HarvestMaster™

BY JUNIPER SYSTEMS

GrainGages™

H2/H3 Twin

HARDWARE MANUAL

H2/H3 Twin GrainGage Hardware Manual

Part Number: 30557-00

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Cautions

⚠ **CAUTION:** This symbol indicates that failure to follow directions could result in damage to equipment or loss of information.

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Contents

GrainGages™

H2/H3 Twin

CHAPTER 1

Introduction

1. Introduction

The H2 and H3 Twin GrainGage systems deliver highly accurate measurements of plot weight, moisture, test weight, and more during the harvest of large plot, high-volume grain samples. The key difference between the H2 and H3 GrainGage models lies in their moisture sensing technology. The H2 uses an EM moisture sensor, while the H3 uses SCiO™ near infrared (NIR) spectroscopy.

The Twin GrainGage features a double-hopper system designed for split combines, enabling efficient harvesting of dual plots. The GrainGage processes the left and right sides using a single weigh bucket, ensuring consistent measurements and reducing coefficient variations between plots.

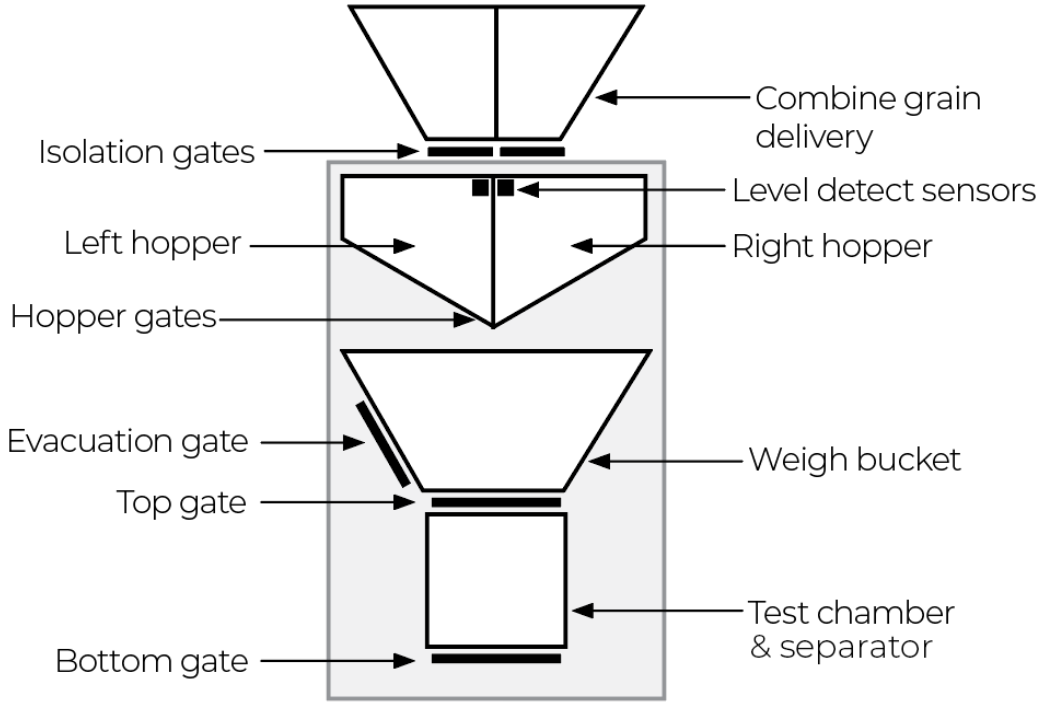
The GrainGage controls the flow of harvested material through the measurement system and compensates for slope and motion to produce results similar to those on a stationary, level platform. The heart of the GrainGage is the DSP (Digital Signal Processing) electronics module, which handles the bulk of logic, communications, and control in the GrainGage.

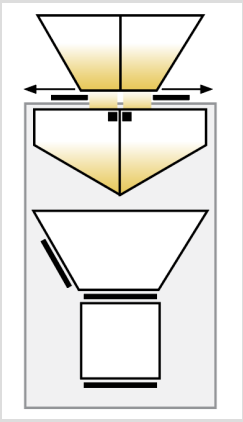
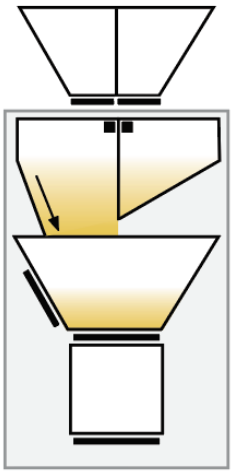
1.1 Illustration of the Twin GrainGage System

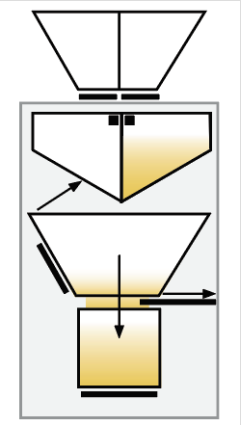
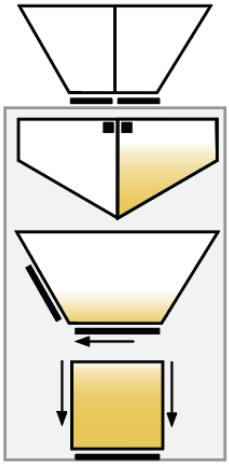
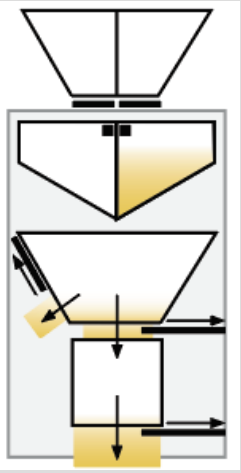
The Twin GrainGage processes grain as it is being harvested, measuring the total weight per plot, test weight (lb/bu or kg/hL), and moisture percentage. The number of cycles per plot is determined by the amount of harvested grain. You select from two harvest modes, depending on the amount of grain in your plots:

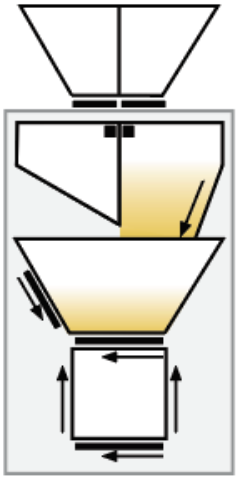
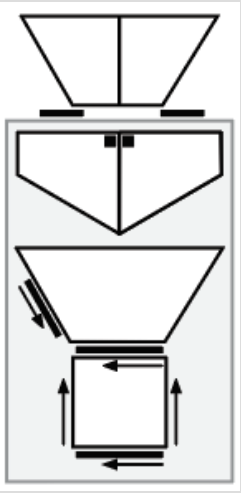
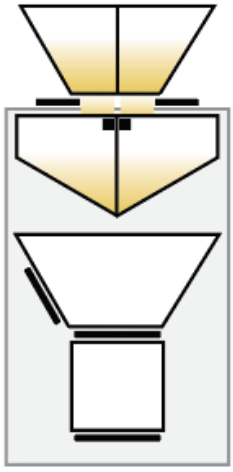
- Select **Plot mode** when the harvested grain from a plot will fit in one hopper (1 plot = 1 hopper). Two parallel plots are cut simultaneously and deposited into individual hoppers. The grain in each hopper is then weighed and measured in succession.
- Select Strip mode when the harvested grain in each plot will be too large to fit in one hopper. As you are harvesting, the level detect sensors in each hopper signal when the hopper nears capacity and signals the GrainGage to start a cycle.

The basic process for harvesting in plot mode and strip mode is outlined below.

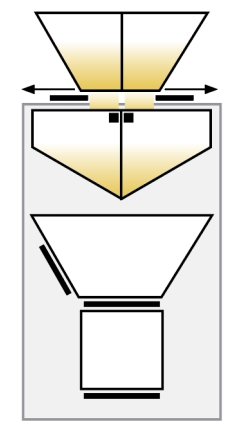
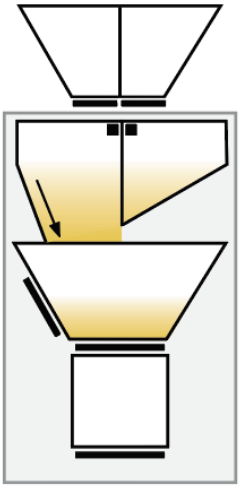
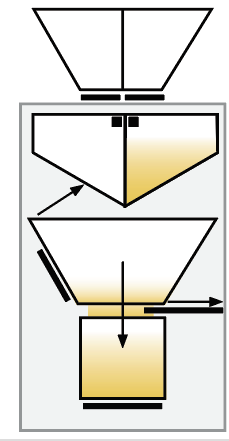


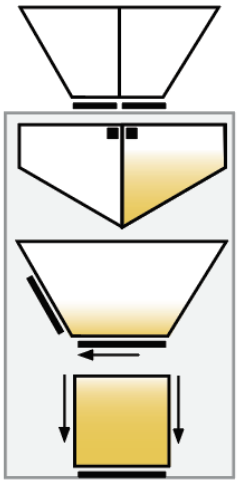
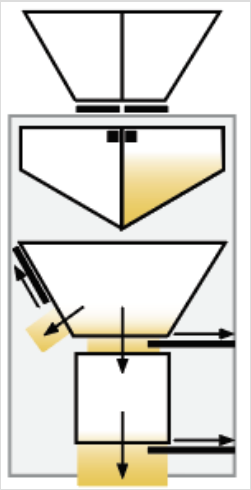
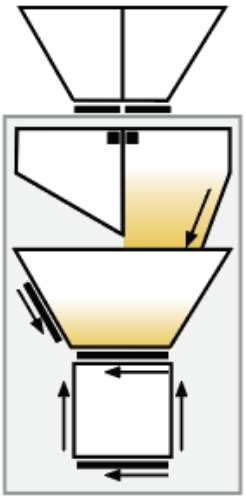
Basic Harvest Process in Plot Mode		
Step	**Description**	**Diagram**
1. Incoming grain flows into the left and right hoppers.	The isolation gates are open by default, which allows the grain to fill the left and right hoppers. The operator initiates the cycle. *Note: The test cup is docked to the weigh bucket.*	
2. Grain empties into the weigh bucket.	Both isolation gates close and the left hopper opens and fills the weigh bucket.	

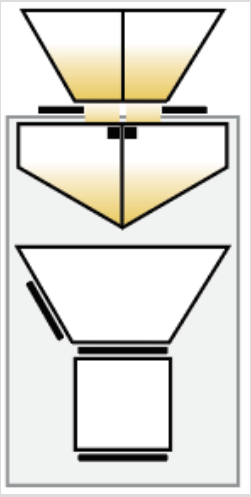
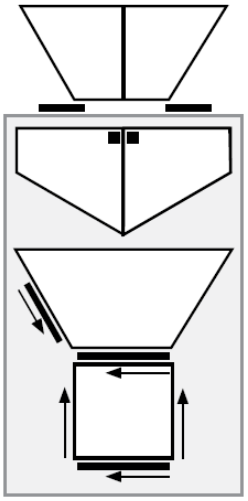
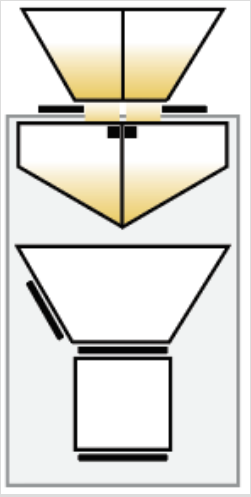
3. The GrainGage prepares to measure.	The left hopper gate closes. ▪ If the amount of harvested grain from the hopper is above the minimum weight threshold, the top gate opens and fills the test chamber with grain from the weigh bucket. ▪ If the amount of harvested grain is below the minimum weight threshold, the sample is weighed but no test weight or moisture is taken. The bottom, top, and evacuation gates all open at the same time, evacuating the sample.	
4. The GrainGage measures the grain from the left hopper.	The top gate closes. The test chamber drops and separates from the weigh bucket. The GrainGage measures total bucket weight, test weight, moisture, and NIR constituents (when using H3).	
5. The grain evacuates from the GrainGage.	The top, bottom, and evacuation gates open, evacuating the grain from the weigh bucket and test chamber. *Note: We do not recommend enabling subcycles with a twin plot harvester. Subcycles are turned off by default.*	

6. The GrainGage weighs, measures, and evacuates grain in the right hopper.	The GrainGage repeats the process of weighing, measuring, and evacuating the grain for the right hopper.	
7. The GrainGage prepares for the next plot.	The GrainGage performs a tare check and docks the test chamber to the weigh bucket.	
8. The operator starts harvesting the next plots.	Grain falls directly into both hoppers.	

Basic Harvest Process in Strip Mode		
Step	Description	Diagram

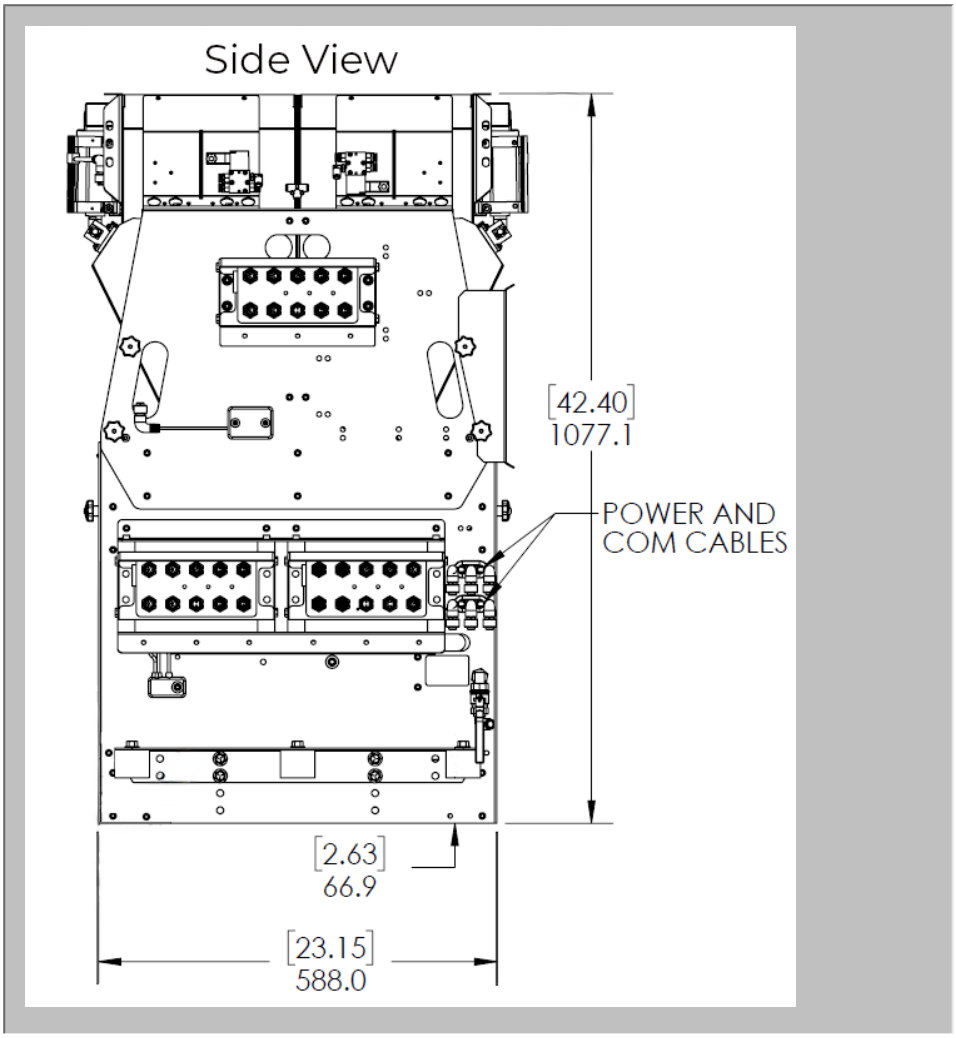
1. Incoming grain flows into the left and right hoppers.	The isolation gates open, and grain fills the left and right hoppers in succession.	
2. Grain empties into the weigh bucket.	When the grain reaches the level detect sensor in either the right or left hopper, the both isolation gates close and the left hopper opens and fills the weigh bucket.	
3. The GrainGage prepares to measure.	The left hopper gate closes. ▪ If the amount of harvested grain from the hopper is above the minimum weight threshold, the top gate opens and fills the test chamber with grain from the weigh bucket. ▪ If the amount of harvested grain is below the minimum weight threshold, the sample is weighed but no test weight or moisture is taken. The bottom, top, and evacuation gates all open at the same time, evacuating the sample.	

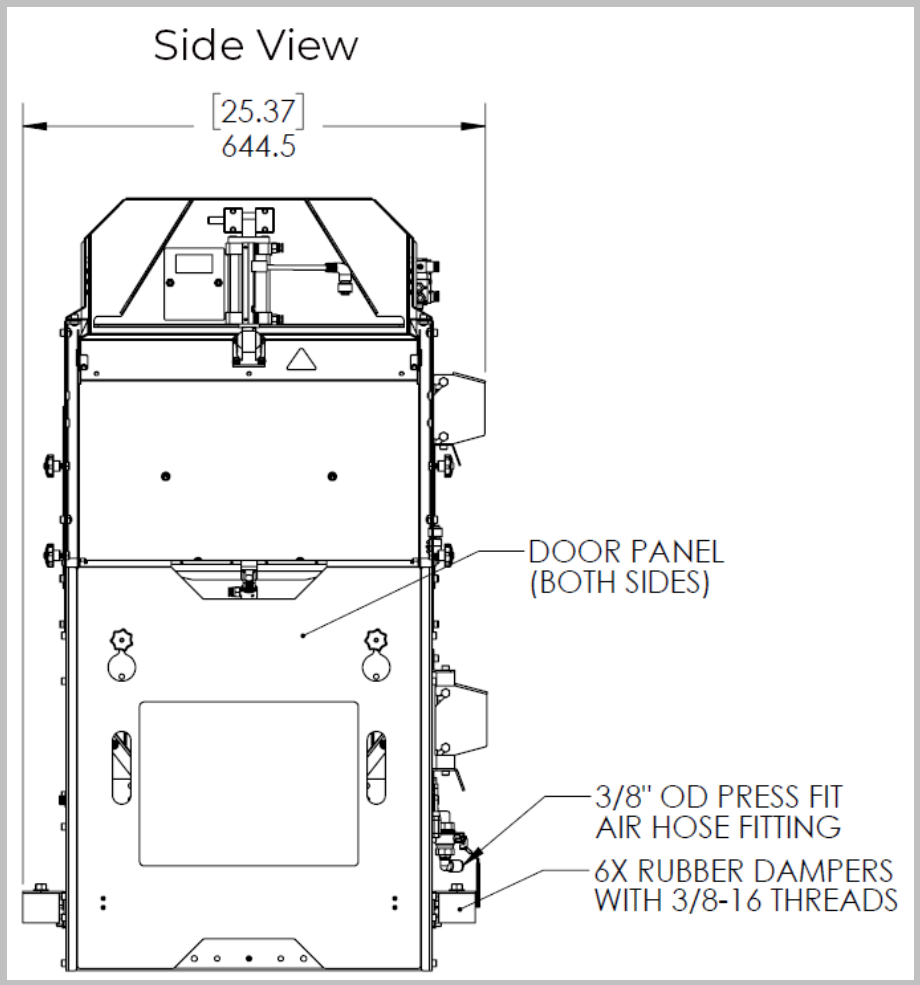
4. The GrainGage measures the grain from the left hopper.	The top gate closes. Test chamber drops and separates from the weigh bucket. The GrainGage measures total bucket weight, test weight, moisture, and NIR constituents (when using H3).	
5. The grain evacuates from the GrainGage.	The top, bottom, and evacuation gates open, evacuating the grain from the weigh bucket and test chamber.	
6. The GrainGage weighs, measures, and evacuates grain in the other hopper.	The GrainGage repeats the process of weighing, measuring, and evacuating the grain for the other hopper. Both left and right isolation gates open.	

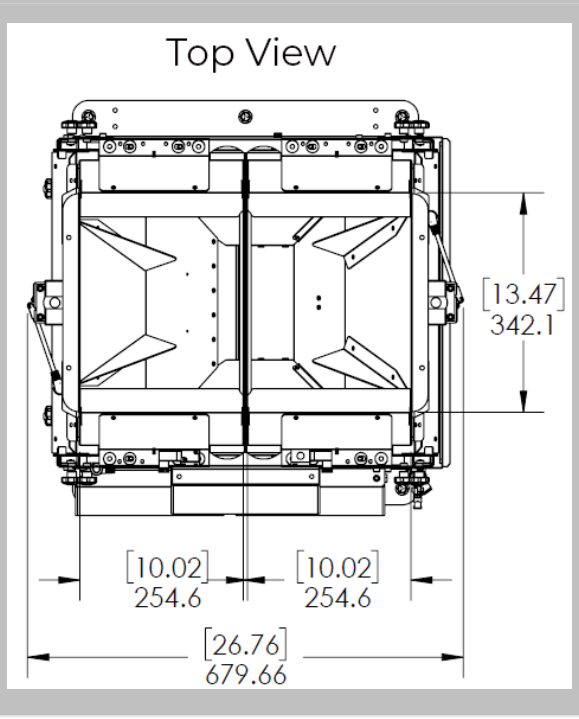
7. The GrainGage continues to measure any additional cycles.	The GrainGage initiates another cycle if the level detect sensor in either hopper is tripped. When the operator reaches the end of the strip plot and grain clears from the machine, Mirus and the GrainGage pause.	
8. Strip plot harvest is completed, and the GrainGage prepares for the next strip plot.	The operator presses the Enter press or Cycle button. Mirus initiates a flush cycle and records the data for each hopper. Adding and combining all the plot cycles and averaging all the test weight/moisture cycles. The evacuation, top, and bottom gates close. The GrainGage performs a tare check. The test chamber docks to the weigh bucket.	
9. The operator starts harvesting the next strip plot.	Grain falls directly into both hoppers.	

1.2 Twin GrainGage Specifications and Dimensions

These images show the outer dimensions of the H2 and H3 Twin GrainGage chassis.


