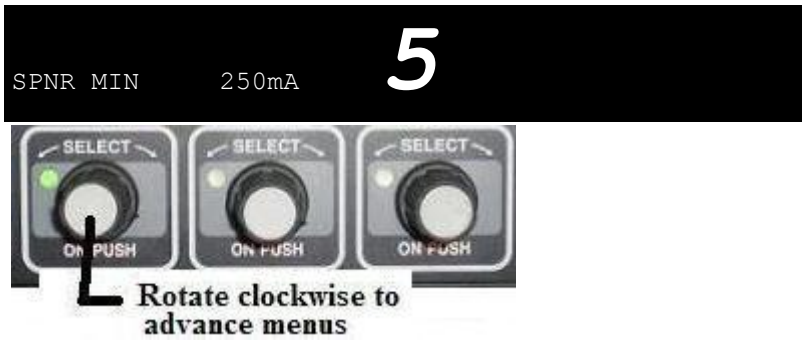
5 Increase truck engine speed to about 1500 RPM

6 Activate spinner by pressing SPREADER knob

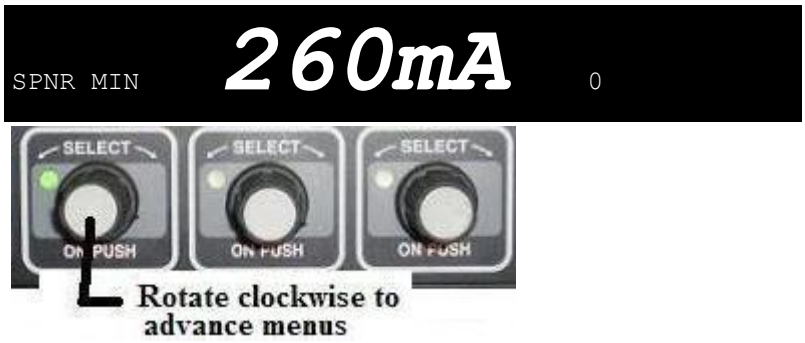
7 If the spinner is not yet rotating, increase the current (**270** in picture) until spinner is rotating



8 Spinner should be rotating and spinner RPM (**5** in picture) should now be above zero



9 Decrease the current (**260** in picture) until spinner stops rotating



10 Deactivate spinner by pressing SPREADER knob

11 Decrease truck engine speed to idle

12 Record the spinner minimum current (**260** in picture) on record sheet

Spinner Max

1 **Note:** The spinner maximum current is the current required to rotate the spinner at the maximum spinner dial setting. It helps the spinner run at optimum performance.

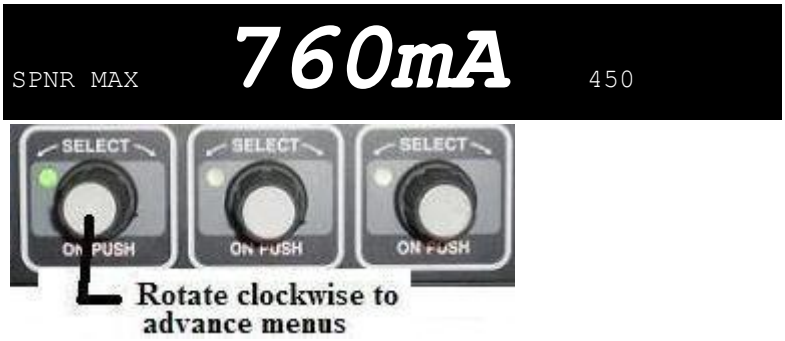
2 **When** - This test should be done any time the controller is responding poorly for no apparent reason or the catch test is failing. Some shops also choose to do this test as part of scheduled (i.e. annual) calibration.

3 Advance to spinner maximum current screen

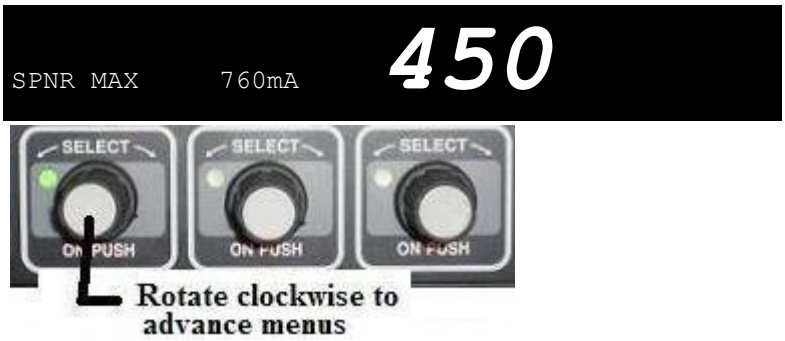
4 Ensure all persons are clear of truck and sander