Side View
[42.40]
1077.1
POWER AND
COM CABLES
[2.63]
66.9
[23.15]
588.0

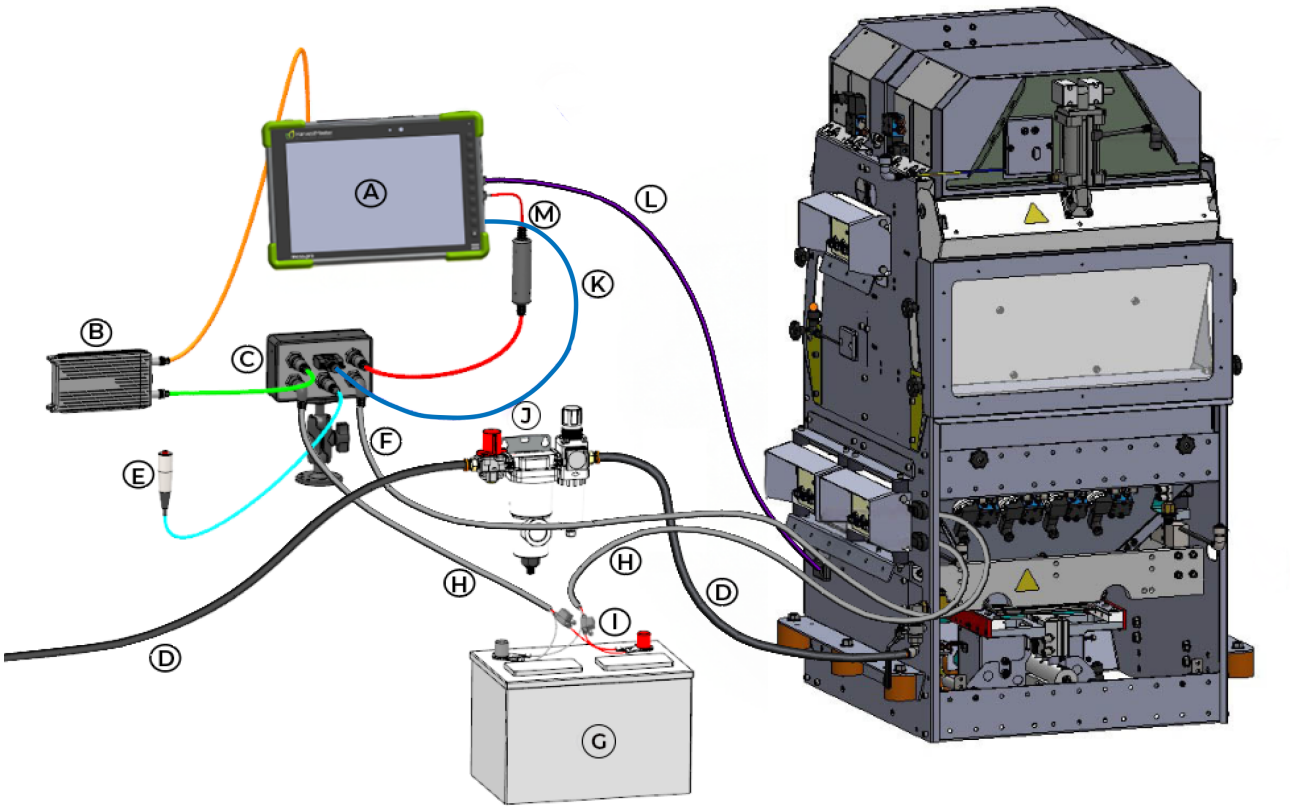




For more product specifications, refer to H2 Single & Twin GrainGage data sheet or H3 GrainGage data sheet.

1.3 Twin GrainGage System Diagram

The following diagrams show the basic layout and parts of the Twin GrainGage system. For detailed installation instructions and a complete list of parts, see Install the GrainGage.



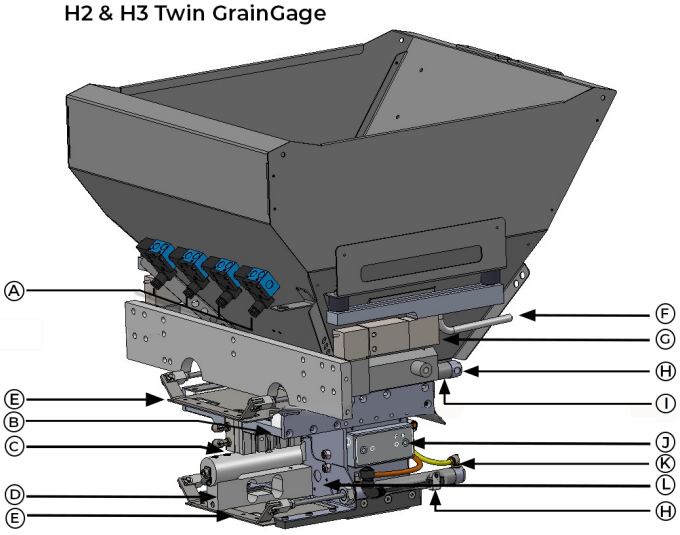
A. Rugged tablet, such as Mesa Pro (PN ST1-112)	**H.** 12 V DC power cable (PN 27156)
B. Mesa Pro 12-32 V Lind charger with cables (PN 31640)	I. ATC 20 A fuses *
C. System controller and RAM mount (PN 25030)	J. Pneumatic air prep/regulator (PN 15450)
D. Black poly air hose (PN 9455)	K. RS-232 serial cable (PN 23237) **
E. Remote enter button (PN 15374)	L. SCiO serial to USB cable for H3 (PN 31517)
F. Long CAN cable (PN 28315)	M. CAN to USB cable (PN 27092) **
G. 12 V DC automotive battery	

** HarvestMaster requires that you install ATC 20 A fuses (I) on all power cables that connect to the battery.*

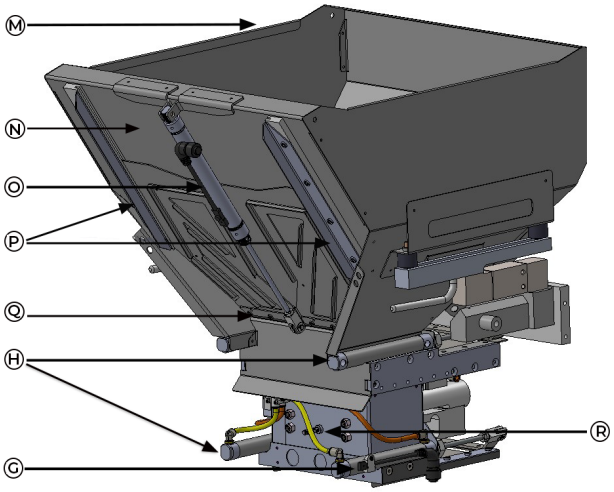
*** You will use either the serial cable (K) or the CAN to USB cable (M). Do not use both at the same time. We recommend using the serial cable for a more solid, reliable connection.*

Internal Components of the Weigh Bucket and Test Chamber

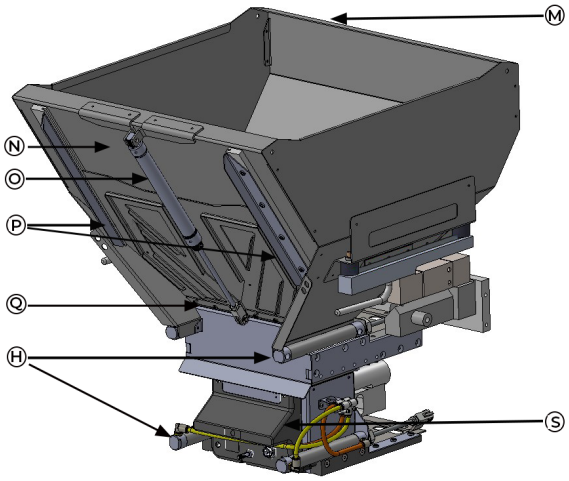
H2 & H3 Twin GrainGage



H2 Twin GrainGage



H3 Twin GrainGage

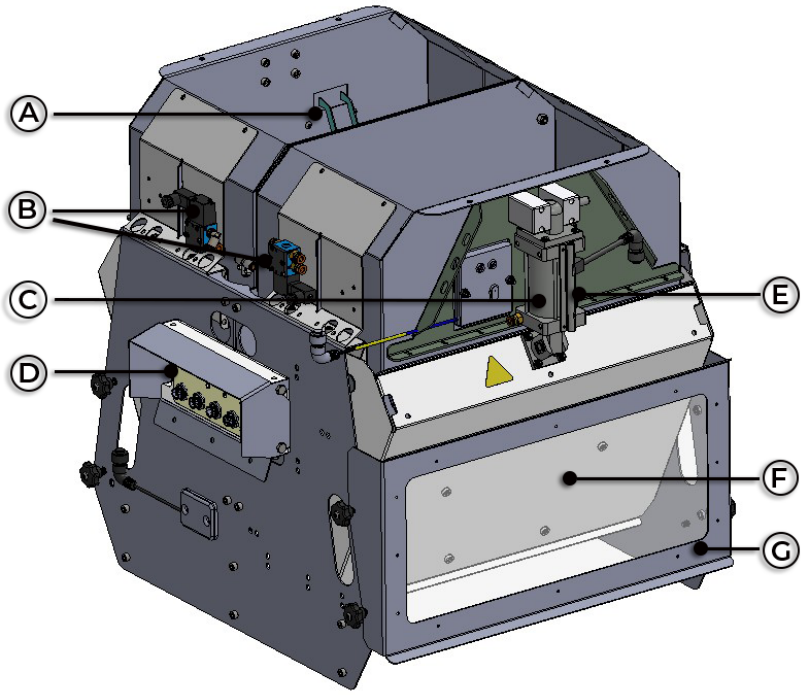


A. Actuator control solenoids (PN 24434)	K. NPT air fitting 1/4 in. elbow (PN 7397)
B. Separator limit switch (PN 24442)	L. Test chamber
C. Separator cylinder (PN 26114)	M. Plot bucket
D. Test chamber load cell (PN 24563)	N. Evacuation bypass door (PN 24435)
E. Top and bottom slide gate (PN 24423)	O. Evacuation bypass gate air cylinder (PN 24433)

F. Calibration hook for plot weight	**P.** Evacuation gate slide
G. Plot weight load cell (PN 26514)	Q. Evacuation bypass gate gasket (PN 25499)
H. Top and bottom air cylinder (PN 24422)	R. Calibration hook for test weight
I. Top and bottom cylinder limit switch (PN 24443)	S. SCiO NIR Sensor for H3 (PN 30715) *
J. Grain moisture sensor, *optional for H3** (PN 29111)	

** The H3 GrainGage can use either an EM sensor or a SCiO Sensor to measure moisture. If you remove the EM sensor, cover the opening with the EM sensor plug plate (PN 31796). If you remove the SCiO sensor, cover the opening with the SCiO plug plate (PN 31740). For instructions, refer to* *Change the Moisture Sensor (H3 only)*

Internal Components of the Hoppers



A. Level detect sensor (PN 27440)	E. Twin hopper limit switch (PN 15321)
B. Actuator control solenoid (PN 24434)	**F.** Bucket door (PN 22772)
C. Twin hopper air cylinder (PN 13102)	G. Wind guard (PN 28710)
D. Actuator module (PN 31686)	

1.4 **Twin** GrainGage System Components

The following table describes the components in the GrainGage system. For assistance with connections and wiring, refer to Appendix F: Connections and Wiring Diagrams.

System Components	
Component	**Description**
DSP module	An electronic module that controls the signal conditioning, measurement, isolation door, and some control of the GrainGage.
Primary actuator module (lower)	Controls the top, bottom, separator, and evacuation gates.
Secondary actuator module (upper)	Controls the left and right hopper doors.
H3 SCiO NIR Sensor	Analyzes the moisture, protein, oil, and other constituents (when applicable) of the test chamber sample using near-infrared (NIR) technology.
EM3 moisture sensor	Measures the permitivity of the test chamber grain sample and converts that value to a grain moisture percentage, using the following formula: $Percent\ moisture = 100\ (\ Mw / (\ Md + Mw\ )\ )$ *Mw* is the mass of the water in the grain. *Md* is the mass of the grain.
System controller	Provides communications and signal interface to the GrainGage, including a serial communications interface, a remote enter button connection, a computer power supply, CAN (Control Area Network) connectivity, a USB connection, and system power switch.
Tablet	Runs the Mirus software for field data collection. Mirus software runs on Windows 10 or later.
Plot bucket	Holds the harvested plot.
Test chamber	Holds the grain sample while it is measured for moisture and test weight.
Isolation gate	Prevents grain from dribbling or flowing into the plot bucket during a measurement cycle.
Left and right hopper gates	Holds the grain harvested from the two plots. The left and right hopper gates open separately to allow each hopper to be measured.

Top gate	Regulates the amount of grain entering the test chamber.
Bottom gate	Closes to hold grain in the test chamber and opens to allow grain to flow out of the GrainGage. Located at the bottom of the test chamber.
Evacuation gate	Opens between cycles or plots to help evacuate the sample quicker.
Separator cylinder	Moves the test chamber upwards into the filling position or downwards to the weighing position.
Load cell	The GrainGage has three aluminum, full-bridge strain gauge load cells. Two are used to make precise weight measurements of the entire plot bucket of the GrainGage, and the third load cell measures the weight of the test chamber contents.
Solenoid	The GrainGage has five solenoids, which are controlled by the DSP and actuators module and independently open and close gates and separate/dock the test chamber.
Actuator (air cylinder)	Moves the GrainGage gates using pneumatic cylinders.
Limit switch	Senses if the gates are closed.

1.5 Terminology

Terminology	
Term	Definition
CAN	The Control Area Network (CAN) is a robust electronic communication protocol common in automotive applications.
Minimum weight threshold	The minimum amount of weight required to include moisture, test weight, and NIR constituent data from that specific sub-cycle in the average for that plot.
Flush cycle	The last cycle of the plot and Mirus advances to the next plot.

Strip mode vs plot mode	Strip mode enables the left and right level detect sensors, allowing the GrainGage to harvest multiple cycles per plot. Plot mode disables the left and right level detect sensors, limiting the harvest to only one cycle per plot. You can still set up sub-cycling in plot mode.
Sub-cycle	A sub-cycle is a measurement of test weight, moisture, and NIR constituent data performed when the test chamber drops. The number of sub-cycles taken for each plot bucket of grain is adjustable in Mirus based off individual needs. Data for each sub-cycle is available in the backup file.
Plot weight	The plot weight is the total weight of grain for an individual plot. This would be cumulative weight for all GrainGage weight-trip cycles within a plot.
Test weight	The test weight is weight per unit volume of a sample of grain in the test chamber. Test weight is measured in lb/bushel or kg/hL.

1.6 Inspect the GrainGage Shipping Crate

The GrainGage ships in a corrugated cardboard shipping crate and is secured with packing material. Upon delivery, inspect the shipping crate for any signs of damage. If you identify any damage, contact the shipping company to file a claim. The insuring agency must inspect the package before it is opened. If you do not find any issues with the shipping crate, open it and inspect the items you received.

⚠ **CAUTION: Do not open the shipping crate if you identify damage. Contact the** shipping carrier of the insuring agency so that they can inspect the package before it is opened. Otherwise your claim may be denied.

⚠ CAUTION: Take care when unpacking the GrainGage. Use extra care with the weigh system load cells. Dropping one may result in permanent damage, which is not covered under HarvestMaster's standard warranty.

GrainGages™

H2/H3 Twin

CHAPTER 2

Install the GrainGage

2. Install the GrainGage

2.1 Components and Parts

The following tables list the standard components, installation parts, and optional accessories for the Twin GrainGage.

2.1.1 Standard Components and Accessories

Standard Components and Accessories				
PN	Qty	Description	Notes/Purpose	Photo
24402	1	H2 Twin GrainGage		
31002	1	H3 Twin GrainGage		
25030	1	System controller with RAM mount and two button-head cap screws	Allows the operator to turn on/off the power to the GrainGage.	
24407	1	Test chamber calibration weight (approx. 3 lb (1.4 kg))	Use the calibration weight (stamped with its precise weight) to calibrate the weight measurement of the test chamber.	

24408	1	Plot bucket calibration weight (approx. 11 lb (5 kg))	Use the calibration weight (stamped with its precise weight) to calibrate the weight measurement of the plot weight hopper.	

2.1.2 **Twin** H2/H3 Cable Kit

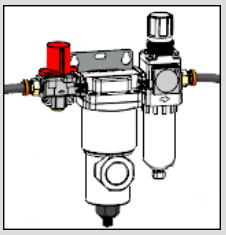
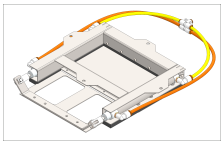
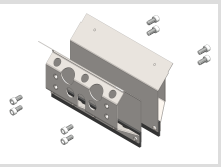
Parts Included in the Twin **H2/H3 Cable Kit (PN** 25088)				
PN	Qty	Description	Notes/Purpose	Photo
15332	2	HM8 12 V DC power cable, 20 ft	One cable provides power to the system controller. The second cable provides power to the GrainGage power bulkhead cable.	
15336	1	HM8 CAN communications cable, 25 ft	The CAN communications cable connects the system controller to GrainGage CAN bulkhead cable.	
15374	1	HM8 remote enter button and cable assembly	The remote enter button allows the operator to manually trigger a measurement cycle on the GrainGage.	
15386	1	Actuator cable assembly	Controls the isolation gate solenoid.	
24434	1	Solenoid valve mac 45 in-line	Operates the isolation gate.	

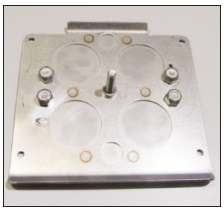
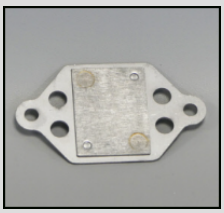
23237	1	HM 9-pin serial cable, 10 ft (3 m)	Connects the computer to the system controller.	
24942	1	H2 actuator bulkhead cable		
	1	HM fuse kit	Includes the materials and instructions for installing fuses on the battery cables connected to the GrainGage.	
9455	30 ft	PLS polyurethane tubing 0.375 in. OD, 0.250 in. ID	Provides pressurized air to the GrainGage.	
9592	5 ft	PLS polyurethane tubing 0.25 in. OD, 0.16 in. ID	Connects the auxiliary pneumatic actuator to its pneumatic control valve.	

2.1.3 Optional Parts

Use these parts as needed for your unique installation.

Accessories				
PN	Qty	Description	Notes/Purpose	Photo

15450	1	Pneumatic air prep (regulator)	Use between the air tank and the GrainGage to regulate or shut off air pressure and to remove oil aerosols, liquids, and fine particles.	
26530	1	Isolation gate kit	Add an isolation gate if your combine doesn't already have one.	
26545	1	H2 low yield insert kit	(H2 only) Use the low yield insert kit to measure test weight and moisture in low volume plot samples.	
26566	1	DSP I/O actuator cable	Connects to GPIO 1 of the DSP module and breaks out the actuator 5 & 6 controls.	
27092	1	HMS USB-CAN right angle connector	Use for troubleshooting.	
31045	1	H3 low yield insert subasy kit	(H3 only) Use the low yield insert kit to measure test weight and moisture in low volume plot samples.	
31517	1	SCiO serial to USB cable	(H3 only) Connects the SCiO Sensor junction on the GrainGage to the rugged tablet. Use the extension cable (PN 31518) if this cable is too short.	

31740	1	H3 sensor hole plug subasy kit	(H3 only) Covers the SCiO Sensor hole in the test chamber. Install if you are using an EM sensor.	
31796	1	H3 moisture sensor plug plate subasy kit	(H3 only) Covers the EM sensor hole in the test chamber. Install if you are using a SCiO Sensor.	
31798	1	H3 low yield insert plug plate kit	(H3 only) Covers holes in the test chamber. Install if you are not using the low yield insert.	
31518	1	SCiO 15 ft serial to USB extension cable	(H3 only) An extension cable for the SCiO serial to USB cable (PN 31517).	

2.1.4 Tablet Computer Options

Below are the rugged tablet computer options for running Mirus and operating the GrainGage.

Tablet Computer Options			
PN	Description	Notes/Purpose	Photo
ST1-112	Mesa® Pro	10-inch ultra-rugged tablet computer running Microsoft® Windows 11	
MS4-CFG	Mesa 4	7-inch ultra-rugged tablet computer running Windows 11	

25681	Mesa powered vehicle dock	Powered vehicle dock for the 7-inch Mesa 3 or Mesa 4 tablet computer	
22485	Tablet C size (1.5 in.) RAM ball	Use to mount the rugged tablet in the combine. Works in conjunction with part numbers 22484 and 23848.	
22484	Tablet C size (1.5 in.) RAM double socket	Use to mount the rugged tablet in the combine. Works in conjunction with part numbers 22485 and 23848.	
23848	Tablet RAM mount with versa plate	Use to mount the rugged tablet in the combine. Works in conjunction with part numbers 22485 and 22484.	
31822	Mesa Pro 1000 W vehicle dock Lind charger		
25414	Mesa 3 or Mesa 4 mounting bracket (7 in.)		
31814	Mesa Pro powered vehicle dock		 

31016	Mesa Pro mounting bracket		
31640	Mesa Pro Lind power supply (12–32 V)		

2.2 Installation Types

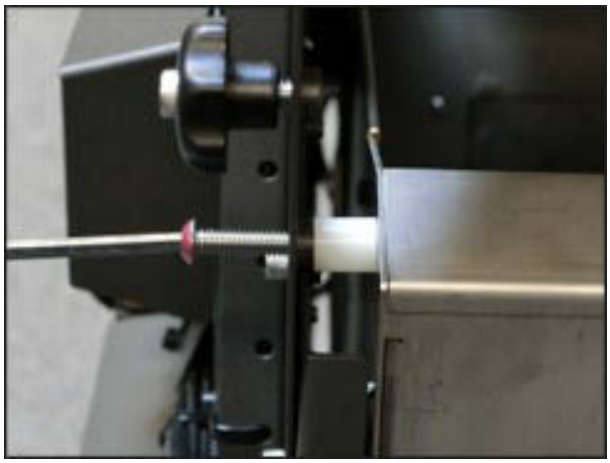
Always use the base mounts to install the GrainGage. There are multiple configurations using slides (not included), swing hinges (not included), or solid mounts.

2.2.1 Remove Shipping Stops

During shipping, four white plastic shipping stops stabilize the weigh bucket and prevent damage to the GrainGage.

Before installing and using the GrainGage,

1. Remove the 1/4–20x1.25 in. stainless steel screws and lock nuts that hold the white plastic shipping stops in place.



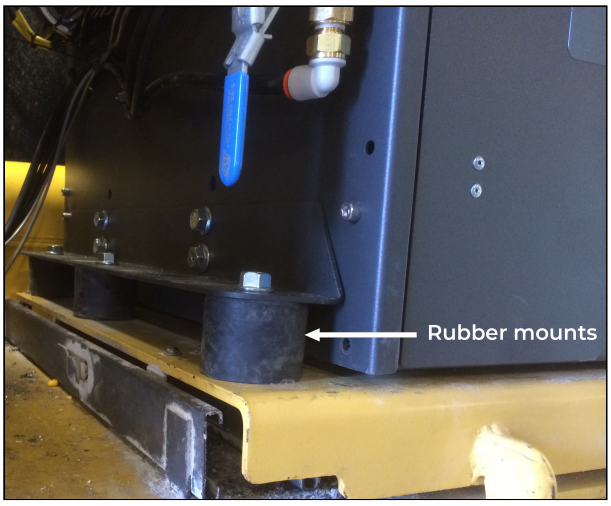
2.2.2 Install on a Combine

To install the GrainGage on a combine,

1. Park the combine on a level surface and check the tire pressure to make sure all tires are at normal operating pressure.
2. Identify the location on the combine where the GrainGage will be mounted. When selecting a location, ensure the cyclone, GrainGage, and sump are aligned and there is enough room for the grain to exit from the side evacuation gate. Additionally, ensure that you have clearance to perform maintenance, daily checks, and repairs.

   Note: In the example below, the GrainGage will be mounted with the evacuation gate opening toward the cab of the combine. Mounting it in the opposite direction will not allow the grain to evacuate into the return hopper.

3. Mount the GrainGage on the combine. Ensure it is straight and level. The GrainGage can be mounted on slides or a robust hinging mechanism to give better access for calibration and maintenance. Options for slides are available from http://www.generaldevices.com.
4. Use the rubber mounts already installed on the GrainGage to cushion it from the mechanical shocks of the operating combine.



If the GrainGage is mounted in a location where you cannot see the grain flow and the gates moving, consider mounting a camera to allow observation of the gates and the grain as it flows through the system. Commercially available vehicle backup camera systems can serve this purpose.

2.3 Install the System Controller, Tablet, and Cabling

The system controller switches power to the system and indicates the status of operation. It also charges the tablet (12 V DC, maximum 12 A unregulated), provides the connection point for the remote enter switch, and serves as the CAN interface between the GrainGage and the tablet.

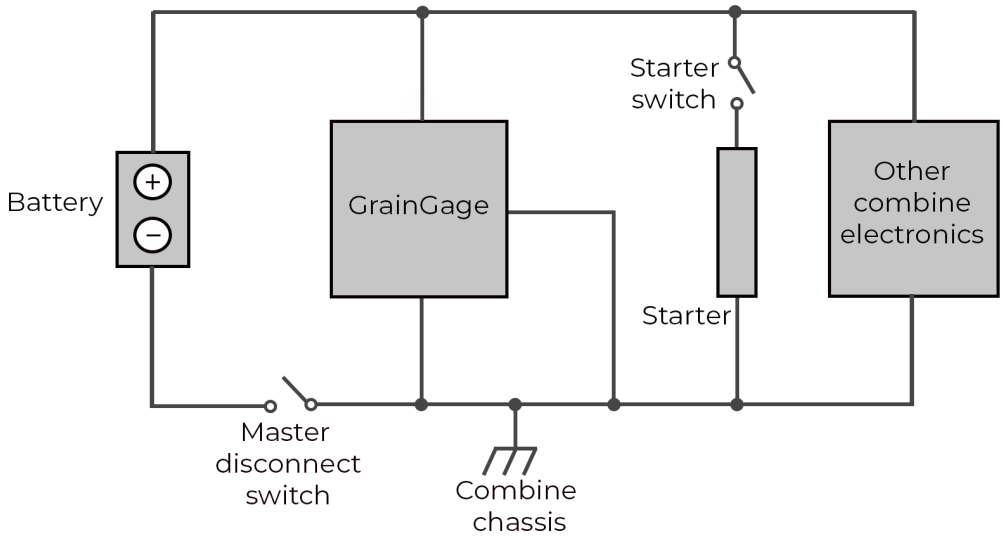
To install the system controller and tablet on the combine,

1. Identify mounting locations in the cab for the system controller and the tablet. Position the tablet and controller within easy reach and view of the operator and close enough to allow serial cable (PN 23237) or CAN to USB cable (PN 27092) to reach between them.
   ⚠ CAUTION: Prevent premature wear or damage to the connectors by providing **strain relief for the** connections so that the weight of the cable does not pull on the connectors.
2. Use the RAM mount in the appropriate position for your installation.
3. Mount the tablet in the desired location.
4. Determine the route of cables and hoses that keeps them out of the way of moving parts. If routing cables along existing cables or hoses, use plastic zip ties to hold them in place (at least one tie every 2 ft (.6 m)).
   ⚠ CAUTION: Ensure the cables are free from pinching or kinking during use and maintenance to prevent damage to the cables.
5. Before wiring, locate the combine's master disconnect switch. If the combine does not have a master disconnect switch, go to step 6.

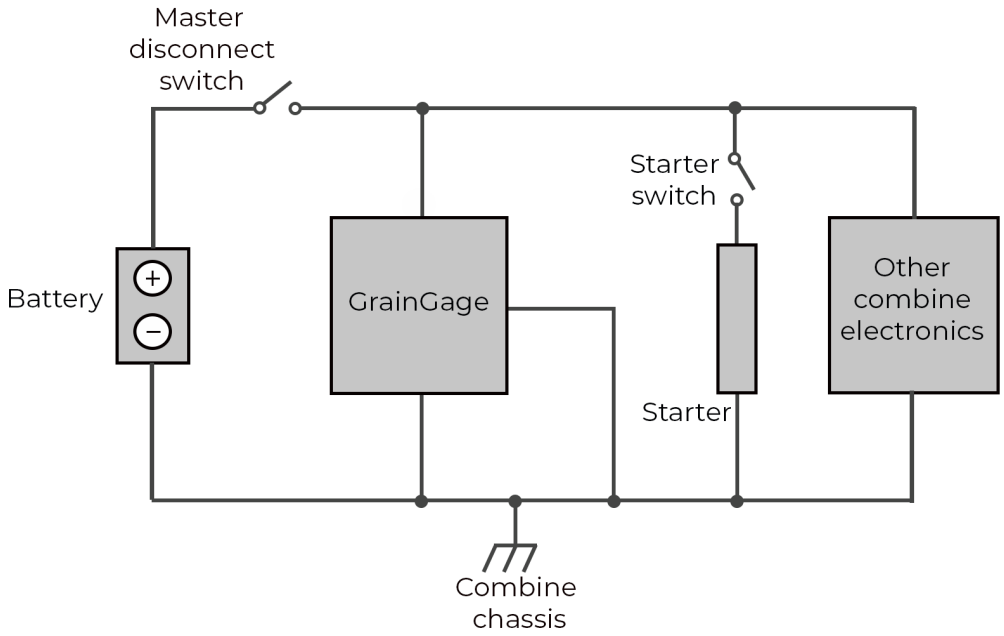
   Determine whether the disconnect switch controls the negative or positive battery terminal. The GrainGage power cable connected to that terminal must pass through

the disconnect switch. This ensures power to the GrainGage is fully cut off when the switch is off.

Option 1: Master disconnect switch connected to negative battery terminal



Option 2: Master disconnect switch connected to positive battery terminal



6. Route two separate power cables (PN 15332) from the battery to the GrainGage components.
   - Cable 1—Connects the system controller and the battery.
   - Cable 2—Connects the bulk head power connector (dual ports on the side of the GrainGage) and the battery.

   Route the appropriate cable (based on the wiring identified in step 5) through the master disconnect switch. If the combine does not have a master disconnect switch, connect directly to the 12 V battery source.
7. Trim the pigtail end of both cables to the appropriate length for battery connection.

8. Install an ATC 20 A fuse (included) on all power cables leading to the battery to protect the GrainGage and system controller and reduce the risk of fire if your cable is damaged. (For installation instructions, see Install Fuse on HarvestMaster Power Cables.)
9. Route the CAN cable (PN 15336) from the system controller to the bulk head power cable (dual CAN ports on the side of the GrainGage).
10. For the H3 Twin GrainGage, route the SCiO serial to USB cable (PN 31517) from the SCiO Sensor junction cable (PN 30712) on the outside of the GrainGage to the tablet.

⚠ CAUTION: The GrainGage requires a clean 12 V DC supply in the range of 11.5 V to 18.0 V. The power supply must be free of transient power spikes.

⚠ **CAUTION: When using a battery booster for welding on the machine or to furnish a** quick charge on the combine battery, disconnect the GrainGage power source to prevent **damage. DC voltages over 18 V can damage GrainGage electronics. Many automotive** battery boosters exceed 18 V.

2.4 Install a Pressurized Air Supply

The GrainGage requires pressurized air between 75–85 PSI. The air tank must be at least two gallons and must have a water drain petcock valve on the bottom. Use a pneumatic conditioner and air shutoff (PN 15450 or similar) between the air tank and the GrainGage to regulate the pressure and to remove oil aerosols, liquids, and fine particles. The air supply should have a filtration of 5 micron or smaller. HarvestMaster recommends using the air filter from your combine engine.

Note: Before mounting anything, make sure the air hose can reach from the air tank to the pneumatic conditioning center (with shutoff valve) and then to the GrainGage.

To install a pressurized air supply,

1. Mount the air tank in a location that allows the operator to drain the tank daily.
2. Mount the pneumatic conditioner and shutoff. Ensure the operator can access the shutoff valve.
3. Connect the air hose from the air tank to the pneumatic conditioner and shutoff.
4. Connect air from the pneumatic conditioner and shutoff to the GrainGage with ⅜ in. poly tubing.

⚠ CAUTION: Lubricating the actuators and solenoid valves in the GrainGage system may lead to premature failure of these components.

2.5 Use Isolation Gates

The isolation gate halts the flow of grain into the GrainGage during a measurement cycle. The gate is installed by the combine manufacturer or the company that split the machine. If you need assistance with the isolation gate, contact your combine equipment provider.

2.6 Add Low Yield Inserts to the Test Chamber

Low yield inserts make it possible for the GrainGage to measure test weight and moisture for smaller plot samples. The number of inserts you can install and the process you use for installing the inserts depends on whether you are using an EM sensor or a SCiO Sensor in your GrainGage. See Appendix A: Volume, Weight, and Industry Standard Values for volume and weight requirements.

Low Yield Inserts

GrainGage Model	Sensor Type	Part Number	**Installable Inserts**
H2 Twin GrainGage	EM Sensor	26545	One or Two
H3 Twin GrainGage	SCiO Sensor	31045	One
	EM Sensor	31045	One or Two

Note: The low yield inserts are designed specifically for each GrainGage model and are not interchangeable.

2.6.1 Add Low Yield Inserts with the EM Sensor

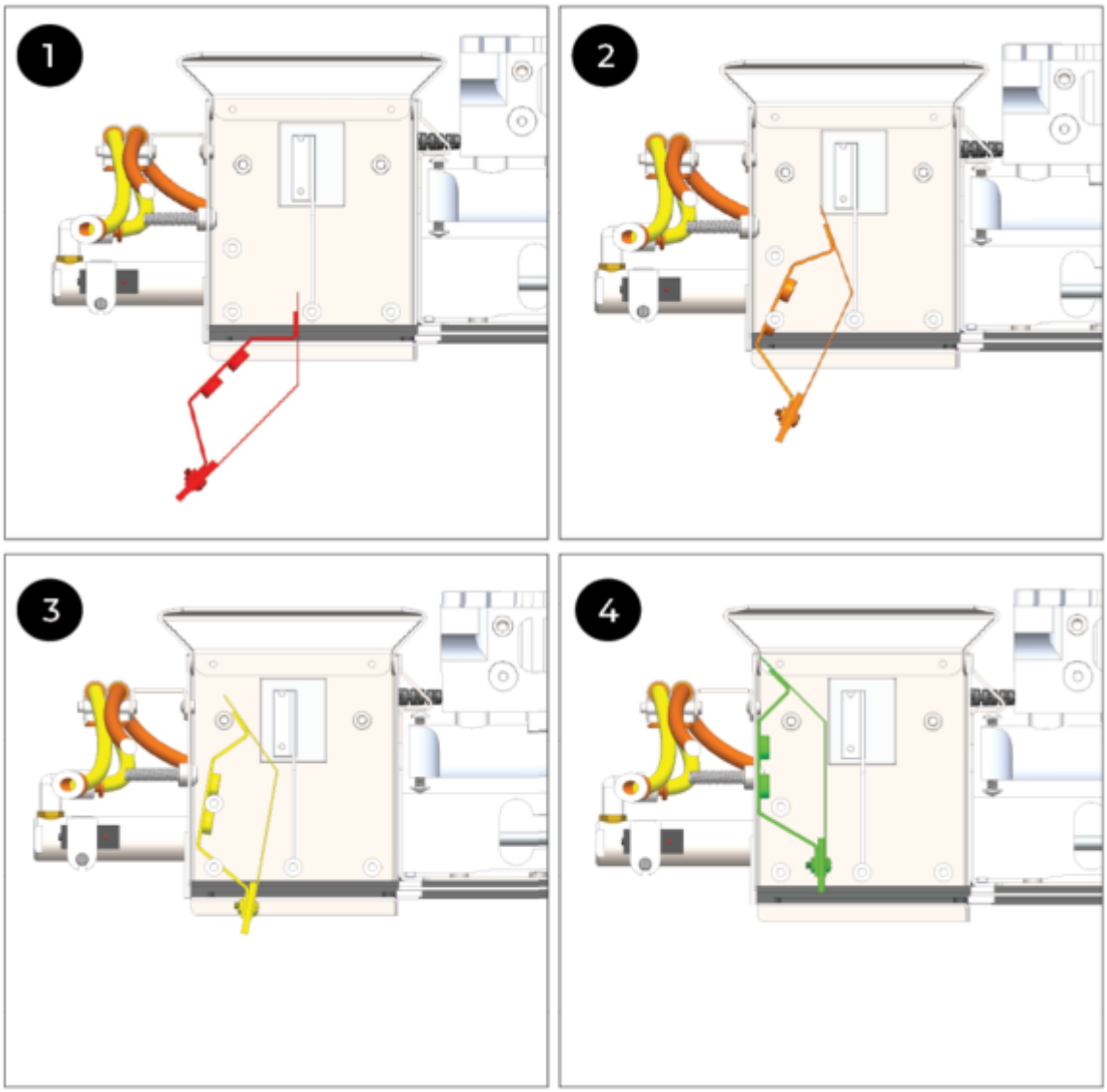
With the EM sensor, you can install one or two low yield inserts. The holes in the test chamber for the low yield inserts are plugged by two metal plates (one on each side) with four hex nuts.

To install a low yield insert,

1. Open the bottom gate.
2. Remove the low yield plug plate from the side on which you want to install the low yield insert. Save the plates and nuts to cover the holes when the inserts are removed.

   Note: If you are using only one insert, install the insert on the side where the calibration weight hangs.
3. Slide the insert up and into the test chamber. Begin the insertion between the pressed in nuts on the bottom of the test chamber.

4. Angle and rotate the insert as you slide it into place against the wall of the test chamber.



5. Secure the insert with four hex-drive, socket-cap screws (¼-20 x 0.5 in.).
6. Repeat this procedure to install a second insert on the other side of the chamber.

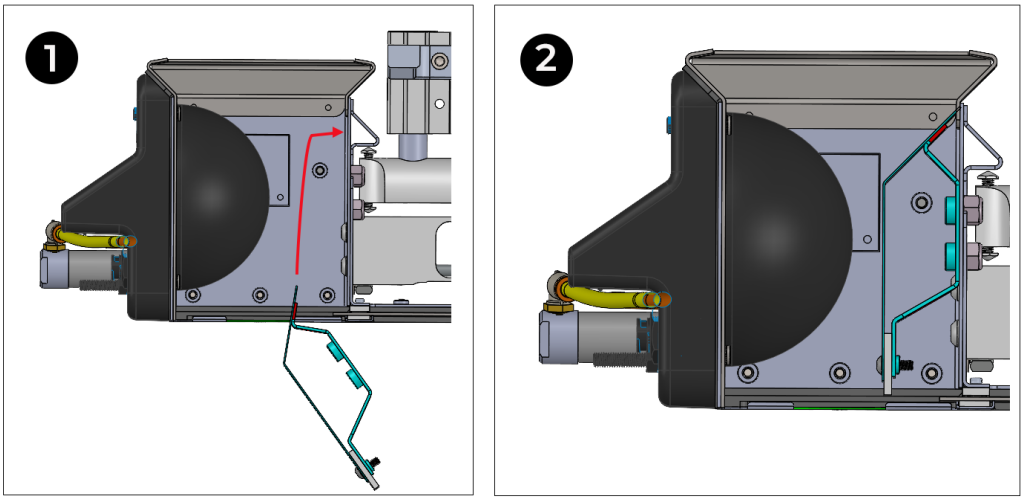
2.6.2 Add a Low Yield Insert with the SCiO Sensor (H3 Only)

With the SCiO Sensor, you can install one low yield insert in the test chamber on the side opposite the SCiO Sensor. The holes in the test chamber for the low yield insert are plugged by a metal plate with four hex nuts.

To install the low yield insert,

1. Open the bottom gate.
2. Remove the low yield plug plate from the wall of the test chamber opposite the SCiO Sensor.
3. Slide the insert up and into the test chamber. Begin the insertion between the pressed in nuts on the bottom of the test chamber.

4. Angle and rotate the insert as you slide it against the wall opposite the SCiO Sensor.



5. Secure the insert with four hex-drive, socket-cap screws (¼-20 x 0.5 in.).

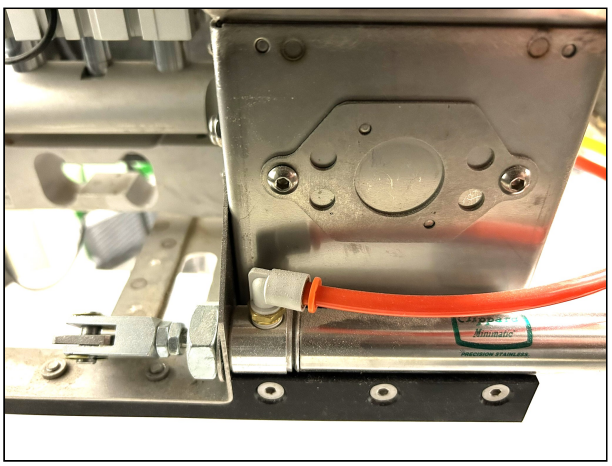
2.7 Change the Moisture Sensor (H3 only)

The H3 Twin GrainGage uses either a SCiO Sensor or an EM sensor for detecting moisture. The SCiO Sensor comes with the H3 Twin GrainGage, and the EM sensor can be purchased separately. Use the instructions below to change the moisture sensor installed in the H3 Twin GrainGage.

2.7.1 Install EM Moisture Sensor

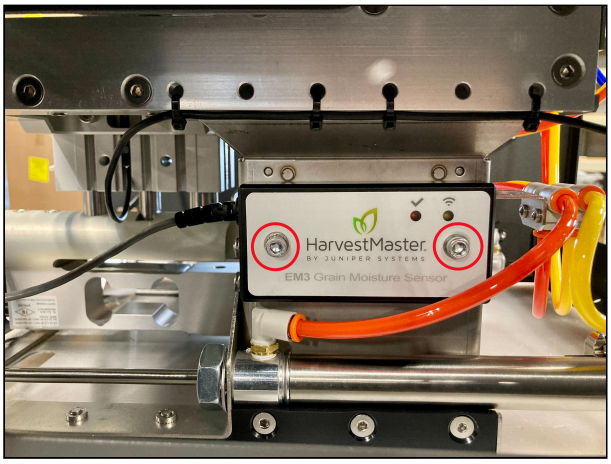
To install the EM sensor in the H3 GrainGage,

1. Remove the EM moisture sensor plug plate from the exterior of the test chamber. Save the plug plate and screws for future installation.

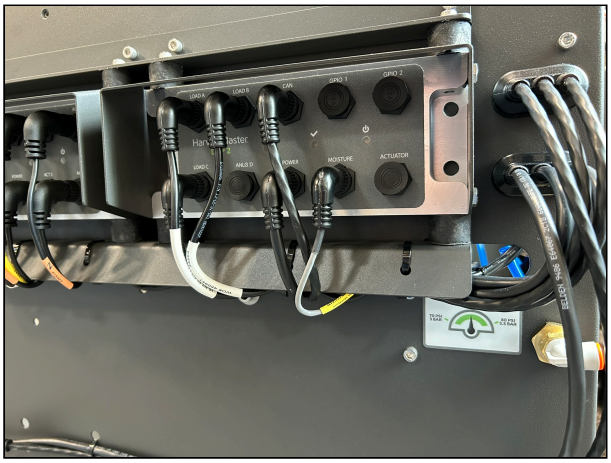


2. Insert the EM sensor into the opening on the test chamber. Ensure the label on the EM sensor is facing up.

3. Secure the EM sensor to the test chamber with two star washers and captive screws.



4. Route the EM sensor moisture cable along the GrainGage frame to the DSP module.
5. Attach the moisture cable to the DSP moisture port.

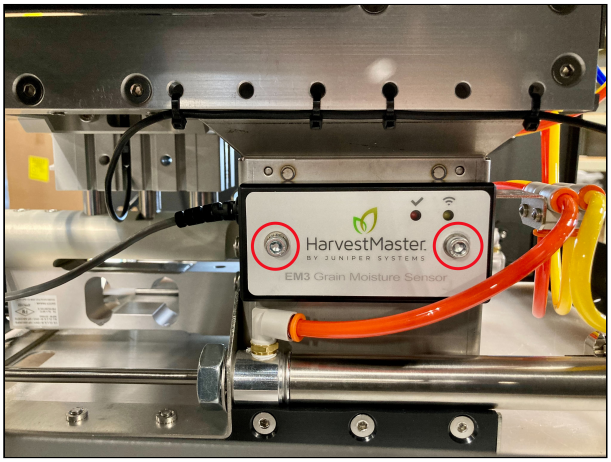


6. Use zip ties to secure the moisture cable to the GrainGage frame, as shown. For best results,
    - Leave enough slack in the moisture cable so that it does not pull on the test chamber and interfere with the weight measurement.
    - Ensure the moisture cable does not touch the bottom gate.

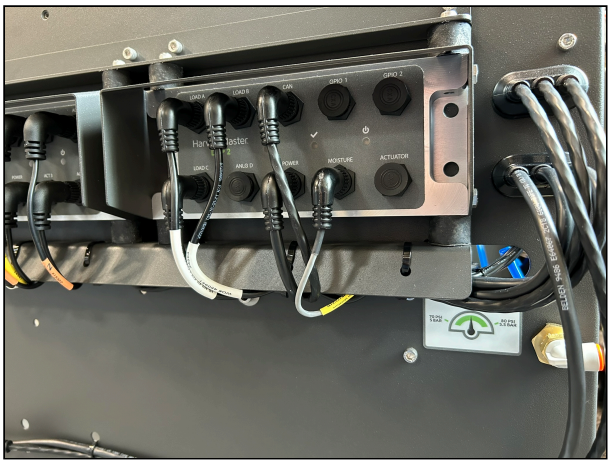
2.7.2 Remove the EM Sensor

To remove the EM sensor,

1. Remove the two star washers and captive screws that secure the EM sensor.
   Note: Save the washers and screws if you plan to reinstall the EM sensor in the future.

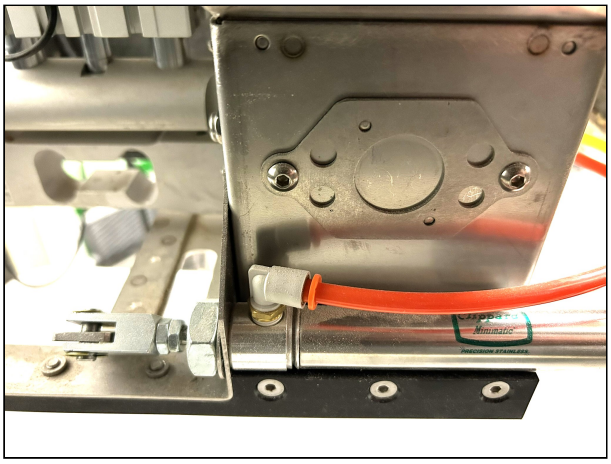


2. Remove the EM sensor.
3. Cut the zip ties securing the moisture cable to the GrainGage frame.
4. Disconnect the EM moisture cable from the DSP moisture port.



5. Cover the opening for the EM moisture sensor with the H3 moisture sensor plug plate (PN 31796). Attach it to the test chamber with two 8-32 x 3/16 SS button head socket

head cap screws.



2.7.3 Install SCiO Sensor

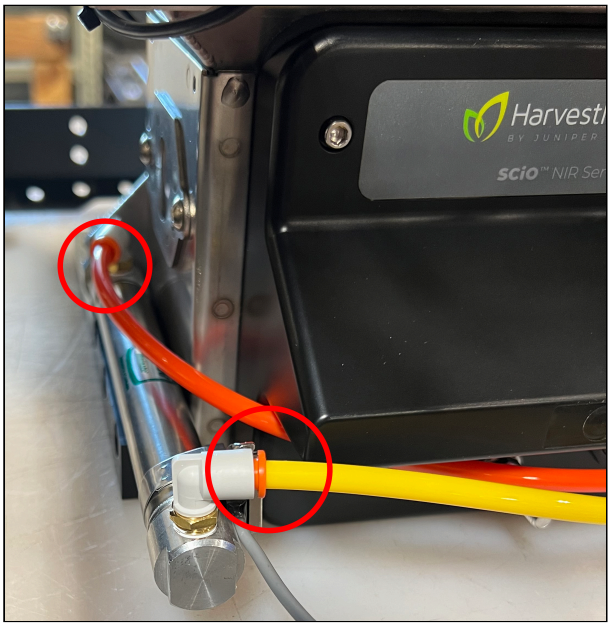
To install the SCiO Sensor in the H3 GrainGage,

1. Disconnect the orange and yellow air hoses from the left of the cylinder to give access to the SCiO Sensor mounting area.
2. Remove the four 8-32 x 3/16 SS button socket head cap screws securing the H3 SCiO hole plug plate (PN 31740) to the test chamber. Save the plug plate and screws for future installation.
3. Position the SCiO Sensor in the test chamber. For best results,
   - Match the top of the sensor to the top of the chamber opening.
   - Insert the sensor at a slight angle with the top of the sensor angled toward the opening.