5 Increase truck engine speed to about 1500 RPM

6 Adjust the current (**760** in picture) up or down until desired maximum spinner speed is reached (spotter will direct us)



7 Spinner RPM (**450** in picture) will be displayed on screen



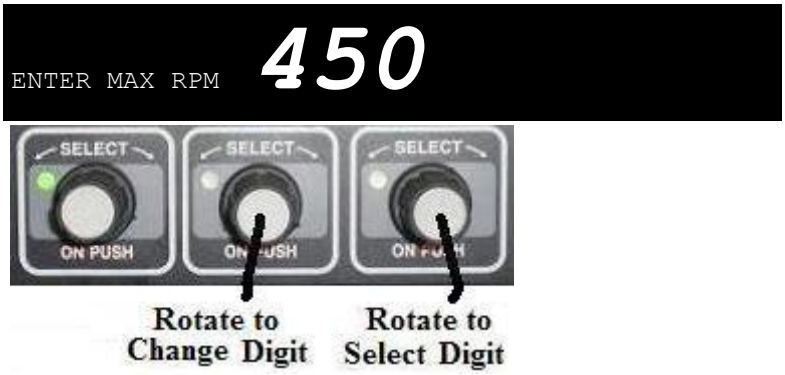
8 Deactivate spinner by pressing SPREADER knob

9 Decrease truck engine speed to idle

10 Record the spinner maximum RPM (**450** in picture) on record sheet

11 Advance to enter max screen

12 Enter Auger Max spinner RPM value recorded in previous step (i.e. **450**). It is suggested to enter a number here of 750 or below (if reading is above 750, enter 750).



Manual Sander Controller Calibration

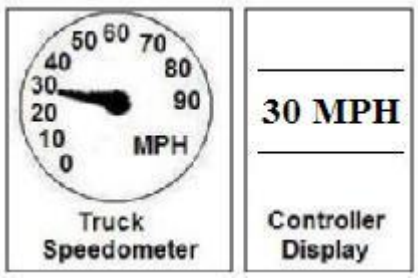
Manual Sander Controller Calibration

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 If a truck has a ground speed sensor, then 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'.



4 Park the truck and let idle

5 Turn on the parking brake

6 Clean and put index mark on auger to help in counting auger turns

7 Load the truck with material

8 Tie the spinner up (you may find with experience that some weighing methods do not require spinner up)

9 Put the auger/salt shield in place (if truck has one)

10 Turn spinner control to zero for safety

11 Set auger control to normal

12 Ensure all persons are clear of truck and sander

13 Prime the auger by tilting the truck box up

14 Run the auger for a few seconds to fill it

Determine Auger Pounds Per Revolution

1 Use 'Auger Pounds Per Revolution Form' located in back of this guide

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

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

4 Ensure all persons are clear of truck and sander

5 Assure that auger is still full. If not, fill it by tilting box and running auger for a few seconds

6 Increase truck engine speed to about 1500 RPM

7 Spotter should be ready to count auger revolutions

8 **Start auger** and spotter should **start counting auger revolutions.** Note that is yes acceptable to start the auger in blast mode for this test.

9 Fill container(s) until sufficiently full (try for 200 pounds minimum)

10 **Stop auger** and spotter should **stop counting auger revolutions**

11 Weigh material

12 Add weight and revolutions count to form

13 Repeat two more times

14 Complete form to determine pounds per auger revolution

15 If using multiple material types (i.e. sand, salt, mixes) then repeat for each type

Determine Application Rates

1 Note: Prior to doing these steps do the 'Determine Auger Pounds Per Revolution' steps

2 Use 'Application Rate Form' located in back of this guide

3 Assure that auger is still full. If not, fill it by tilting box and running auger for a few seconds.

4 Get ready to time this test for 15 seconds

5 Spotter should be ready to count auger revolutions

6 Set auger control setting to lowest (slowest) position

7 **Start auger** and spotter should **start counting auger revolutions.**
Tip: Note that most ForceAmerica 1100 units will allow you to run the auger while stationary if you first set the spreader switch to off and then hold the blast button down and continue to hold down while setting spreader switch to on.
Tip: On some manual controllers you will not be able run the auger while the truck is not moving. Try moving the truck very slowly so that the auger will engage. You can then count auger turns while the truck moves very slowly for a short distance across the truck yard.

8 After 15 seconds, **stop auger** and spotter should **stop counting auger revolutions**

9 Add revolutions count to form 

10 Repeat for each control setting

11 Complete form to determine application rates 

12 If using multiple material types (i.e. sand, salt, mixes) then repeat for each type

Verification For Other Automatic Controllers

(Only use these steps if your automatic controller is not specifically included in this guidance)

General Steps for Verification

When - Any time you want to check if the controller is well-calibrated or needs calibration. This is useful for both checking how well-calibrated controller are. It is especially useful for open-loop systems (no rear auger sensor) so that only calibration is done ‘when needed’ because those systems usually require programming to calibrate.