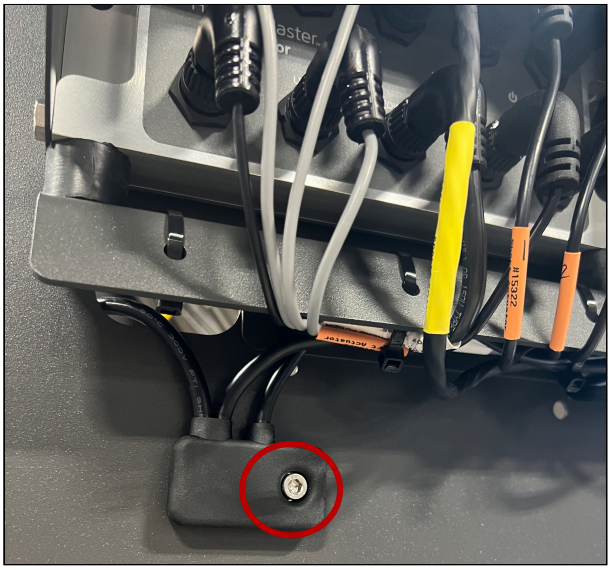
4. Tighten the four captive screws in the sensor, using a cross pattern.
   ⚠ CAUTION: The screws will still tighten even when misaligned, and it's not **always obvious.** If the sensor plastic is recessed or misaligned, loosen the four screws and realign.
5. Ensure the SCiO Sensor aligns properly with the test chamber from the inside. In proper alignment,
   - The square portion of the sensor inserts fully through the sheet metal.

- The sensor plastic is flush with the inside of the sheet metal. It is not recessed. There is no gap.

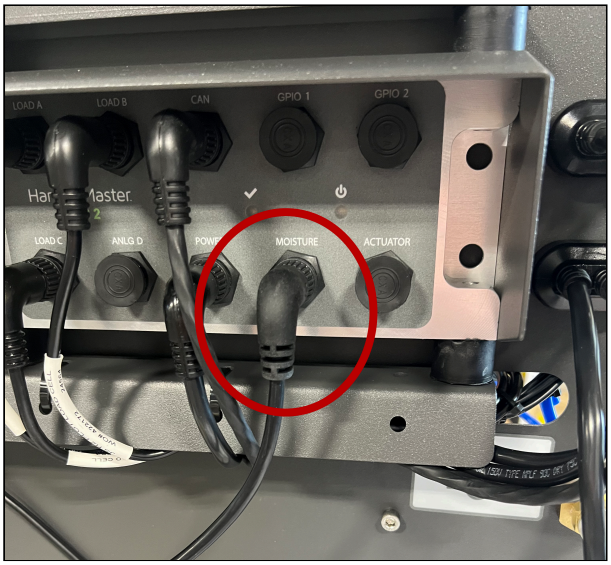
6. Connect the air lines to the left of the air cylinder.



7. If not installed, attach the SCiO cable assembly (PN 30712) to the outside of the GrainGage, using the 1/4–20x1/2 in. socket head cap screw and nylock nut.



8. Route the H3 SCiO cable into the GrainGage, and route the computer and DSP module cables under the cable rail.
9. Attach the moisture cable to the DSP moisture port.



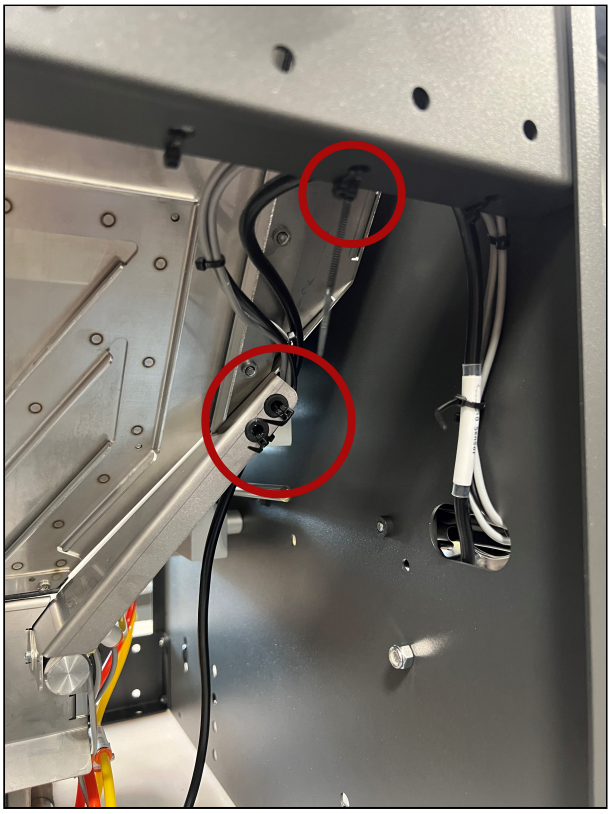
10. Position the computer cable end as needed. Shown in the image below inside the chassis.

11. Coil and secure the computer and moisture cables to the cable rail, using zip ties.

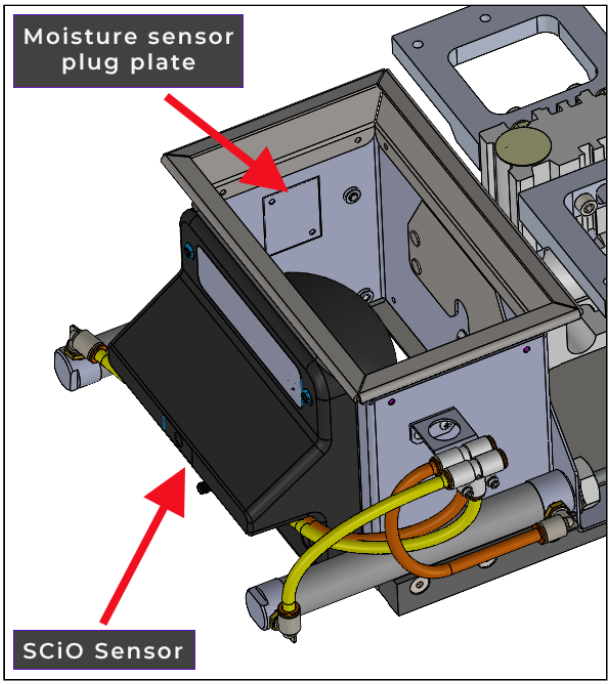
12. Attach the SCiO cable to the SCiO Sensor.

13. Secure the cable (as shown) with zip ties. Allow enough slack for the test chamber to cycle without stretching the cable. A strained cable could affect the accuracy of the test

weight.



14. If not installed, attach the H3 moisture sensor plug plate (PN 31796) to the exterior of the test chamber with two 8-32 x 3/16 SS button head socket head cap screws.

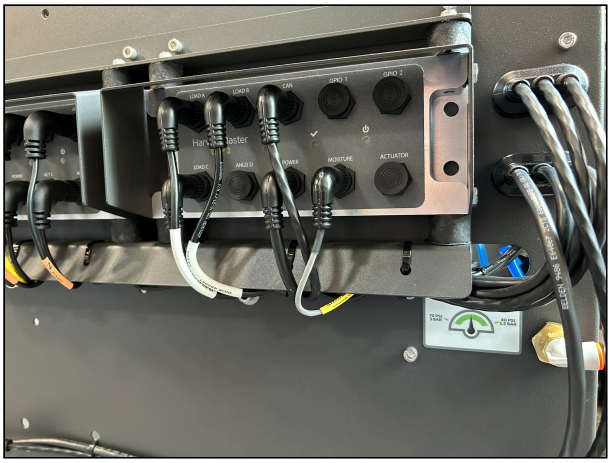


2.7.4 Remove the SCiO Sensor

To remove the SCiO Sensor,

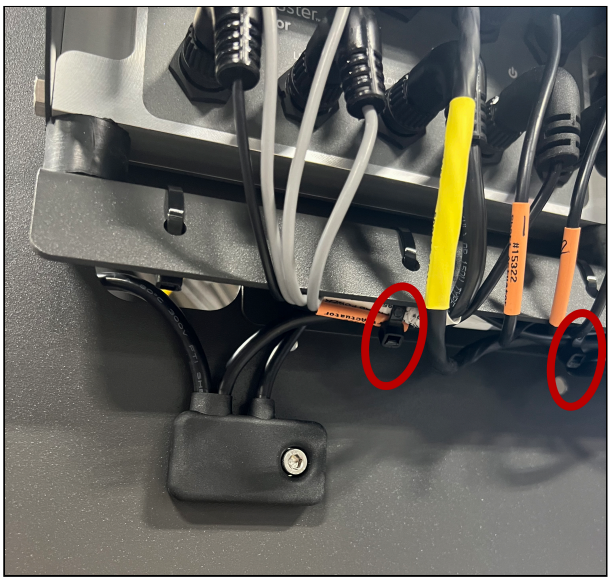
1. Disconnect the SCiO Sensor cable from the SCiO Sensor.

2. Disconnect the moisture cable from the DSP moisture point.

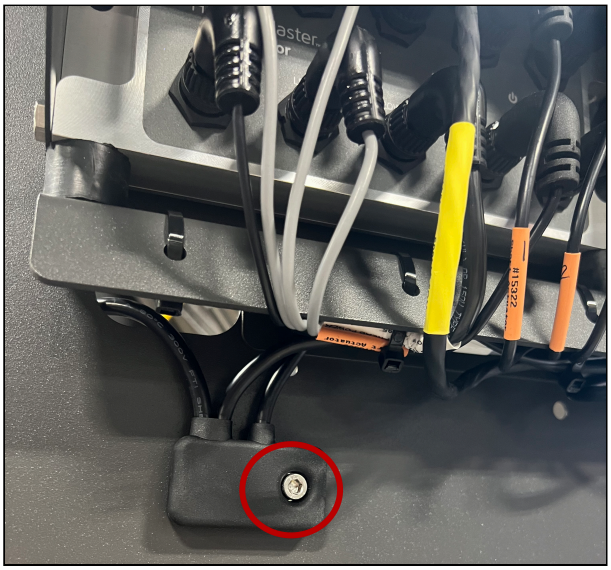


Note: If you will be reinstalling the SCiO Sensor at a later time, leave the SCiO moisture and computer cables routed along the chassis crossbar. Add zip ties as needed to hold the SCiO cables away from the weigh bucket and any moving components.

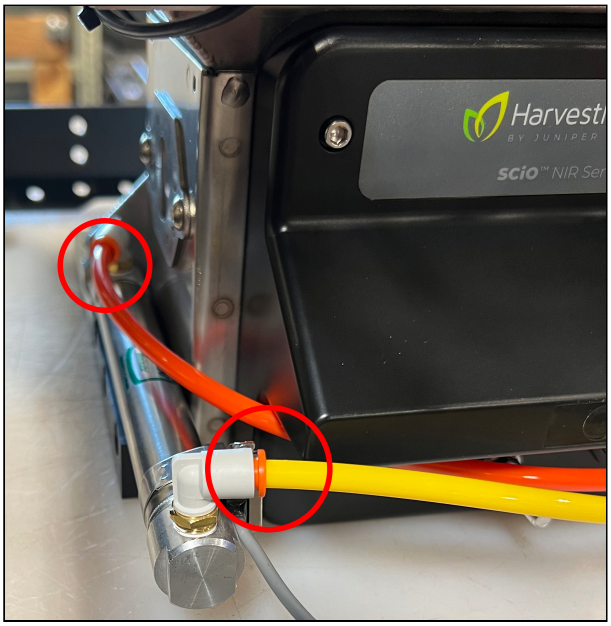
3. (Optional) Remove the SCiO moisture and computer cables by cutting all the zip ties holding it secure.



4. (Optional) Unscrew the 1/4–20x1/2 in. socket head cap screw and nylock nut that attaches the SCiO cable assembly to the outside of the GrainGage.

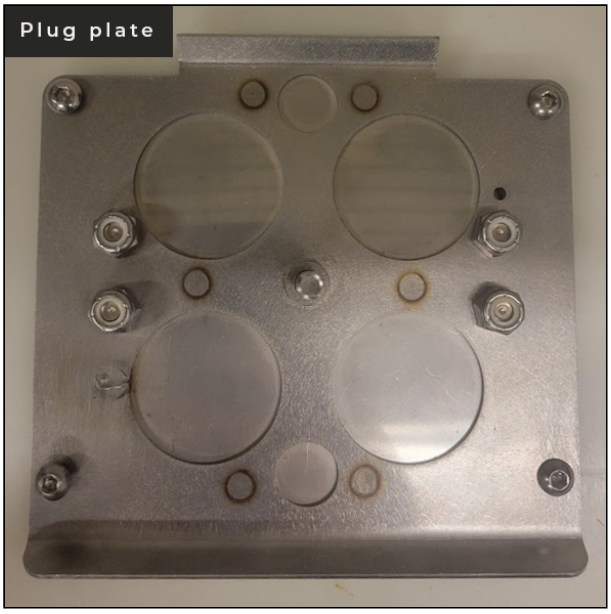


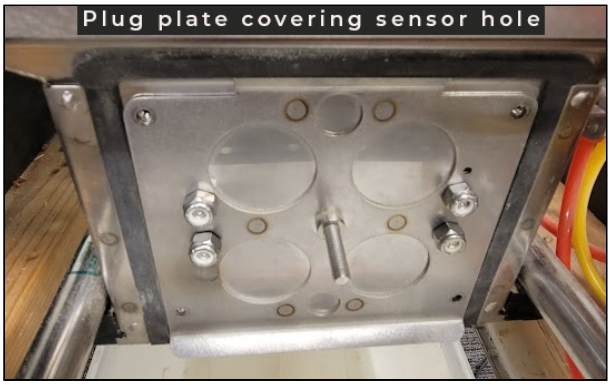
5. Disconnect the air lines to the left of the air cylinder.



6. Remove the four captive screws in the SCiO Sensor.

7. Remove the SCiO Sensor from the test chamber.
8. Cover the SCiO Sensor hole with the H3 SCiO hole plug plate (PN 31740). Attach it to the exterior of the test chamber with four 8-32 x 3/16 SS button head socket head cap screws.





9. Reconnect the air lines to the left of the air cylinder.

GrainGages™

H2/H3 Twin

CHAPTER 3

Inspect the GrainGage

3. Inspect the GrainGage

After you install the GrainGage system (and at the beginning of each harvest season thereafter), perform a mechanical inspection and check the system diagnostics in Mirus.

3.1 Perform a Mechanical Inspection

The inspection includes a mechanical validation of the GrainGage and an operational validation in Mirus.

Mechanical Validation

- Before using the system for the first time, ensure the shipping stops have been removed. (See Remove the Shipping Stops.)
- Check the plot bucket for proper alignment. Verify that it is resting on the load cells and weighing properly. (See Perform Daily System Checks.)
- Check all cables and electrical connections. Verify that they are secure and have not come loose.
- Inspect all cables for mice damage.
- Ensure the cables and hoses are securely tied on each side to minimize movement. Cables and hoses should not have any tight bends or kinks.
- Turn off the air and verify that all gates fully open and close at the end of the stroke. HarvestMaster recommends keeping some spare gate cylinders on hand for needed replacements.
- If you are using the EM sensor, clean the EM moisture blade.
- If you are using the SCiO Sensor, clean the glass dome on the SCiO sensor with glass cleaner and a non-abrasive microfiber cloth.
- Turn on the air and set the regulator to 80 psi. (The system supports air pressure between 75–85 PSI.) Check for air leaks throughout the system while opening and closing the gates.
- Ensure all actuators operate normally and cycle smoothly.
- Make sure the separator cup moves up and down freely.
- Clean the actuator slide rods with a damp cloth. Do not lubricate or clean the actuator slide rods with WD-40 or other penetrating lubricants. This can degrade the internal seals.

Operational Validation

Check the following weight and moisture calibrations in Mirus.

- Slope and motion
- Weigh bucket
- Test weight load cell
- (Option) SCiO NIR Sensor self test
- Moisture chamber

For detailed instructions, refer to the *Mirus for H2 Twin GrainGage User Guide*.

3.2 Check the Diagnostics in Mirus

As part of the initial GrainGage setup (and periodically thereafter), use Mirus Diagnostics to manually check the weight, moisture, test weight, and actuator diagnostics. For information on diagnostics in Mirus, refer to "GrainGage Diagnostics & Alerts" in the *Mirus for H2 Twin GrainGage User Guide*.

GrainGages™

H2/H3 Twin

CHAPTER 4

Maintain the GrainGage

4. Maintain the GrainGage

Regular maintenance ensures your GrainGage continues to operate efficiently. The following sections outline essential maintenance tasks.

4.1 Clean and Maintain the System

Periodic cleaning and regular maintenance of your GrainGage will assure excellent performance. HarvestMaster field technicians and engineers can come to you and perform a full system calibration and inspection before the harvest season begins.

To clean and maintain the GrainGage,

- Perform daily system checks before you begin harvesting.
- Perform system cleaning and protective measures at the end of season.
- About a month before the harvest season, perform (or have a HarvestMaster Field Engineer perform) a thorough system inspection, which includes checking all cables for mice damage, replacing worn parts, calibrating the system, and checking the measurement diagnostics in Mirus. (See Inspect the GrainGage.)
- If using a SCiO Sensor, perform a SCiO NIR Sensor Self Test in at the beginning and middle of each harvest season. (Refer to "SCiO NIR Sensor Self Test" in the *Mirus for H2 Twin GrainGage User Guide*.

For optimum system service and longevity, HarvestMaster offers service plans.

4.2 Perform Daily System Checks

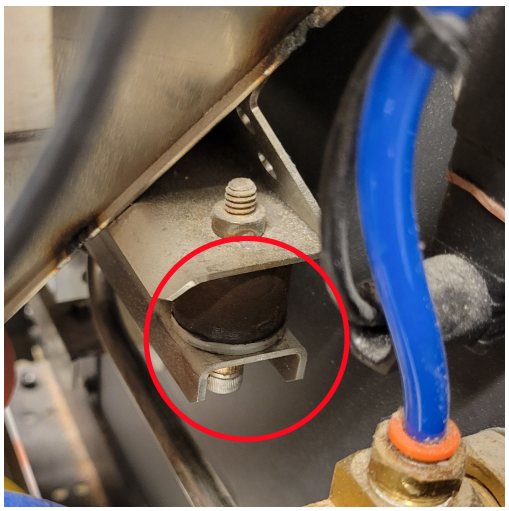
Perform the following system checks before each use of the GrainGage.

4.2.1 Inspect Cables and Air Supply Tubing

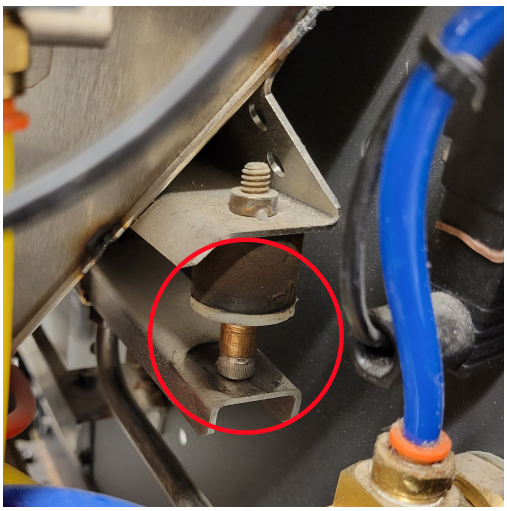
Remove the rear chassis door to view the pneumatic air valves and cylinders. Ensure the cables and air tubing do not interfere with the slide gates or test chamber. Ensure the air supply tubing and instrumentation wiring between the chassis and the test chamber do not rub on anything when the door is in place.

4.2.2 Check Plot Bucket Alignment

Ensure the four plot bucket anchor pins are aligned through the load cell support frame (two resting points above each load cell). Any bumps in the road during transport on a truck can move the hopper up and out of these supports. For accurate weight measurements, the plot bucket must be in its proper operating position.



Aligned



Misaligned

4.2.3 Clean the GrainGage

Use a pressurized air to blow off excess dust, chaff, or trash that has accumulated on all surfaces.

For debris/buildup that cannot be removed by pressurized air, use a grease removing dish soap, such as Dawn, and warm water. If you need something stronger, HarvestMaster recommends Extreme Simple Green Aircraft & Precision Cleaner, which is advertised as safe on metals, plastics, and rubber.

⚠ **CAUTION: Clean the air cylinder rods with a dry** lube only. Do not use dish soap or cleaner.

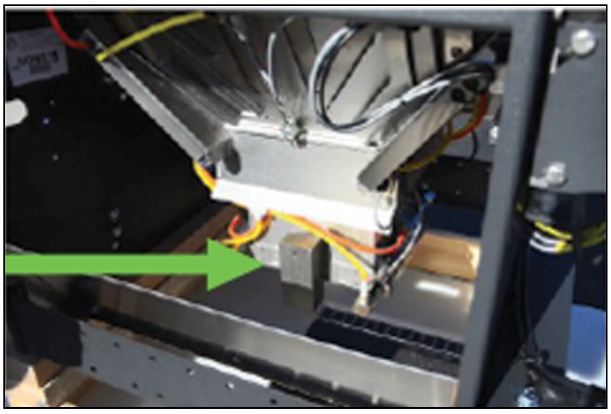
4.2.4 Check the Weigh Bucket

Use the calibration weight (included with your GrainGage system) to check the weigh bucket reading. The calibration weight is stamped with its value.

To check the weigh bucket reading and test the weight readings,

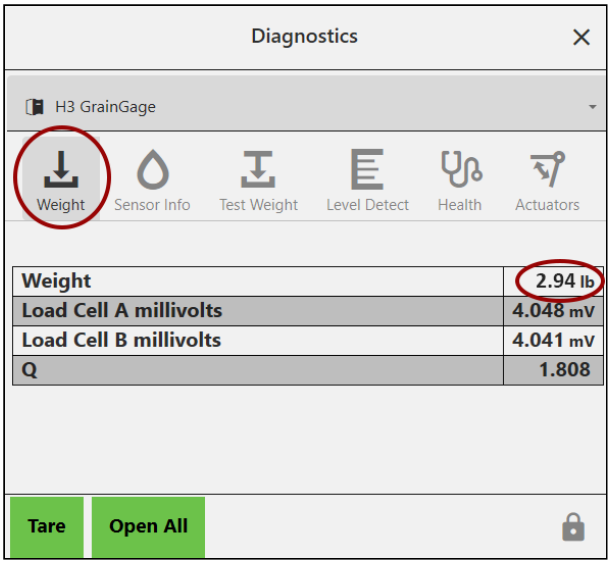
1. Turn off the combine engine.
2. If possible, slide the GrainGage out to access the bottom. If the bottom of the GrainGage is not accessible, remove the GrainGage access panel on the air supply side.
3. Close the top and bottom slide gates.
4. Place the larger calibration weight inside the weigh bucket.