The steps are below are the general steps for verification. First **see the specific section of the guide for your specific controller**. The automatic controllers all have Verification' sections.

If your controller type is not specifically included in this guidance, then use these steps.

Note: This verification process assumes that 'Manual' (or speed simulation) mode is already enabled for your controller. If not, refer to your specific product manual. Set the application rate and ground speed as desired. For this

example we will use 250 pounds per mile and 30 MPH.

1 Find **Test-Time** to run test using one of the 'Calibration Verification Forms' (see **Forms** section). For this example will run for 2 minutes so we expect 250 pounds.

2 Perform the steps outlined in any of the ***'Getting Started'*** sections for one of the specific controllers in this guidance to prepare the truck.

3 Ensure all persons are clear of truck and sander

4 Get Ready to start the auger in stationary mode

5 Spotter says ***start*** -- start stopwatch and auger.

6 When Test-Time elapses, spotter says ***stop*** -- stop auger.

7 ***Weigh*** material

8 ***Compare*** dumped weight versus expected weight

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'.

9 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. Refer to your specific product manual.

Weighing Material for Sander Calibration

Weighing Material for Sander Calibration

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. Dump material onto ground and then shovel into pails.

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 expected weight 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 calibration records as "Expected Value"
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 start dumping material
5. Start stopwatch
6. When ***Test-Time*** has elapsed, s**ignal to calibrator** to stop dumping material
7. Weigh material dumped and enter weight on calibration records as "Measured Value"

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 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, s**ignal 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.

Manual Controller Auger Pounds Per Revolution Form			
	A	B	C
	Weight (Pounds)	Auger Revolutions	Pounds / Revolution (A/C)
Sample #1			
Sample #2			
Sample #2			
		Total	
Average Pounds Revolution (Total/3)			
Reference: Minnesota Snow an Ice Control, 2005, LTAP, LRB, Mn/DOT			

Manual Controller Auger Pounds Per Revolution Form (Example)			
	A	B	C
	Weight (Pounds)	Auger Revolutions	Pounds / Revolution (A/C)
Sample #1	240	25	9.6
Sample #2	242	24	10.1
Sample #2	252	26	9.7
		Total	29.4
Average Pounds Revolution (Total/3)			9.8
Reference: Minnesota Snow an Ice Control, 2005, LTAP, LRB, Mn/DOT			

Manual Controller Application Rate Form									
					Discharge Rates (pounds per mile)				
	D	E	F	G	H				
Control Setting	Auger Revs / 15 Secs	Auger RPM (Col D x 4)	Auger Pounds Per Revolution (Col C from Above)	Discharge Rate (lbs/min) (E * F)	15 MPH (G * 4)	20 MPH (G * 3)	25 MPH (G * 2.4)	30 MPH (G * 2)	35 MPH (G * 1.71)
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									

Manual Controller Application Rate Chart (Example)									
					Discharge Rates (pounds per mile)				
	D	E	F	G	H				
Control Setting	Auger Revs / 15 Secs	Auger RPM (Col D x 4)	Auger Pounds Per Revolution (Col C from Above)	Discharge Rate (lbs/min) (E * F)	15 MPH (G * 4)	20 MPH (G * 3)	25 MPH (G * 2.4)	30 MPH (G * 2)	35 MPH (G * 1.71)
1	1	4	9.8	39	157	118	94	78	67
2	2	8	9.8	78	313	235	188	157	134
3	3	12	9.8	118	470	353	282	235	201
4	4	16	9.8	157	627	470	376	313	268
5	5	20	9.8	196	783	588	470	392	335
6	7	28	9.8	274	1097	823	658	548	469
7	8	32	9.8	313	1253	940	752	627	536
8	9	36	9.8	353	1410	1058	846	705	603
9	10	40	9.8	392	1567	1175	940	783	670
10	11	44	9.8	431	1723	1293	1034	862	737
11	12	48	9.8	470	1880	1410	1128	940	804

Snowplow Sander Calibration Records
Force America 5100

	Truck Id				
	Material				
Calibration Constants	Date				
	By				
	LB/REV				
	AUGER MIN Current (mA)				
	AUGER MAX Current (mA)				
	AUGER MAX RPM				
	SPNR MIN Current				
	SPNR MAX RPM				
	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
Quick Sheets

Weighing Material Using Bottomless Box Quick Sheet

Building Box

Cut lumber so that size is equal to four 5 gallon pails. For example:

- For 2" x 12" board, inside length should be 20-1/4"
- For 2" x 10" board, inside length should be 22-11/32"

Determining Full Box Weight

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 this three times to get an average (i.e. 60 pounds).