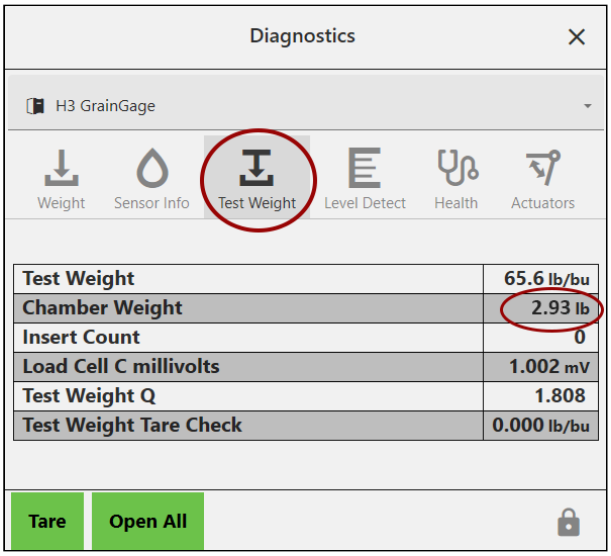
If the top of the weigh bucket cannot be easily accessed, hang the smaller calibration weight from the weight hanger on the test chamber.



5. Open the Diagnostics screen in Mirus.
6. Compare the weight on the Weight tab to the chamber weight on the Test Weight tab.

   The two values should be within 0.02 lb (.01 kg) of the weight stamped on the calibration weight, indicating that the system is operating within the specified range. With the combine engine and thresher running, the weight and chamber weight should be within 0.05 lbs (.023 kg) of the calibration weight.





7. If the reading is outside of this range, do the following:
   - Press down on the plot bucket and then release. The weights should return to within 0.05 lbs (.023 kg). Lift up the test chamber and then release. The weights should return to within 0.05 lbs (.023 kg).
   - Look for objects interfering with the movement of the plot bucket. Check for cables or air lines that may need to be re-tied. Ensure the bucket is in the tracks and not rubbing.

   Note: If the weight readings are drifting, the load cell may be bad.
8. If needed, re-calibrate the slope and motion, weight, and test weight. See "Calibrate Test Weight" in the Mirus for GrainGage user manual.

For additional assistance, call HarvestMaster customer support.

4.2.5 Clean the Glass Dome for the SCiO Sensor

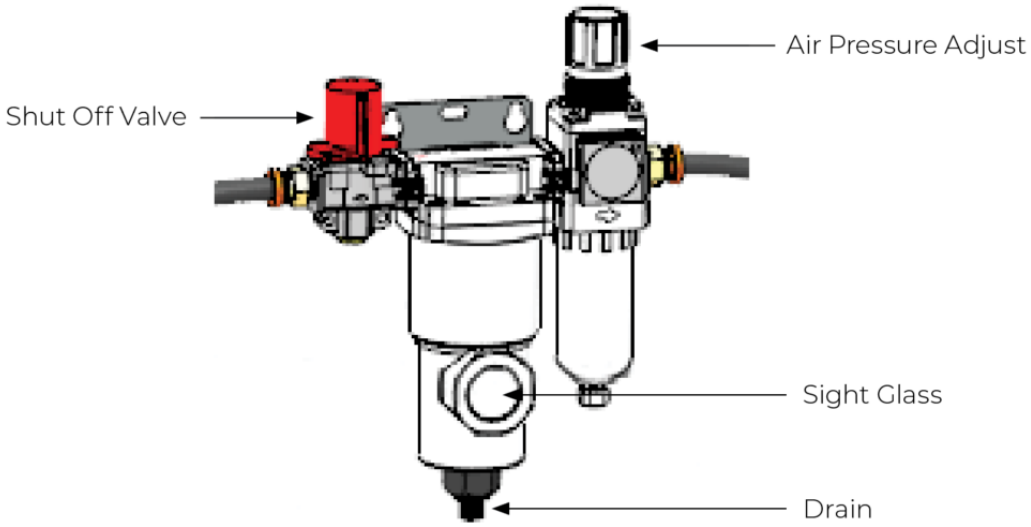
If applicable for your model, clean the glass dome on the SCiO Sensor with glass cleaner and a non-abrasive microfiber cloth.

4.2.6 Drain the Pneumatic Air Prep (Regulator)

At the end of each harvest day, drain the pneumatic air prep (regulator).

To drain the pneumatic air prep,

1. Twist open the drain located on the bottom of the pneumatic air prep.
2. Let the collected fluid drain out.
3. Twist the drain closed.



Note: To adjust the air pressure, pull up and turn. To adjust the shut off valve, press down and turn.

4.3 Perform End-of-Season Maintenance

After the end of the harvest season, complete the following tasks to prepare your system for storage.

- Clean the entire GrainGage, including the gates and slides, with high pressure air.
- Check the battery and system power cables. Clean and replace if necessary.
- If using the EM sensor, clean the EM moisture blade.
- If using the SCiO Sensor, clean the glass dome on the SCiO Sensor with glass cleaner and a non-abrasive microfiber cloth.
- Inspect rubber ISO mounts for cracks or damage. Replace if necessary.
- Check and clean the intake filters for the compressor. HarvestMaster recommends changing the intake filters annually.
- Lubricate the gates with a dry film lubricant that is safe for Nitrile seals.
- Use products, such as paste, dryer sheets, or mothballs, to repel rodents from the equipment. Place odor repellents near the wiring harnesses inside the GrainGage and in the cab. Fresh Cab Rodent Repellent repels rodents and is safe for pets. Ensure these products are not placed in locations that could interfere with the GrainGage's operation.

4.4 Unplug Power Cable Before Welding or Jumping the Battery

To avoid damage, unplug the power cable for each GrainGage module and the system controller in the cab before welding on the combine or jumping/boosting the combine battery.

⚠ CAUTION: Although HarvestMaster electronics are protected against power overload, damage may occur if the modules and system controller are plugged in while welding on the machine or jumping the combine battery.

GrainGages™

H2/H3 Twin

CHAPTER 5

Replace Basic Parts

5. Replace Basic Parts

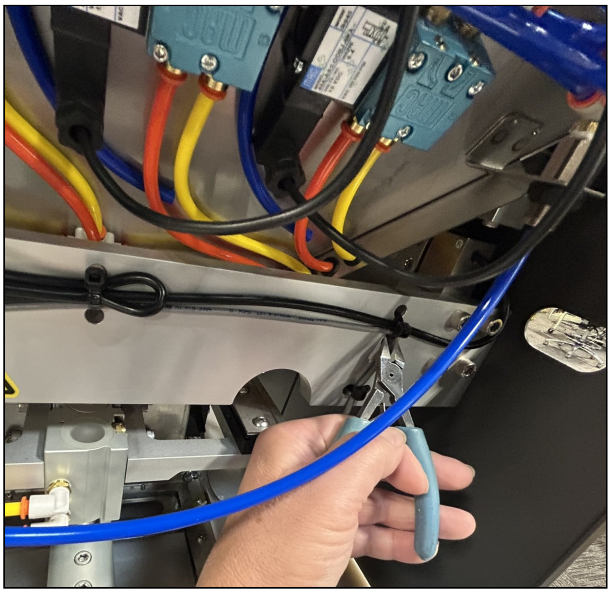
The following sections outline how to replace basic parts on the GrainGage.

5.1 Replace the Plot Bucket Load Cell

To replace the plot bucket load cell,

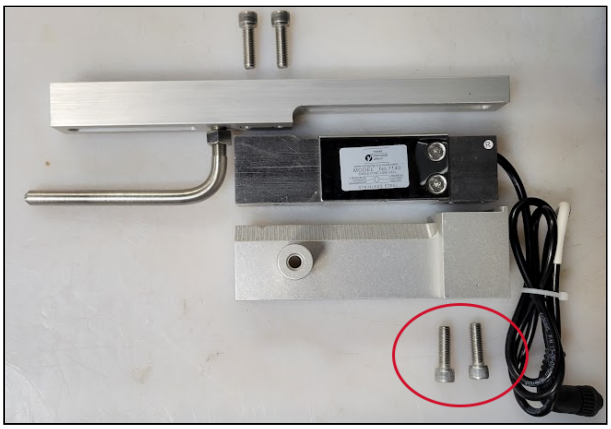
1. Check the voltage to locate the bad load cell.
   For information on checking voltages, see Diagnostics in Mirus.
2. Disconnect the load cell connector from the DSP module.

3. Cut the zip ties holding the load cell cords.

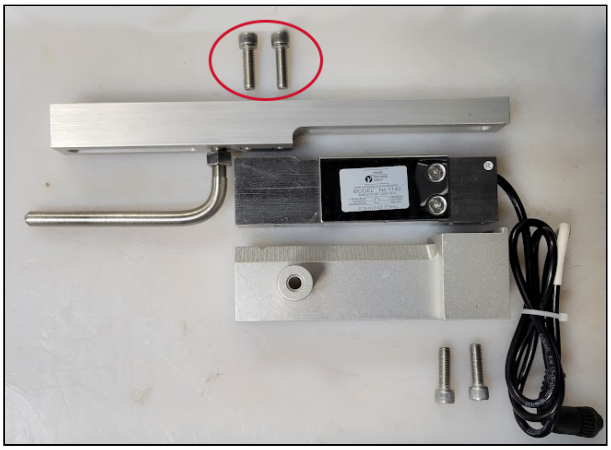


4. Lift the bucket out of the track using a ratchet strap to hold the bucket at least 1–2 inches off the load cell.

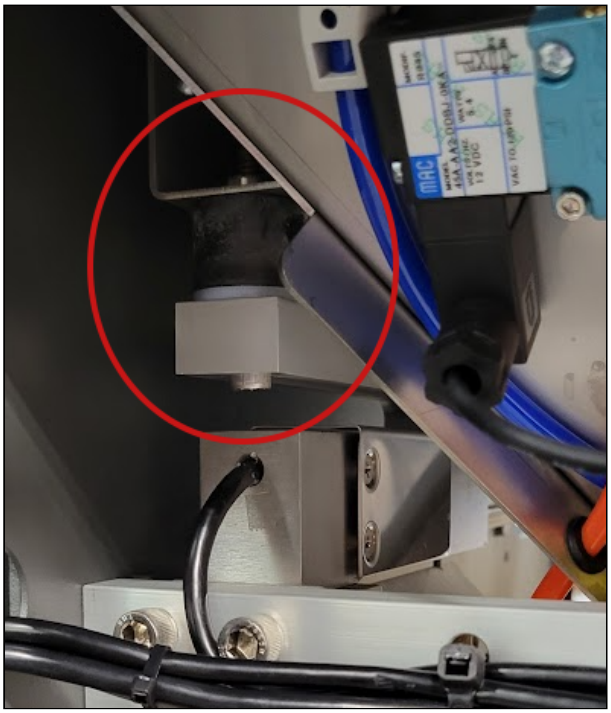
5. Use a 3/16 Allen wrench to remove the two cap screws from the bottom of the load cell. Remove the entire load cell assembly from the GrainGage (load cell and plot bucket track).



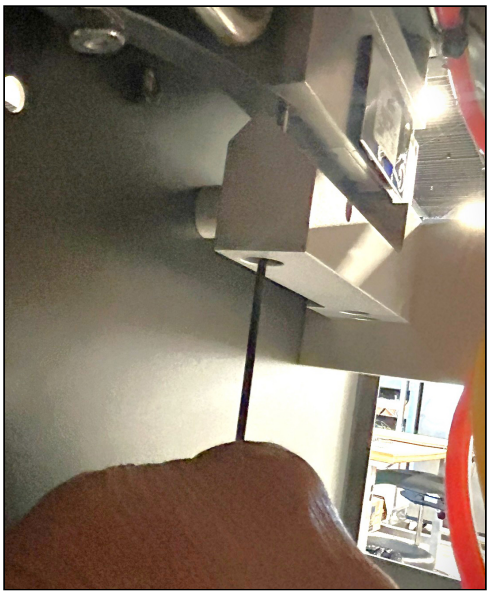
6. Remove the two cap screws from the top side of the bucket track with the 3/16 Allen wrench.

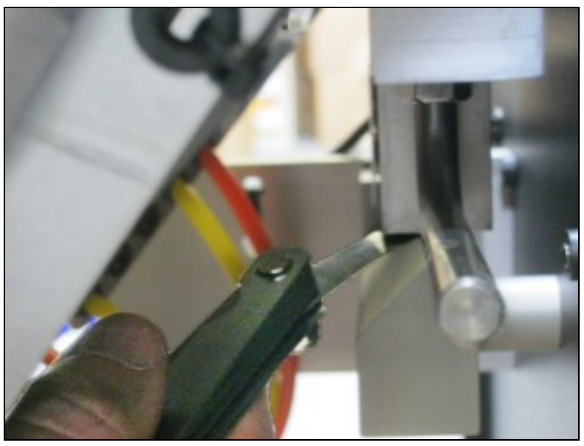


7. Remove the load cell.
8. Insert the new load cell. Apply Loctite 243 to the threads of the two button head screws and tighten the cap screws from the top of the bucket track. Ensure the track and load cell are aligned.
9. Apply Loctite 243 to the threads of the two button head screws and tighten the cap screws into the bottom of the load cell. Ensure everything is aligned, and the bucket is in the track.



10. Remove the ratchet strap and let the bucket rest on the load cells.
11. Use a 7/64 Allen wrench to set your overload protection screw, so it is snug on the .010 feeler gauge.





12. Plug the load cell cord into the port on the DSP module.

13. Route the load cell cables as they were originally installed before removing the load cell. Use zip ties to secure the load cell cables. Clip the end of the zip ties.

Note: Only secure the black load cell cables with zip ties. Leave the air line cables untied to allow unrestricted movement.

14. Re-calibrate the weigh bucket. (Refer to the *Mirus for H2 Twin GrainGage User Guide*.)

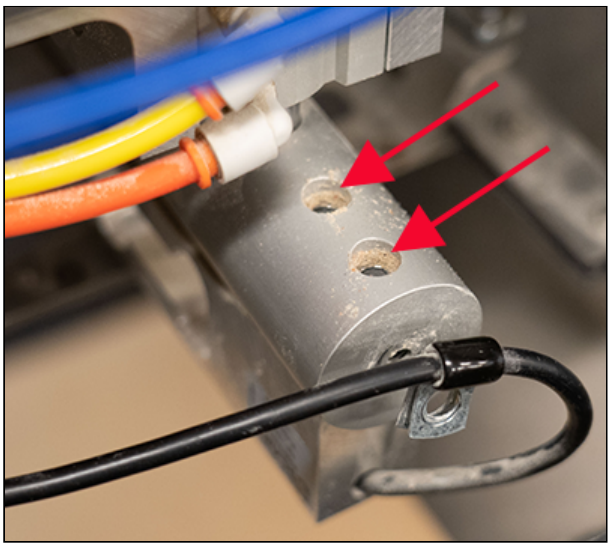
For additional assistance, contact a HarvestMaster Field Service Engineer.

5.2 Replace the Test Weight Load Cell

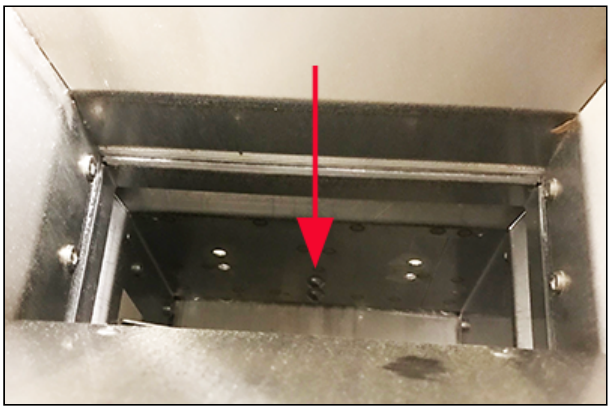
To replace the test weight load cell,

1. Use a 3/16 Allen wrench to remove the socket cap screw holding the load cell cable to the separator cylinder.

2. Use the same wrench to remove the two socket cap screws holding the separator cylinder and load cell together.



3. Turn off the GrainGage air and manually slide open the bottom gate.
4. For the H3 GrainGage, remove the SCiO Sensor. (For instructions, see Remove the SCiO Sensor.)
5. While supporting the test weight chamber, use a 5/32 Allen wrench to remove the two button head screws from inside the test weight chamber.

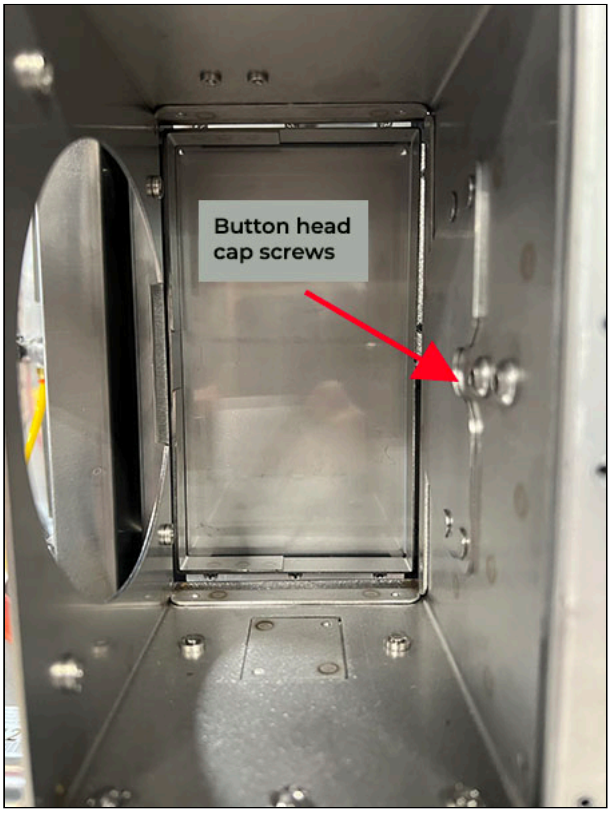


⚠CAUTION: Be careful not to round the screws. Clean the dirt from the head of the screws. If they are locked too tight, heat the screws with a small blow torch to loosen the Loctite®.

Note: The test weight chamber is now loose and must be supported with your hand or a zip tie.

6. Cut the zip ties that route the load cell cable to the DSP module.
7. Remove the load cell from the system.
8. Install the new load cell.
    a. Reinstall the two screws securing the separator cylinder to the load cell.
    b. Reinstall the screw securing the load cell cable to the separator cylinder.

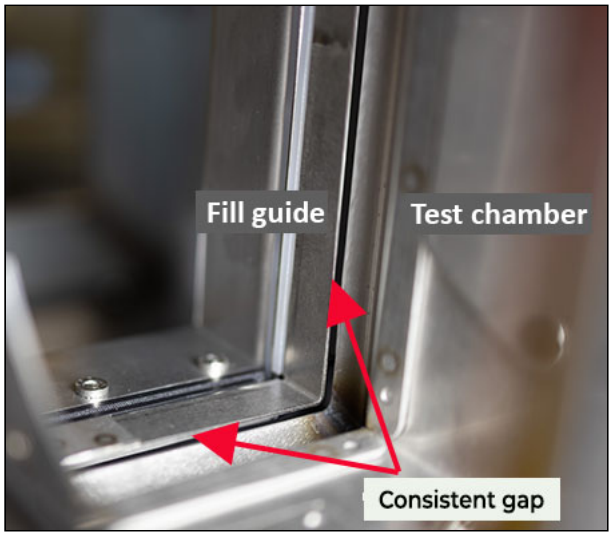
9. Apply Loctite 243 to the threads of the two button head screws. Hand tighten the screws.

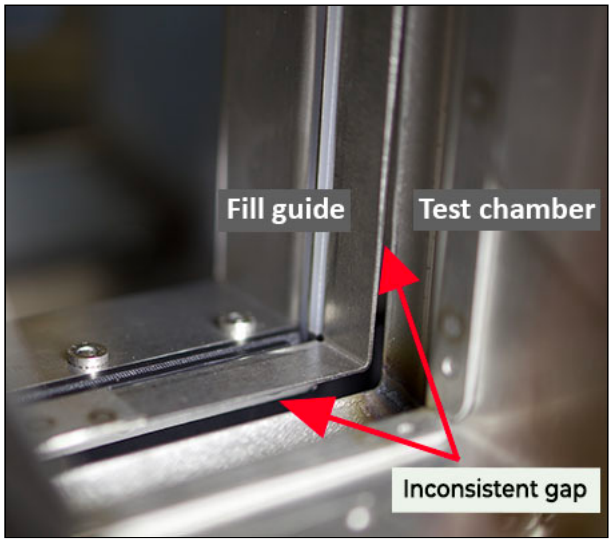


10. Check that new chamber is properly aligned.

    - The gap between the fill guide and the chamber is even and consistent. Check the gap when the chamber is in the down position.

- The chamber slides freely. It does not rub or bump.





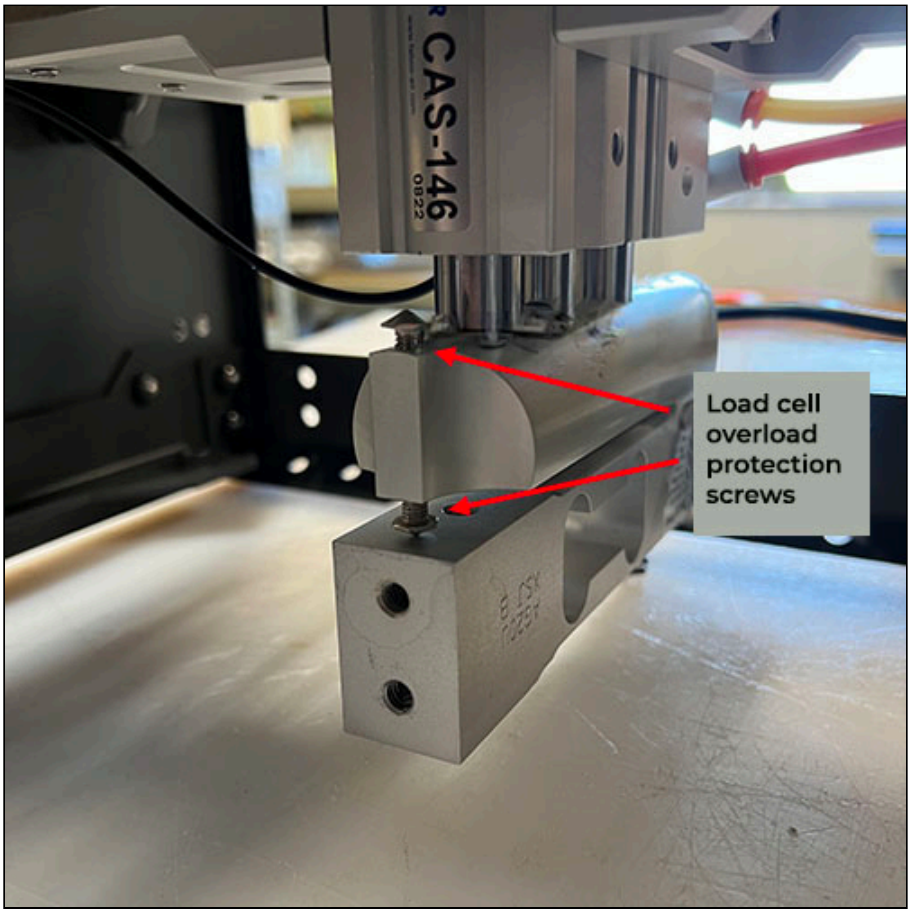
11. Tighten the button head screws securely.

    ⚠ CAUTION: Make sure the test chamber can slide up and down freely without contacting the fill guide.

    Note: It is possible to install the test chamber crooked enough that it will hit the fill guide when it raises. Lightly tighten the test chamber screws, ensure proper alignment, and then tighten the test chamber screws completely.