Multiply material weight for one pail (i.e. 60 pounds) by 4 to obtain approximate weight of material when box is full (i.e. 60 * 4 = 240 pounds)

Weighing Material during Test

Position box under spinner. You may or may not have to remove or tie up spinner. Some shops leave spinner on and let material drop from spinner into box.

Slightly "overfill" with material.

Scrape material "overage" excess onto ground using straight board.

Shovel small overage excess from ground into pail and weigh pail with scale (i.e. say 11 pounds weighed). Say pail is 3 lbs empty. So, overage material = 11 – 3 = **8 pounds**

Determine weight of material as full box weight plus overage excess (i.e. 240 pounds + 8 pounds = 248 pounds).

Force America 5100 Application Rate Calibration Quick Sheet

(see detailed instructions in guide for more information)

Advancing Menus

Entering a number

Selecting YES

Turn **spinner and spreader dials off (zero)** 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.

Advance to '**calib**' menu, then push left knob

Enter password and rotate left knob when done

Advance to **Setup Granular**, Push **YES**

SETUP GRANULAR? YES

Advance to **Granular Mode**, Choose CLOSED

GRANULAR MODE: CLOSED

Advance to the **Gate Mode,** Choose NONE

GATE MODE: NONE

Advance to **Calibrate**, Push **YES**

CALIBRATE MAT-A? YES

Advance to the **Scale Type,** Choose PORTABLE

SCALE TYPE: PORTABLE

Position container, ensure all persons clear of truck

Advance to the auger screen, Enter about 30%

AUGER 30% TURNS 0

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

Start auger by **pressing SPREADER knob**

Stop auger by **pressing SPREADER knob**

Advance to **WGT**, and enter weight

MAT-A **WGT** 275 lb

Advance to **CALC** material screen, **Press Yes**

CALC MAT-A LB/REV? YES

Press Right Knob to continue, record LB/REV (may need to turn left select knob). **If done**, push left knob.

DONE

Force America 5100 Application Rate Verification Quick Sheet

(see detailed instructions in guide for more information)

Advancing Menus

Entering a number

Selecting YES

Turn **spinner and spreader dials off (zero)** 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.

Find Test-Time, i.e. 500 lbs/mile, **60 seconds**, **expected weight of 250 lbs**.

Advance to 'calib' menu, then **push left knob**

Enter password and **rotate left knob** when done

Advance to **SET SPREADER CONFIG**, Push **YES**

Advance to **ENABLE SIMSPD**, Choose **YES**

Press left knob to exit calibration mode

In operation mode, **select desired application rate** – i.e. 500 lbs/mile using Spreader Dial

Advance to simspd; **activate** by pressing left knob

Advance to simset; **activate** by pressing left knob

Enter sim speed rotating **left** button, i.e. 30 MPH

Press left knob to exit calibration mode

Position container, ensure all persons clear of truck

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

Notify spotter **, Start watch, press** SPREADER knob

Spotter signals **stop** at time, **press** SPREADER knob

Compare actual dumped weight versus expected weight and record % difference

Many shops use 10% as 'closeness criteria'

When done, go back into CALIB mode and disable SIMSPD (set to NO in above steps)

Manual Controller Calibration Quick Sheet

(see detailed instructions in guide for more information)

Turn **spinner and spreader dials off (zero)** for safety 

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

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

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

Determine Auger Pounds Per Revolution

See *"Manual Controller - Auger Pounds Per Revolution Form"*

Position container to catch material 

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

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

Start auger and spotter should **start counting auger revolutions.** Note that is yes acceptable to start the auger in blast mode for this test. Dump at least 200 lbs.

Stop auger and spotter should **stop counting auger revolutions**

Add weight and revolutions count to form sheet (i.e. 240 lbs and 25 revolutions) and repeat two more times to complete form (i.e. 9.8 lbs/revolution).

Determine Application Rates

See "*Manual Controller Application Rate Chart (Example)"*

See **"**Running Auger In Stationary Mode" below

Set auger control setting to any position that you would use in operation

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

Start auger and spotter should **start counting auger revolutions.**

After 15 seconds, stop auger and stop counting **auger revolutions**

Enter revolutions in column "D" of form

Repeat for other control setting positions you would use in operation

Complete Form (See "Example" form in guide)

Running Auger In Stationary Mode

- Note that most ForceAmerica 1100 units will allow you to run the auger while stationary if you first set the spreader switch to off and then hold the blast button down and continue to hold down while setting spreader switch to on.
- On some manual controllers you will not be able run the auger while the truck is not moving. Try moving the truck very slowly so that the auger will engage. You can then count auger turns while the truck moves very slowly for a short distance across the truck yard.