12. Route the load cell cable to the module as it was routed on the previous load cell.

13. Locate the two overload protection screws.



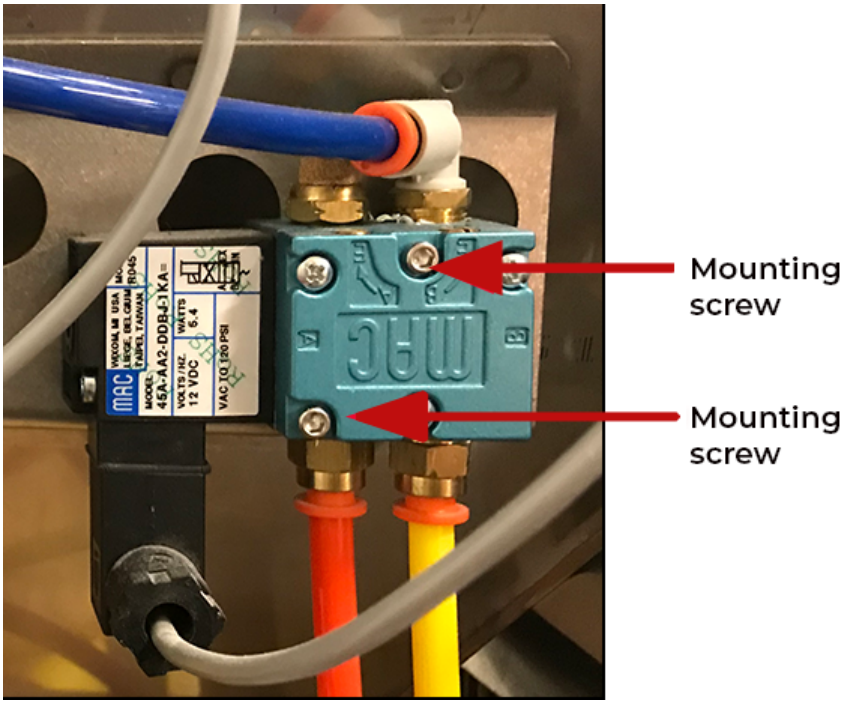
14. Adjust the overload stops to the following specifications:
    - Top screw: 0.009 in. gap
    - Bottom screw: 0.014 in. gap
15. Recalibrate the test weight load cell as outlined in the *Mirus for H2 Twin GrainGage User Guide*.

5.3 Replace the Solenoid

To replace the solenoid,

1. Turn off the air and power to the GrainGage.
2. Disconnect the airlines from the solenoid. Note the location of each color.

3. Remove the mounting screws with a 7/64 Allen wrench.



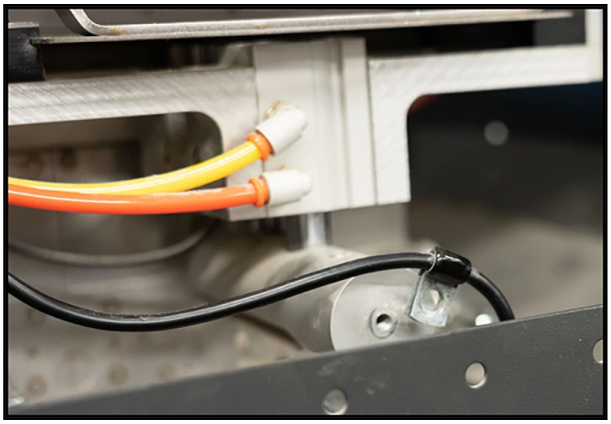
4. Disconnect the cable by removing the cable screw underneath the black cable box and unplugging the cable.

5. Plug the cable connector into the new solenoid and tighten the cable screw.
6. Secure the new solenoid in place with the mounting screws.
7. Reconnect the airlines.
8. Turn on the air and power to the GrainGage.

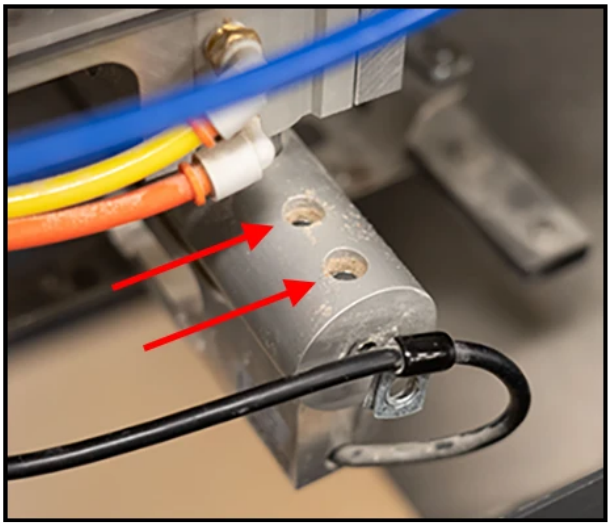
5.4 Replace the Test Weight Separator Cylinder

Remove the Faulty Cylinder

1. Remove the load cell wire support socket cap screw with the 3/16 Allen wrench.

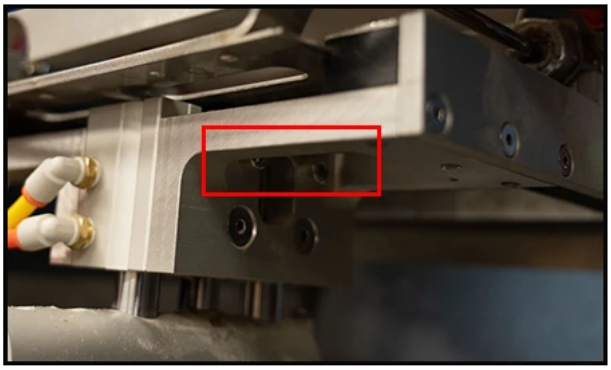


2. Remove the socket cap screws that attach the load cell to the support arm.

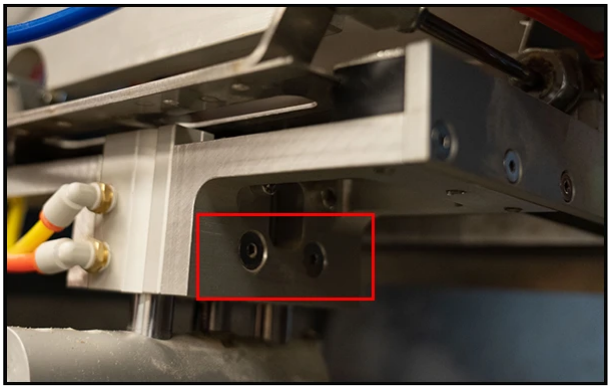


Note: The test weight chamber will drop down when the load cell socket cap screw is removed. Support the test weight chamber so that it does not hang on the load cell and limit switch wires.

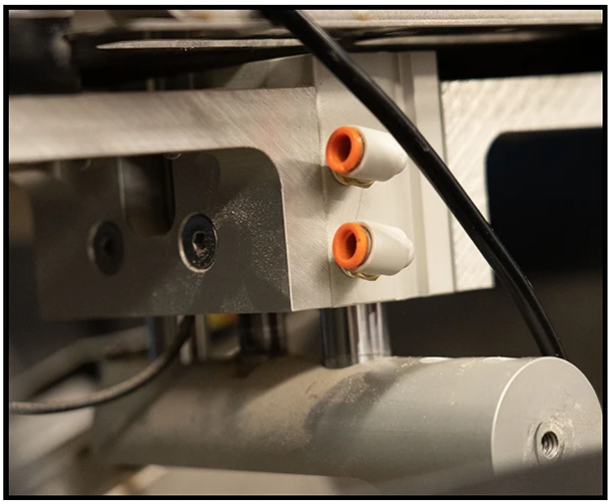
3. Remove the two socket cap screws on either side of the separator cylinder supports with the 3/16 Allen wrench.



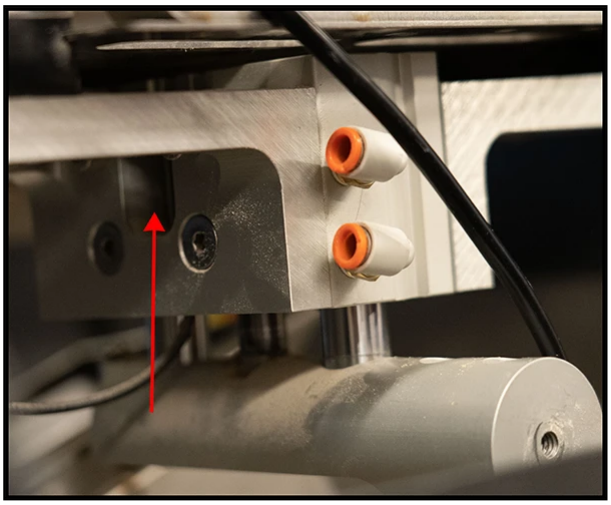
4. If the bracket has two countersunk Allen screw on each side of the separator, remove the screws with the 5/32 Allen wrench.



5. Detach the air hoses by compressing the orange collar and pulling out the hose. Note the location of each color.



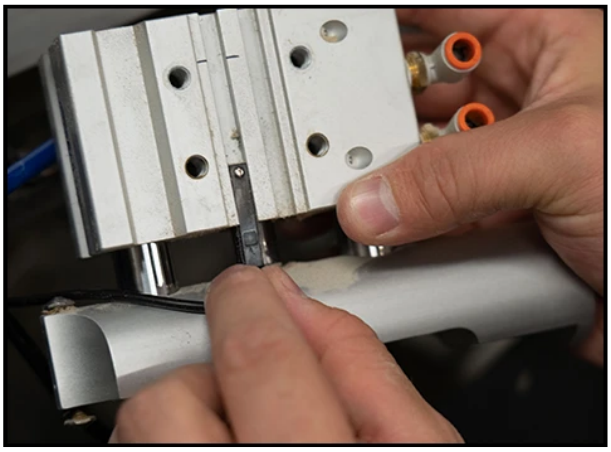
6. Lower the separator cylinder from the supports and loosen the limit switch sensor with the small 1.8 mm flathead screwdriver. Extend the separator cylinder to fully release the sensor from the cylinder.



Note: Pay attention to the orientation of the limit switch sensor, including which side the sensor is on and which channel the sensor is in.

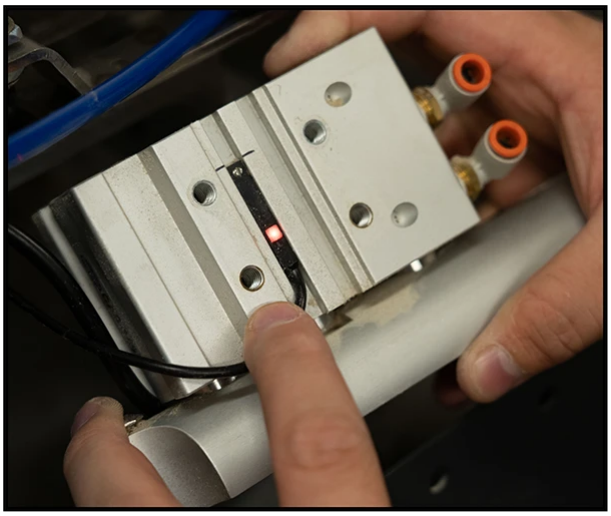
Install the New Cylinder

1. Turn on the GrainGage console.
2. Extend the new separator cylinder and slide the limit switch into the channel.
3. Retract the separator cylinder.



With the GrainGage power on, the red LED will light up when sliding the sensor up and down in the channel.

4. Put the sensor in the middle of the lit-up range and tighten securely with the small flathead screwdriver.
5. Apply medium strength Loctite to all four threaded holes on both sides of the separator cylinder.



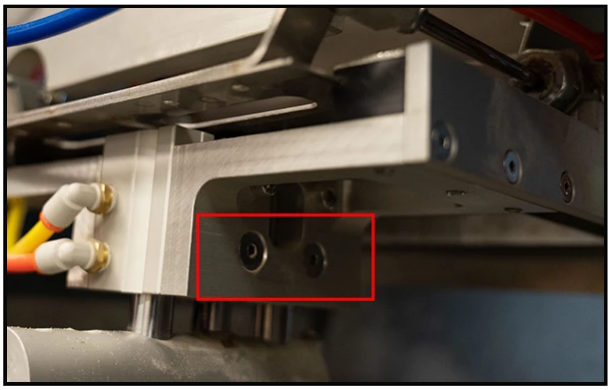
6. Raise the separator cylinder carefully between the support brackets from the bottom of the brackets up.

7. Reinstall the two socket cap screws on each side of the separator cylinder.

8. Reinstall the two countersunk Allen screws on each side of the separator cylinder.

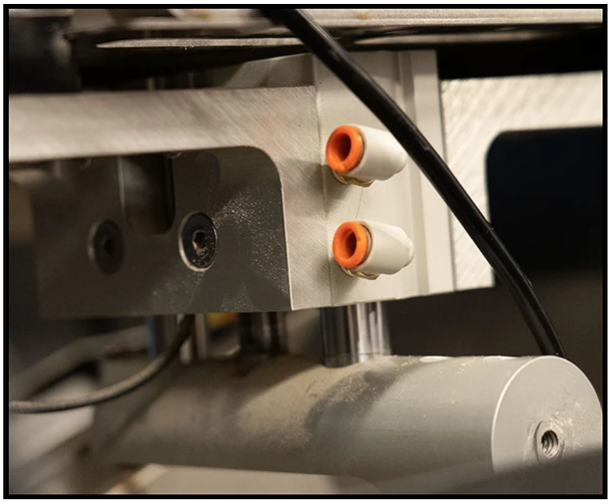
   Note: Tighten the countersunk Allen screws before tightening the socket cap screws to align the separator into place.

9. Apply non-permanent Loctite to the two threaded holes in the top of the load cell and raise the test weight chamber back into place. It may take a little work to get the weight chamber into place on top of the overload protection screws in the load cell support arm.

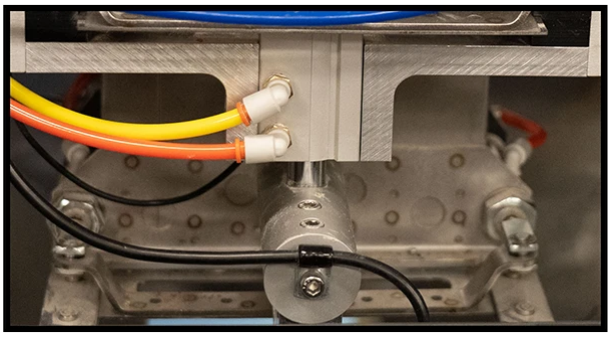


10. Reinstall the two socket cap screws through the support arm into the load cell and tighten.

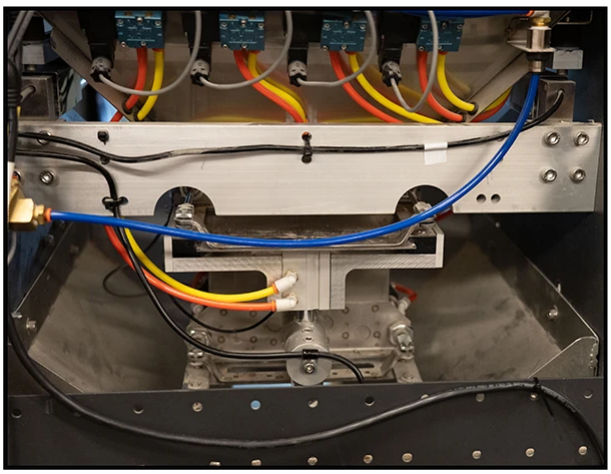
11. Apply medium strength Loctite to the threaded hole at the end of the load cell support arm.



12. Reattach the load cell wire support hanger with the socket cap screw.
13. Reattach the air hoses.



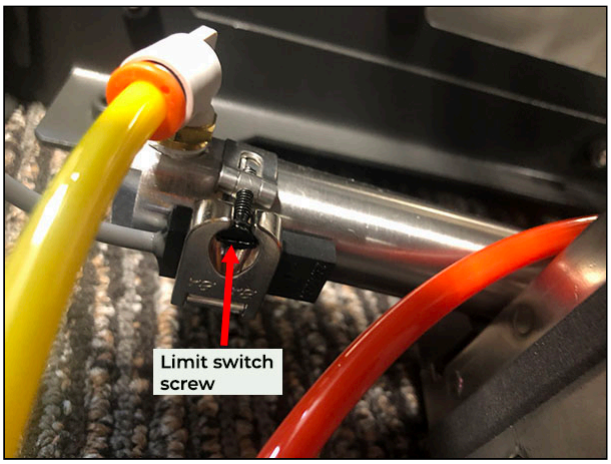
14. Adjust the overload protection screws, using the 5/16 wrench with the feeler gauge to a .009 gap on the top of the overload screw followed by a .014 gap on the bottom overload screw by the load cell.
15. Verify that the new separator cylinder operates smoothly.



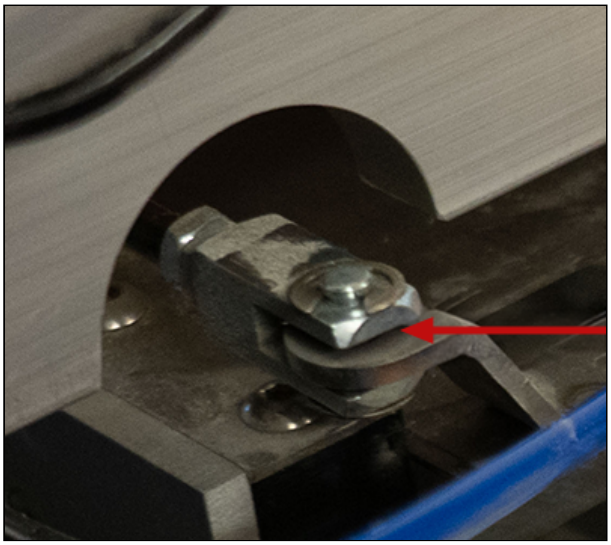
5.5 Replace the Gate Air Cylinders

To replace the gate air cylinders,

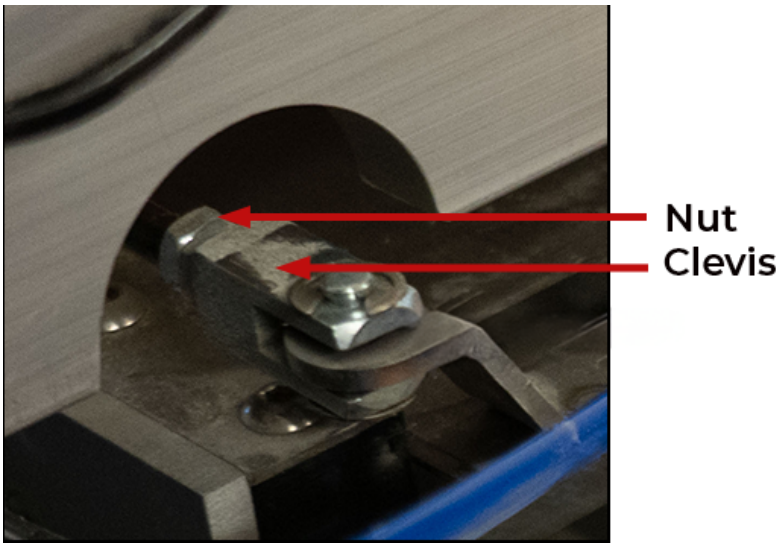
1. Turn off the air and power.
2. Disconnect the airlines to the desired cylinder. Note the location of each color.
3. Remove the screw on the limit switch and mounting bracket. Set the screw aside.



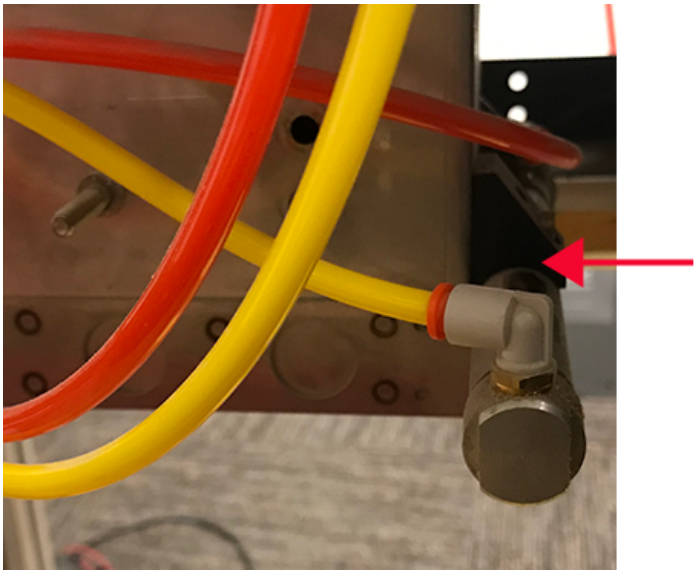
4. Remove the snap ring and retaining pin that holds the air cylinder clevis to the slide gate.



5. From the open access panel, hold the nut with a 7/16 wrench and use another 1/2 wrench to remove the clevis from the cylinder rod.

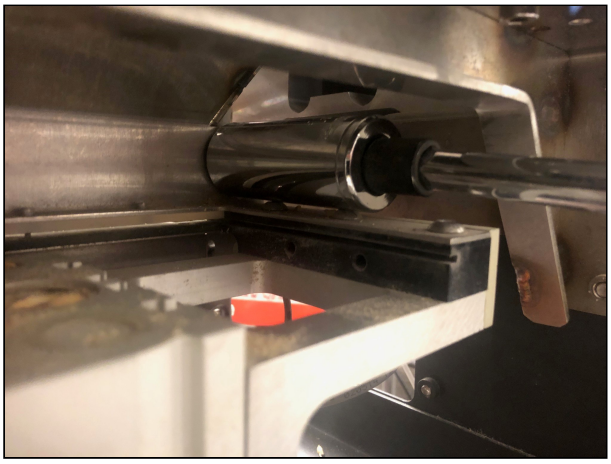


6. Remove the remaining nuts with the 7/16 wrench.
7. Remove and discard any black retainer blocks from the cylinder. Plug the hole with a shorter bolt.



8. Use a 5/8 wrench to hold the back of the cylinder while using a 5/16 deep socket and extension to remove the large nut securing the cylinder.

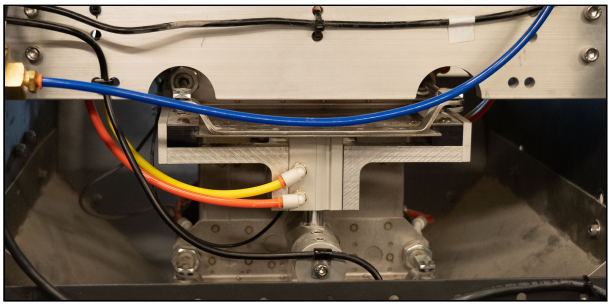
9. Remove the cylinder.



10. Remove the NPT fittings (air fittings) from the old cylinder and install the fittings on the new cylinder. Use Teflon tape to seal the threads.
11. Install the two 1/4 inch nuts and clevis on the new cylinder rod. Tighten the nuts to the end of the threads on the rod.
12. Slide in the new cylinder and position it so that the air inlet/outlet matches the position of the old cylinder.
13. Tighten the larger nut on the new cylinder with a 15/16 socket and extension while holding the back of the cylinder with 5/8 wrench.
14. Reattach the slide gate to the air cylinder clevis using the snap ring and retaining pin.
15. Reinstall the limit switch.

16. Adjust the gate cylinder limit switches. (See Adjust the Bottom Gate Limit Switch or Adjust the Top Gate Limit Switch.)

17. Reconnect the airlines and turn on the power and air to the GrainGage.



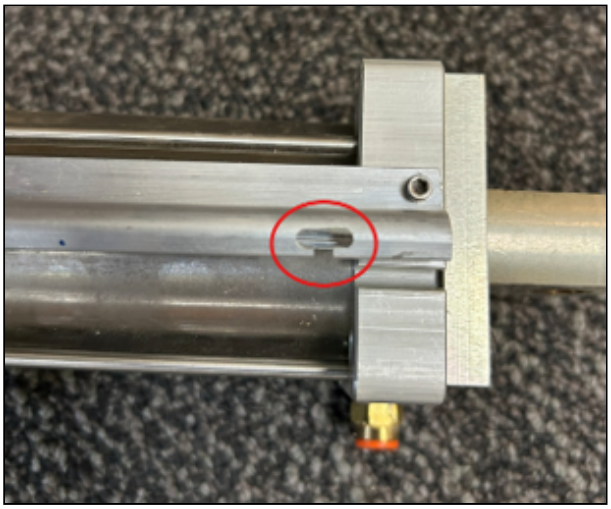
5.6 Replace a Twin Hopper Air Cylinder

To replace the left or right air cylinder,

1. Turn off the air and power to the GrainGage.
2. Disconnect the air lines to the air cylinder that you want replace by pressing the orange plastic tabs close to the cylinder while pulling on the hose. Note the location of each color.

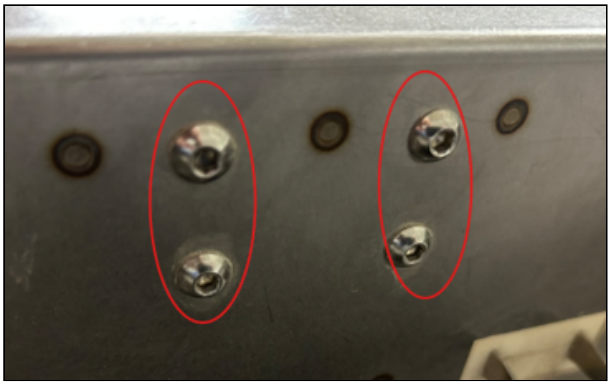
3. Loosen the screw on the limit switch and remove the limit switch from the mounting bracket by sliding it to the area where it can be removed. Set the screw and limit switch

aside.



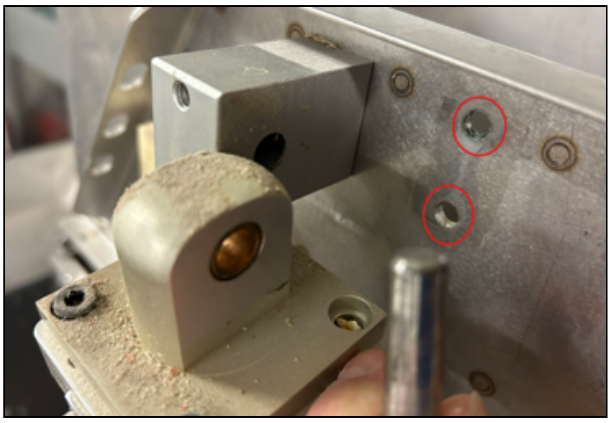
4. Remove the snap ring and retaining pin that holds the shaft of the air cylinder to the hopper door and set it aside.

5. Use the 5/32 in. Allen wrench to remove two screws from one of the aluminum blocks holding the cylinder in place. It does not matter which ones you choose.



⚠ CAUTION: Be careful to not round the screws. Clean the dirt from the screw heads. If the screws are locked too tight, heat the screw with a small blow torch to loosen the Loctite.

6. Remove the retaining pin and set all the parts inside.



7. Remove the NPT air fittings from the old cylinder and install the fittings on the new cylinder. Use Teflon tape to seal the threads.
8. Remove the clevis from the shaft end of the cylinder and install on the new cylinder.

9. Install the cylinder, reversing the order from the removal.
10. Adjust the limit switch. (See Adjust the Twin Hopper Limit Switch.)

5.7 Upgrade to SCiO NIR Sensor (H2 Only)

With the H2 NIR Upgrade Kit, you can replace the EM moisture sensor with an NIR sensor and convert an H2 GrainGage to an H3 with a few simple modifications. For instructions on upgrading to the NIR sensor, see H2 NIR Upgrade Installation Guide.

GrainGages™

H2/H3 Twin

CHAPTER 6

Obtain HarvestMaster Service Help

6. Obtain HarvestMaster Service Help

For technical questions or repairs, contact a HarvestMaster Field Service Engineer. In many situations, a HarvestMaster Field Service Engineer can resolve problems over the phone and even guide you in replacing parts.

USA	Europe
Web: www.HarvestMaster.com Email: support@HarvestMaster.com Phone: +1 (435) 753-1881	Web: www.HarvestMaster.eu Email: support@HarvestMaster.eu Phone: +43 724 221 9333

6.1 Add HarvestMaster Service Plans

The warranty covering the GrainGage protects against manufacturer's defects. In addition to the warranty, HarvestMaster offers service plans to help reduce downtime during the busy harvest season.

GrainGages™

H2/H3 Twin

CHAPTER 7

Standard Weight, Volume, and Moisture

7. Appendix A: Volume, Weight, and Industry Standard Values

7.1 Test Chamber Volume and Weight on H2

This table includes the chamber volume and minimum required test chamber weight including 20% head room for the H2 Twin GrainGage.

H2 Test Chamber Volume and Weight			
Crop	Number of Inserts	Volume	Minimum Weight
Canola 47 lb/bu (60 kg/hL)	0	142 in^3 (2325 cm^3)	3.72 lb (1.46 kg)
	1	113 in^3 (1850 cm^3)	2.96 lb (1.16 kg)
	2	84 in^3 (1375 cm^3)	2.20 lb (0.85 kg)
Soybeans 55 lb/bu (71 kg/hL)	0	142 in^3 (2325 cm^3)	4.35 lb (1.76 kg)
	1	113 in^3 (1850 cm^3)	3.46 lb (1.40 kg)
	2	84 in^3 (1375 cm^3)	2.58 lb (0.98 kg)
Wheat 60 lb/bu (77 kg/hL)	0	142 in^3 (2325 cm^3)	4.75 lb (1.84 kg)
	1	113 in^3 (1850 cm^3)	3.78 lb (1.46 kg)
	2	84 in^3 (1375 cm^3)	2.81 lb (1.05 kg)
Barley 48 lb/bu (61 kg/hL)	0	142 in^3 (2325 cm^3)	3.80 lb (1.72 kg)
	1	113 in^3 (1850 cm^3)	3.02 lb (1.37 kg)
	2	84 in^3 (1375 cm^3)	2.25 lb (1.02 kg)
Corn 56 lb/bu (72 kg/hL)	0	142 in^3 (2325 cm^3)	4.43 lb (2.01 kg)
	1	113 in^3 (1850 cm^3)	3.53 lb (1.60 kg)
	2	84 in^3 (1375 cm^3)	2.62 lb (1.89 kg)
Rye 56 lb/bu (72 kg/hL)	0	142 in^3 (2325 cm^3)	4.43 lb (2.01 kg)
	1	113 in^3 (1850 cm^3)	3.53 lb (1.60 kg)
	2	84 in^3 (1375 cm^3)	2.62 lb (1.19 kg)

Sorghum 56 lb/bu (72 kg/hL)	0	142 in^3 (2325 cm^3)	4.43 lb (2.01 kg)
	1	113 in^3 (1850 cm^3)	3.53 lb (1.60 kg)
	2	84 in^3 (1375 cm^3)	2.62 lb (1.19 kg)
Oats 32 lb/bu (41 kg/hL)	0	142 in^3 (2325 cm^3)	2.53 lb (1.15 kg)
	1	113 in^3 (1850 cm^3)	2.02 lb (0.92 kg)
	2	84 in^3 (1375 cm^3)	1.50 lb (0.68 kg)
Sunflower 25 lb/bu (32 kg/hL)	0	142 in^3 (2325 cm^3)	1.98 lb (0.90 kg)
	1	113 in^3 (1850 cm^3)	1.57 lb (0.71 kg)
	2	84 in^3 (1375 cm^3)	1.17 lb (0.53 kg)

7.2 Test Chamber Weight for SCiO Sensor on H3

This table includes the minimum required test chamber weight including 20% head room for the H3 Twin GrainGage with SCiO Sensor.

H3 Test Chamber Weight with SCiO Sensor		
Crop	Number of Inserts	Minimum Weight
Canola 47 lb/bu (60 kg/hL)	0	3.52 lb (1.60 kg)
	1	2.64 lb (1.20 kg)
Soybean 55 lb/bu (71 kg/hL)	0	4.12 lb (1.87 kg)
	1	3.09 lb (1.40 kg)
Wheat 60 lb/bu (77 kg/hL)	0	4.50 lb (2.04 kg)
	1	3.37 lb (1.53 kg)
Barley 48 lb/bu (61 kg/hL)	0	3.60 lb (1.63 kg)
	1	2.70 lb (1.22 kg)
Corn 56 lb/bu (72 kg/hL)	0	4.20 lb (1.91 kg)
	1	3.15 lb (1.43 kg)
Rye 56 lb/bu (72 kg/hL)	0	4.20 lb (1.91 kg)
	1	3.15 lb (1.43 kg)

Sorghum 56 lb/bu (72 kg/hL)	0	4.20 lb (1.91 kg)
	1	3.15 lb (1.43 kg)
Oats 32 lb/bu (41 kg/hL)	0	2.40 lb (1.09 kg)
	1	1.80 lb (0.82 kg)
Sunflower 25 lb/bu (32 kg/hL)	0	1.87 lb (0.89 kg)
	1	1.40 lb (0.64 kg)

7.3 Test Chamber Weight for EM Sensor on H3

This table includes the minimum required test chamber weight including 20% head room for the H3 Twin GrainGage with EM sensor.

H3 Test Chamber Weight with EM Sensor		
Crop	Number of Inserts	Minimum Weight
Canola 47 lb/bu (60 kg/hL)	0	4.04 lb (1.83 kg)
	1	3.12 lb (1.42 kg)
	2	2.20 lb (1.00 kg)
Soybean 55 lb/bu (71 kg/hL)	0	4.73 lb (2.15 kg)
	1	3.65 lb (1.66 kg)
	2	2.58 lb (1.17 kg)
Wheat 60 lb/bu (77 kg/hL)	0	5.16 lb (2.34 kg)
	1	3.98 lb (1.81 kg)
	2	2.81 lb (1.27 kg)
Barley 48 lb/bu (61 kg/hL)	0	4.13 lb (1.87 kg)
	1	3.19 lb (1.45 kg)
	2	2.25 lb (1.02 kg)
Corn 56 lb/bu (72 kg/hL)	0	4.82 lb (2.19 kg)
	1	3.72 lb (1.69 kg)
	2	2.62 lb (1.19 kg)

Rye 56 lb/bu (72 kg/hL)	0	4.82 lb (2.19 kg)
	1	3.72 lb (1.69 kg)
	2	2.62 lb (1.19 kg)
Sorghum 56 lb/bu (72 kg/hL)	0	4.82 lb (2.19 kg)
	1	3.72 lb (1.69 kg)
	2	2.62 lb (1.19 kg)
Oats 32 lb/bu (41 kg/hL)	0	2.75 lb (1.25 kg)
	1	2.12 lb (0.96 kg)
	2	1.50 lb (0.68 kg)
Sunflower 25 lb/bu (32 kg/hL)	0	2.15 lb (0.98 kg)
	1	1.66 lb (0.75 kg)
	2	1.17 lb (0.53 kg)

7.4 Test Chamber Volume for SCiO and EM Sensors on H3

This table includes the test chamber volume for the H3 Twin GrainGage with SCiO Sensor or EM sensor.

H3 Test Chamber Volume for SCiO and EM Sensors		
Number of Inserts	SCiO Sensor	EM Sensor
0	134 in³ (2200 cm^3)	154 in^3 (2525cm^3)
1	101 in³ (1650 cm^3)	119 in^3 (1950 cm^3)
2	n/a	84 in^3 (1375 cm^3)

7.5 Standard Moisture and Test Weight

Test weight should always be calibrated using a sample with a moisture content as close to the industry standard as possible. The table shows the industry moisture standards for some common grains.

Standard Moisture and Test Weight		
Grain	Moisture	Test Weight
Canola	8.5%	47 lb/bu (60 kg/hL)

Soybean	13%	55 lb/bu (71 kg/hL)
Wheat	13.5%	60 lb/bu (77 kg/hL)
Barley	14.5 %	48 lb/bu (62 kg/hL)
Corn	15.5%	56 lb/bu (72 kg/hL)
Rye	14%	56 lb/bu (72 kg/hL)
Sorghum	13%	56 lb/bu (72 kg/hL)
Oats	13.5%	32 lb/bu (41 kg/hL)
Sunflower	10%	25 lb/bu (32 kg/hL)

*These measurements are based on the United States (Winchester) bushel.

References for Standard Moisture and Test Weight

Devkota P., & Mulvaney M. J. (2020, May). Adjusting crop yield to a standard moisture content. IFAS Extension, University of Florida. https://edis.ifas.ufl.edu/pdf%5CAG%5CAG44200.pdf.

Isleib, J. (2012, August 6). Test weight in small grains. Michigan State University Extension. https://www.canr.msu.edu/news/test_weight_in_small_grains.

GrainGages™

H2/H3 Twin

CHAPTER 8

Troubleshooting

8. Appendix B: Troubleshooting

This chapter contains basic troubleshooting information and additional help can be found in the HarvestMaster knowledge base. Refer to Maintain the GrainGage for additional information on maintaining your system.

8.1 Troubleshooting SCiO Sensor (H3 only)

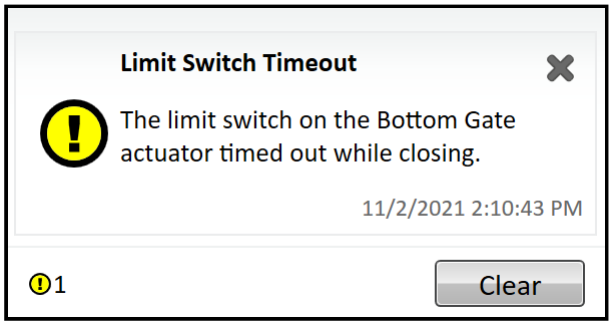
To troubleshoot the SCiO Sensor,

- Check the SCiO glass dome for damage.
- Clean the SCiO glass dome with glass cleaner and a microfiber cloth.
- Ensure the SCiO serial to USB cable (PN 31517) and the SCiO Sensor junction cable (PN 30712) are undamaged and properly connected between the GrainGage and rugged tablet.
- Ensure the SCiO Sensor junction cable (PN 30712) is properly routed to the SCiO Sensor and does not impede the movement of the test chamber.
- Check the alignment of the SCiO Sensor in the test chamber. When properly aligned, the square portion of the sensor inserts fully through the sheet metal and the sensor plastic is flush with the inside of the sheet metal and is not recessed.

For more information on troubleshooting the SCiO Sensor from Mirus, refer to the *Mirus for Twin GrainGage User Guide*.

8.2 Correct Limit Switch Error Message

If you receive a limit switch error message in Mirus for the top or bottom gate, check the air pressure and the functionality of the gate. For more information about checking the air pressure, see Install a Pressurized Air Supply.

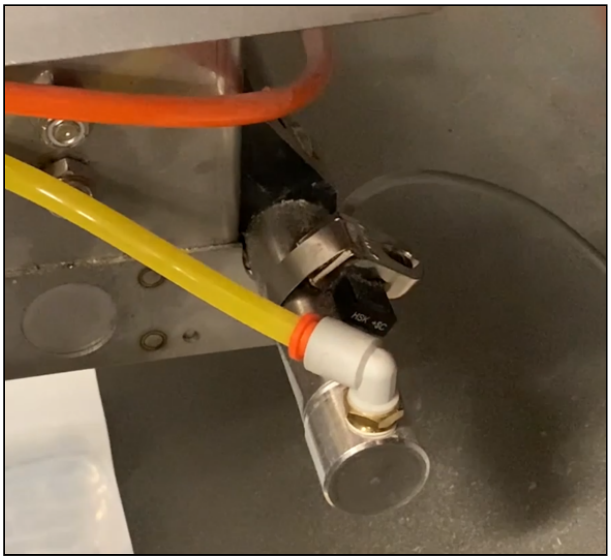


If the gate is uninhibited and the air pressure is correct, adjust the limit switches.

8.3 Adjust Bottom Gate Limit Switch

To adjust the bottom gate limit switch,

1. Ensure the bottom gate is closed.
2. Use a small flat head screwdriver to loosen the screw of the limit switch.



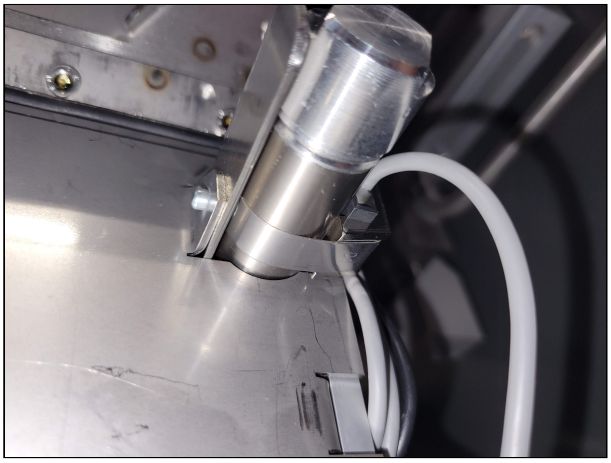
3. Move the limit switch toward the test chamber. After the light turns on, move the limit switch an additional quarter inch until the light turns off.
4. Tighten the limit switch screw.
5. Use Mirus to open and close the bottom gate. Then, verify the limit switch notification is gone. (For more information, see Check Actuator Diagnostics.)

   If you are still receiving the notification, contact a HarvestMaster Field Service Engineer.

8.4 Adjust Top Gate Limit Switch

To adjust the top gate limit switch,

1. Ensure the top gate is closed.
2. Use a small flathead screwdriver to loosen the screw of the limit switch.



3. Slide the band behind the rivet to ensure the limit switch is as far down as it will go.
4. Tighten the limit switch screw.
5. Use Mirus to open and close the top gate. Verify the limit switch notification is gone. (See Check Actuator Diagnostics.)

   If you are still receiving the notification, contact a HarvestMaster Field Service Engineer.

8.5 Adjust a Twin Hopper Limit Switch

To adjust a Twin hopper limit switch,

1. Ensure the power is on, air is enabled, and the pressure is set at 75-85 psi.
2. Close the hopper gate.
3. Use a small flat head screwdriver to loose the screw on the limit switch.

4. Move the limit switch toward the shaft/door until the red light in the limit switch turns on. Note the position.

5. Continue moving the limit switch until the light turns off. Note the position.
6. Move the limit switch exactly between where the light turned on and where it turned off. Tighten the screw to secure the switch in place. The red light should still be on.
7. Use Mirus to open and close the door. Verify that the door closes and no error messages or notifications appear. (See Check Actuator Diagnostics.)

Contact a HarvestMaster Field Service Engineer if you are still receiving error messages and notifications.

8.6 Diagnose Air Leaking from Solenoid or Cylinders

If you can hear air coming from the solenoid, you may need to replace the solenoid or cylinders. To determine whether a solenoid or cylinder needs to be replaced,

1. Turn on the air and identify which solenoid is leaking air.
2. Follow the air hoses from the leaking solenoid to its cylinder(s).
3. Remove the non-pressure hose from the cylinder(s).
4. Listen to see whether the air has stopped leaking from the solenoid and is now leaking from the cylinder(s).
    - If air is leaking from the non-pressurized side of the cylinder, the air leak is in the cylinder.
    - If air continues to leak from the solenoid after the hose is removed, the air leak is in the solenoid.
5. Replace the leaking part(s).

For more information, see Replace the Solenoid and Replace the Gate Air Cylinders.

GrainGages™

H2/H3 Twin

CHAPTER 9

Sensor and Module Error Codes

9. Appendix C: Sensor and Module Error Codes

9.1 Moisture Sensor LED Error Codes

The EM3 Moisture Sensor contains an orange LED and a red LED. A red LED blinking at the rate of once per second indicates normal status. The orange LED is off unless communicating with Mirus. The red LED displays error codes by groupings of short pulses, beginning after a long (one second) “on” pulse. For instance, an error code of 21 would be displayed as two short red light pulses, pause, then one short red light pulse followed by a pause. If more than one error code is present, the next error code begins showing right after the first, until all error codes have been displayed. This is followed again by a long (one second) red “on.” Then, the sequence restarts.

Moisture Sensor LED Error Codes	
Error Code	Description
11	Stack overflow—sentinel byte overwritten
12	Watchdog reset has occurred
13	Timed task buffer overflow
21	Input buffer overrun (>25 character pack received)
22	Checksum error detected
23	Unrecognized command
24	RS485 busy (for 5 ms) encountered
25	Transmit message aborted due to the 50 ms RS485 busy
31	Frequency interrupt overrun (missed frequency count)
32	Frequency measurement zero error (no oscillation counts)
33	Frequency measurement range error (>4.2 MHz)
44	System supply voltage below +10.5 V
45	System voltage above +16.0 V
55	Invalid error code

9.2 DSP Module Run-Time Error Codes

The DSP module contains a green LED, orange LED, and red LED. A solid green LED appears when the module is powered on. An orange LED blinking at a rate of once per second indicates normal status. The red LED flashes to show run-time error codes for the DSP module.

The red LED displays error codes by groups of short pulses, beginning after a one-second "on" pulse. For example, an error code of 5 would be displayed as five short red LED pulses in sequence. If there is more than one error code, the next error code begins after the first code until all the codes have been displayed. A red LED displays a one-second pulse at the end of the error codes.

DSP Module Run-Time Error Codes	
Code	Description
1	Hardware error
2	OS software error
4	Hardware stack overflow
5	Software stack overflow
7	BSS overflow
8	OS RAM overflow
9	TCB overflow
10	FIFO overflow
11	CAN overflow

9.3 DSP Module Bootloader Error Codes

If you have a bootloader error on the DSP module, the red and yellow lights flash every 1.5 seconds.

DSP Module Bootloader Error Codes	
Blinking Pattern/ 1.5 Seconds	Description
Single blink	Waiting for update
Double blink	Flash memory empty
Triple blink	Flash memory corrupted
Quadruple blink	Firmware incompatible

GrainGages™

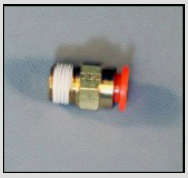
H2/H3 Twin

CHAPTER 10

Replacement Part Numbers

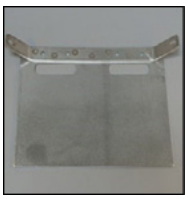
10. Appendix D: Replacement Part Numbers

Refer to the table for a list of common replacement parts for the H2 and H3 Twin GrainGage systems.

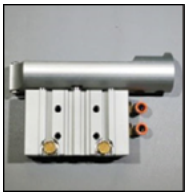
H2 and H3 Twin GrainGage Parts		
PN	Description	Photo
7395	Small straight air - FIT straight 1/40 D-1/8	
7397	Elbow, small	
7398	T-fitting 1/4 in. hose	
9455	Black poly air hose per ft, .375 OD	
9555	Piston rod clevis kit	
9592	Blue air hose, 1/4 in. OD	

13102	H2 Twin hopper air cylinder	
13119	Rubber mount for bucket and module	
15321	H2 Twin hopper limit switch cable	
15323	Actuator cable pigtail	
15332	Power cable	
15335	CAN patch cable, short	
15336	CAN patch cable, long	
15337	CAN breakout box	

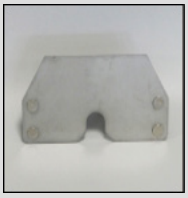
15374	Remote enter cable	
15386	H2 Twin hopper long actuator cable w/ connector	
15450	Pneumatic conditioning center	
23237	HM2 9-pin communications cable	
23385	Exhaust vents VMI 22700, large size	
23695	Yellow air line, 1/4 in. OD	
23696	Orange air line, 1/4 in. OD	

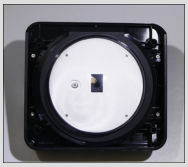
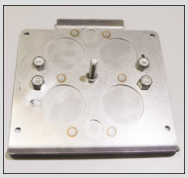
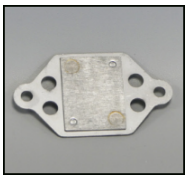
24407	Calibration weight, 3 lb	
24408	Calibration weight, 10 lb	
24412	Overload stop	
24422	Service top/bottom gate cylinder (replaces PN 26267), 7.5 in. length x 4 in. stroke	
24423	Slide gate	
24430	Pinch strip	
24433	Bypass gate cylinder, 9.5 in. length x 5 in. stroke	

24434	Mac solenoid valve with connector	
24442	Separator limit switch for H2 Twin/Single	
24443	Gate limit switch for Twin/Single (with band)	
31683	DSP 3 module	
24524	EM sensor blade	
24563	Test weight load cell	
24564	H2 Twin/Single 30 kg plot load cell	
24940	Bulkhead power cable, 3 cables	

24941	Bulkhead CAN cable, 3 CAN cables for modules	
24942	H2 bulkhead actuator cable (for isolation gate on H2 Single DSP actuator port	
25030	System controller	
25071	Actuator module	
25089	Lind tablet charge cable for Panasonic	
25118	H2 Twin/Single rubber mounting foot	
25797	CAN extension cable (male-female), 25 ft	
26114	Completed separator cylinder kit	

26530	Isolation gate kit	
26545	H2 low yield insert kit	
26566	DSP 8 pin I/O 1 cable (GPIO 1 to DSP 5 Act & 6)	
26829	DSP2 GPIO 1 breakout cable for overflow and Act 5 & 6 (requires actuator cable to access DSP 5 & 6)	
26830	Straight actuator cable subasy	
26831	H2 insert plug plate, 1 each	
27092	Right angle USB/CAN converter cable	

27440	Level detect sensor	
28315	CAN cable with right angle (female-female), 15 ft	
28540	Internal CAN extension cable kit (male-female), 3 ft	
28941	CAN cable right angle (female-female), 100 in.	
29111	EM3 Grain Moisture Sensor	
30711	H3 low yield insert plug, 1 each	
30712	H3 SCiO cable assembly	

30715	H3 SCiO sensor	
31045	H3 low yield insert subasy kit	
31517	SCiO serial to USB cable	
31518	SCiO 15 ft serial to USB extension cable	
31740	H3 SCiO sensor hole plug kit	
31796	H3 moisture sensor plug kit	
31798	H3 low yield insert plug kit	

GrainGages™

H2/H3 Twin

CHAPTER 11

Exploded and Mounting Drawing

11. Appendix E: GrainGage Exploded Views

The following table contains links to exploded drawings for the H2 and H3 GrainGage models.

Drawings	
Model	Type of Drawings
H2 Twin	Test Weight Chamber SubAsy (Exploded) Twin Hoppers SubAsy (Exploded)
H3 Twin	Top Level Assembly (Exploded and mounting)

GrainGages™

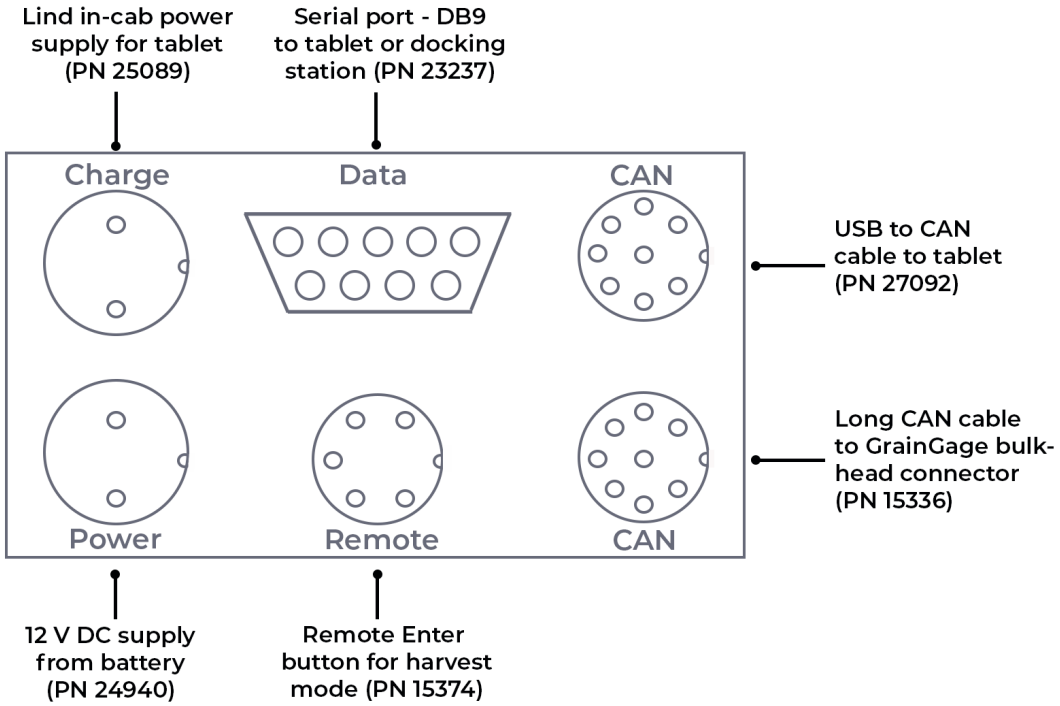
H2/H3 Twin

CHAPTER 12

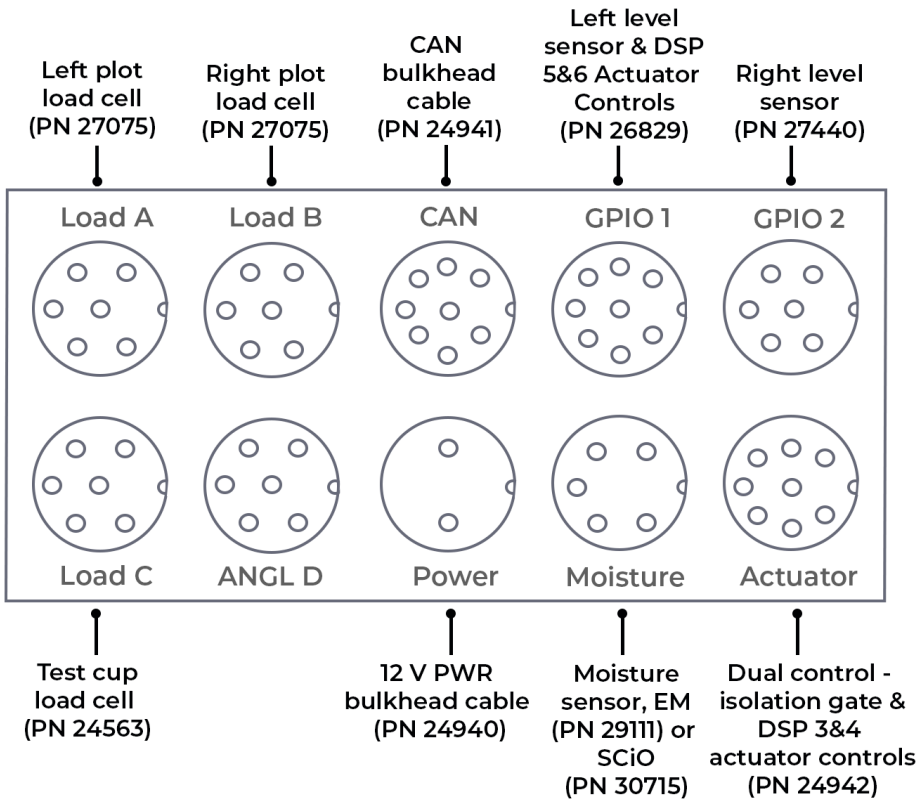
Connections and Wiring Diagrams

12. Appendix F: Connections and Wiring Diagrams

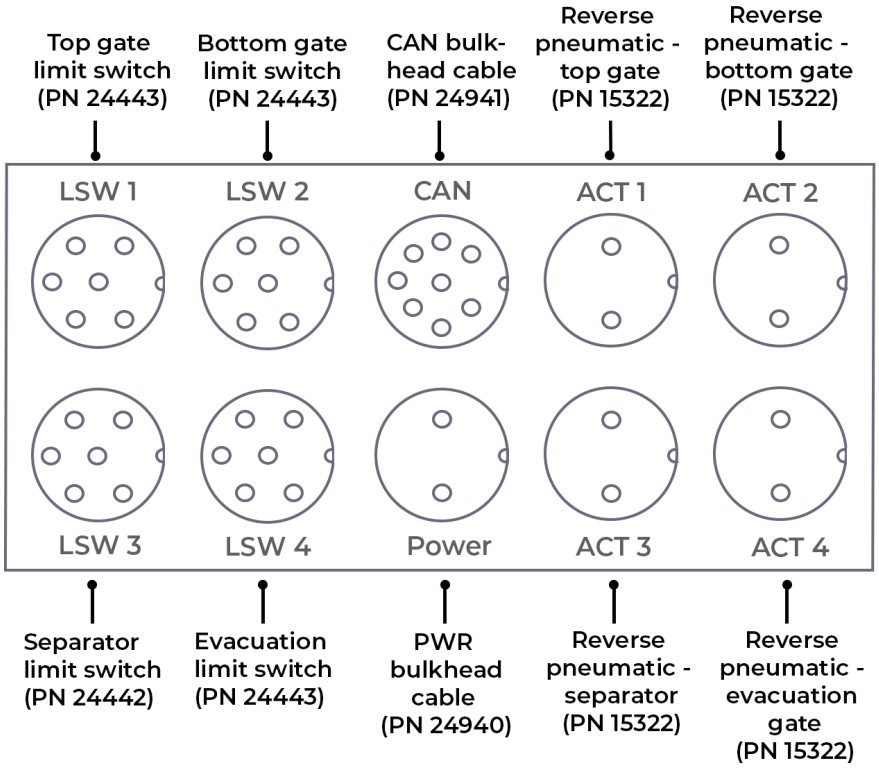
12.1 Wiring for the System Controller



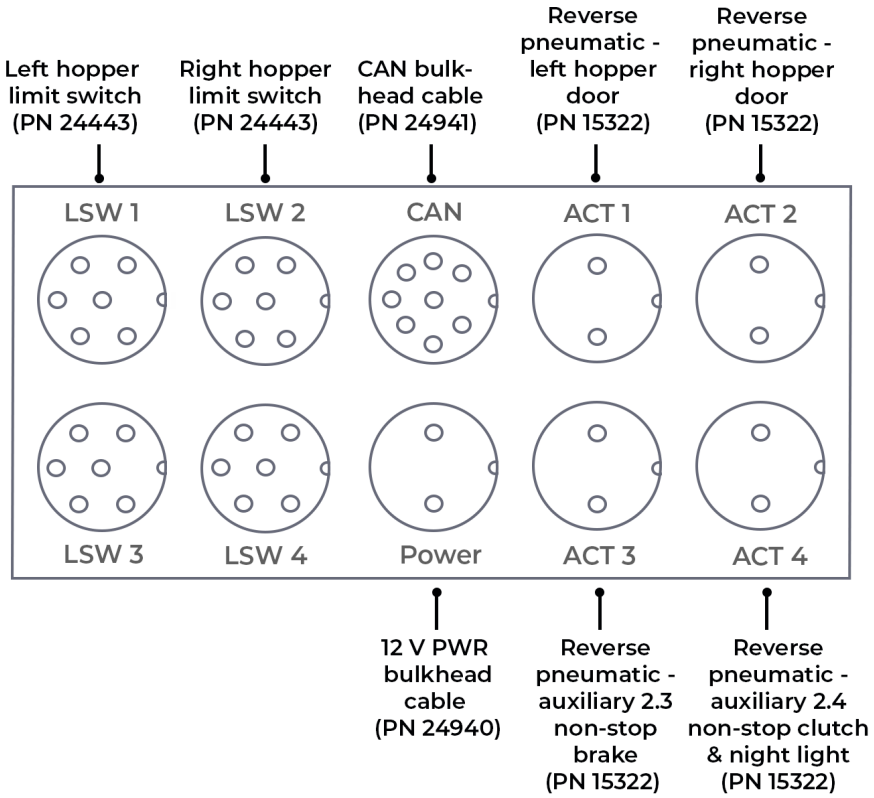
12.2 Wiring for the DSP Module Ports



12.3 Wiring for Actuator 1 Ports



12.4 Wiring for Actuator 2 Ports

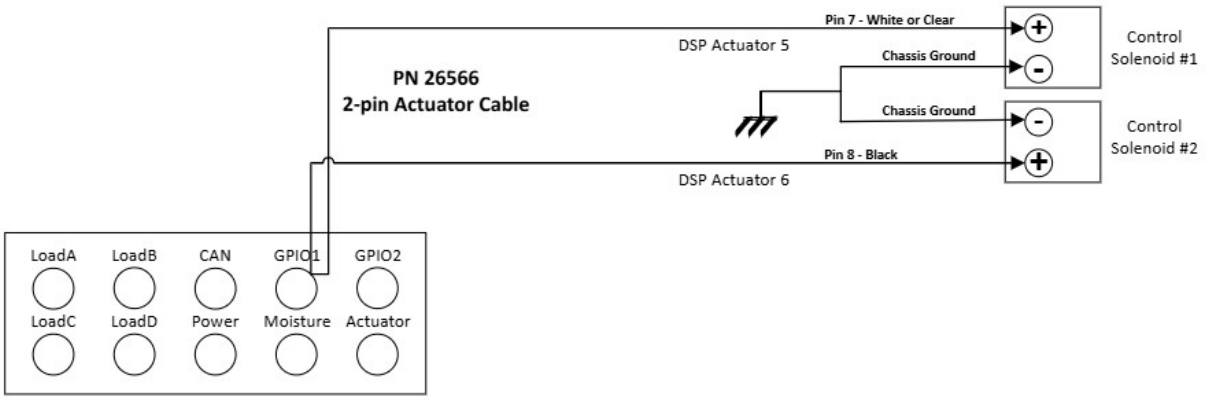


12.5 Cable Wiring Diagrams

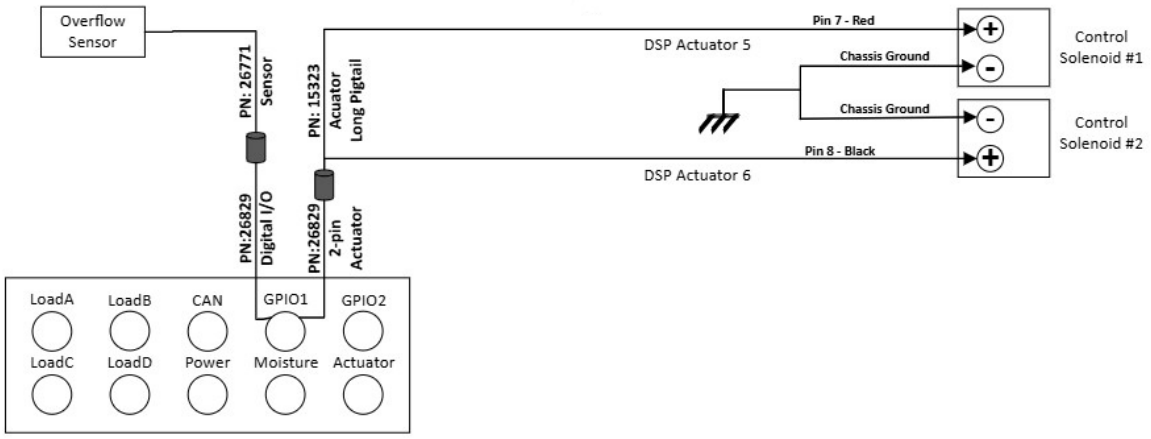
12.5.1 Control Two Separate Actuators (Dual Mode)

When using dual mode, wire the white (or clear) wire to the positive terminal on the solenoid for actuator 5, and wire the black wire to the positive terminal on the solenoid for actuator 6. Use additional wiring (not included with the part or kit) to connect the negative terminals to chassis ground. Dual mode only supports pneumatic actuators.

If DSP 5&6 are not available, another actuator control can be used in a similar way.



DSP Actuators 5 and 6 wiring with PN26566 (dual mode)

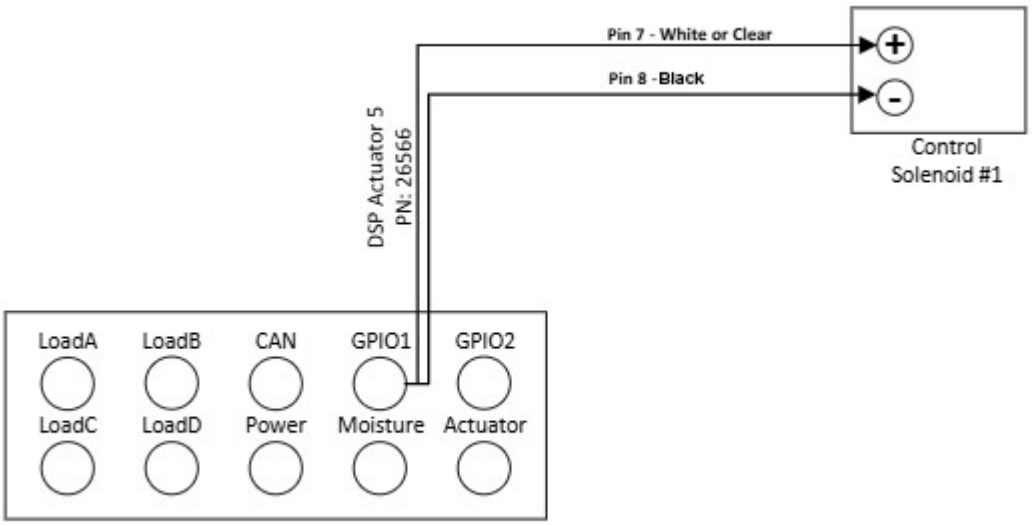


DSP Actuators 5 and 6 wiring with Overflow sensor (dual mode)

12.5.2 Control One Actuator (Non-Dual Mode)

When not using dual mode, wire the white (or clear) wire to the positive terminal and the black wire to the negative terminal. This configuration supports multiple types of actuators, such as pneumatic, hydraulic, or electric.

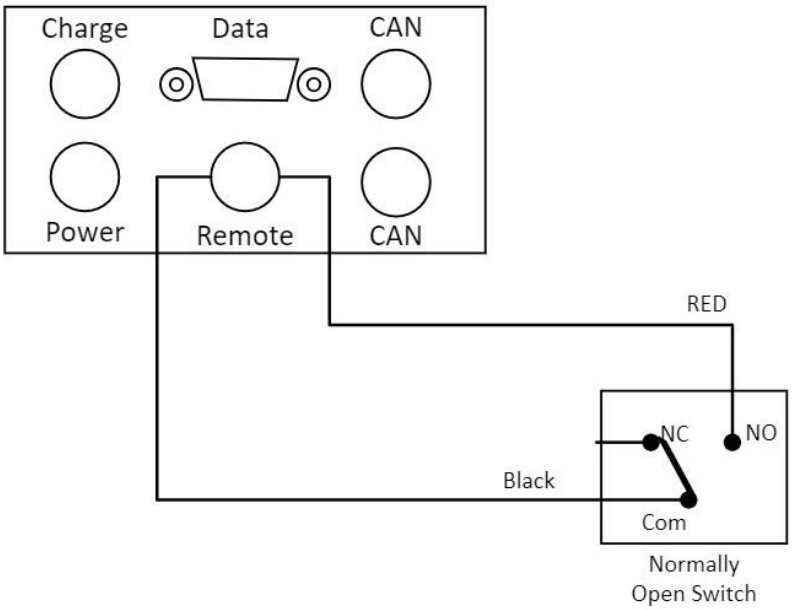
If DSP 5&6 are not available, another actuator control can be used in a similar way.



Actuator 5 wiring with PN26566 (dual mode not used)

12.5.3 Wire a Remote Switch

Use this diagram to wire a remote switch (PN 15374) to remotely cycle Mirus.


Charge
Data
CAN
Power
Remote
CAN
RED
NC
NO
Black
Com
Normally
Open Switch

GrainGages™

H2/H3 Twin

CHAPTER 13

Warranty

13. Appendix F: Warranty

13.1 Hardware

All products manufactured by Juniper Systems, Inc. (Juniper Systems) when properly installed, calibrated, and operated in accordance with instruction manuals accompanying the hardware and used for the purpose for which the hardware was designed shall be free from defects in materials and workmanship for a period of one (1) year from the date of shipment.

In the event a defect in materials or workmanship is discovered and reported to Juniper Systems within the one year period, Juniper Systems will, at its option, repair the defect or replace the defective product. Juniper Systems obligation here-under will be limited to such repair or replacement.

The customer shall have the responsibility to ship the defective equipment to Juniper Systems with all cost of shipment prepaid. After repair or replacement Juniper Systems will, at their own expense, ship the replacement or repaired item back to the customer using the same type of carrier.

13.2 Software

Software products that are designed by Juniper Systems for use with a hardware product and that are properly installed on that hardware product are warranted to the end user not to fail to execute their programming instructions due to defects in material or workmanship for a period of one year from the date of delivery.

If Juniper Systems receives notice of such defects during the one year warranty period, Juniper Systems shall, at its option, repair or replace the defective software media. Warranty is limited to repair or replacement of software media.

The warranties provided herein do not apply in the case of improper or inadequate maintenance or in the case of repair by any person not previously authorized in writing by Juniper Systems to do such maintenance or make such repairs.

These warranties likewise do not apply where the products have been operated outside the environmental specification of the product, where software products other than those specified by Juniper Systems have been used, or where attempts at software interface have been made by any person not previously authorized by Juniper Systems to perform such interfacing operations.

13.3 Disclaimer of Warranties

The warranties set forth herein are in lieu of all other warranties of Juniper Systems, whether written, oral or implied. Juniper Systems makes no warranties regarding its products (hardware or software), including without limitation warranties as to merchantability, fitness for a particular purpose, any warranty arising from course of performance, course of dealing, or usage of trade whether any of the foregoing warranties are either expressed or implied. Juniper Systems specifically makes no warranties as to the suitability of its products for any particular application. Juniper Systems shall in no event be liable for special, incidental, or consequential damages in connection with or arising out of the furnishing, performance or use of any product covered by this agreement whether such claim is based upon warranty (express or implied), contract, strict liability, negligence or otherwise.

13.4 Updates or Modifications

Juniper Systems shall be under no obligation to update or modify its products except as herein noted to correct program errors. Furthermore, the customer agrees that all representations and warranties contained herein shall be immediately null and void in the event of any modification,

alteration or change in or to any product affected by or on behalf of the customer except for a change made by Juniper Systems.

13.5 Removal of Serial Number

Removal of the Juniper Systems serial number label from an instrument will void any warranty on the said instrument. Juniper Systems will not repair or update an instrument and return it to an individual if the instrument is without the said serial number label.

13.6 Extended Warranties

Juniper Systems offers a variety of warranty options to extend coverage beyond the standard warranty. You can contact Juniper Systems Customer Service Department for details at (435) 753-1881 (6 am–5 pm MT, Mon-Fri).