HARDI® SPRAYERS

HARDI® MUSTANG 3500

Operator's Manual

Hardi® P/N 67301603 (6/04)

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Dear Owner,

Thank you for purchasing a HARDI® product and welcome to the ever-increasing family of HARDI® automatic rate controller owners.

Our sprayers and accessories are rapidly becoming a familiar sight on North American farms. We believe that this results from growers becoming increasingly conscious of crop protection input costs and the vital need for cost-effective spray application equipment.

Please take the time to thoroughly read the Operator's Manual before using your HARDI® MUSTANG 3500 Automatic Rate Controller. You will find many helpful hints as well as important safety and operation information.

Some of the features on your HARDI® MUSTANG 3500 Automatic Rate Controller were suggested by other HARDI® owners. There is no substitute for "on-farm" experience and we invite your comments and suggestions.

Please address your correspondence to the Service Manager at one of these branches:

HARDI® MIDWEST
1500 West 76th St.
Davenport, Iowa 52806
Phone: (563) 386-1730
Fax: (563) 386-1710

HARDI® GREAT LAKES
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London, Ontario N6M 1B3
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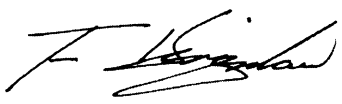
HARDI® WEST COAST
5646 W. Barstow, Suite 101
Fresno, California 93722
Phone: (559) 271-3106
Fax: (559) 271-3107

Sincerely,



Tom L. Kinzenbaw
President

1.0 INTRODUCTION

Your new HARDI® MUSTANG 3500 system is a high-performance controller, designed for superior control of agricultural product applications while providing easy-to-use features to help you manage your farming operation efficiently. From the large, easy-to-read display and controls to the Utilities Software provided, the system is designed with the operator in mind.

The HARDI® MUSTANG 3500 system uses individually entered section widths to determine which portion of the total liquid is being by-passed rather than sprayed from the boom section. For this reason, it is extremely important to adjust and verify the amount of liquid that is diverted by the constant pressure distribution valve when a section is shut off.

The HARDI® MUSTANG 3500 has many built-in features, some of which are described in the following paragraphs.

THREE INDEPENDENT RATE SETTINGS

The system provides three application rate settings with clearly marked buttons to choose the desired rate. The three rates can be set up in two ways: If the same nozzles are always used, three selectable rates can be set up for varying field conditions. If three different sets of quick-change nozzles are used, each of the three rates can be set up for a different set of nozzles. This will save time when changing nozzles, because the console will not need to be calibrated when nozzles are changed.

AREA AND FLOW COUNTERS

Nine independent field area and flow counter pairs, plus total area and flow pair. You are in total control from your cab.

ALARM WITH EASY SET UP AND CONTROL

An internal alarm is provided to alert the operator to error conditions. The alarm is factory-set to turn on if the actual application rate is more than +/– 10% from the target rate, and can easily be turned to a lower volume, or turned off entirely, by simply using the toggle switch on the back of the console. The alarm can also be set to turn on if the tank level is below a set minimum.

FLASH PROGRAM MEMORY

The HARDI® MUSTANG 3500 program resides in flash memory, allowing simple field upgrades to the software, using the provided software utilities and downloadable files, as more features are developed and added.

RS-232 SERIAL INTERFACE

The HARDI® MUSTANG 3500 serial interface allows the HARDI® MUSTANG 3500 to be linked to most desktop, laptop or pocket PC computers. This serial link can be used to calibrate or reprogram the console using the provided software utilities package. It can also be used with appropriate software such as Farm Works® SiteMate to accomplish variable rate application (VRA), or or be used as a data logger. See Appendix C in back of manual. Using the HARDI® printer, data can be printed directly from the RS-232 output to the printer.

SOFTWARE UTILITIES

A compact disc with Utility Software is provided with each system. If you have access to a PC with CD drive, this software can be easily loaded on the PC or pocket PC. The Utility Software includes a calibration “wizard” that directs the operator through the MUSTANG calibration process and automatically sets up calibration for various types of systems. If the PC is connected to the MUSTANG, the calibration parameters can be downloaded directly to the MUSTANG, or the calibration settings can be printed out and entered into the MUSTANG manually. The calibration settings can be stored as files so the MUSTANG can be quickly reconfigured if it is used with different applicators. If the PC is connected to the MUSTANG, the Utility Software also provides the ability to reprogram the MUSTANG with program upgrade files provided by HARDI® via e-mail (or on floppy disk).

2.0 SAFETY INFORMATION

RECOGNIZE SAFETY INFORMATION
This is the safety-alert symbol. When you see this symbol on your machine or in this manual, be alert to the potential for personal injury.

Follow recommended precautions and safe operating practices.

PTO-driven machinery can cause serious injury. Before working on or near the PTO shaft, or servicing or cleaning the driven machine, put the PTO lever in the DISENGAGE position and STOP the engine.

⚠ WARNING

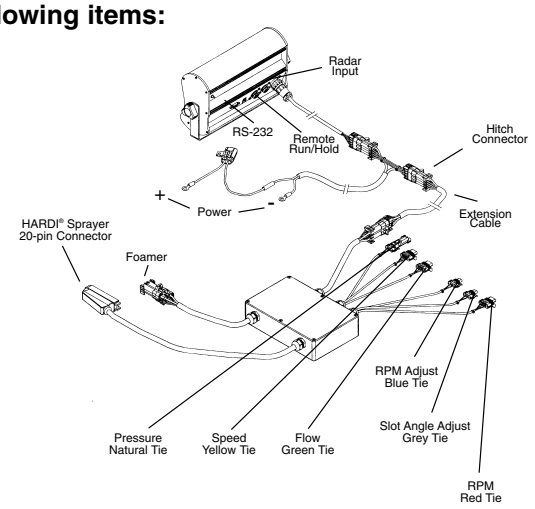
Disconnect all electronic components from power supply before welding on sprayer.

Do not use high pressure cleaner directly on electronic components.

105776

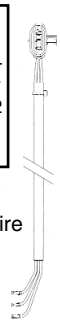
3.0 COMPONENT PARTS AND ASSEMBLY HARDWARE

Before beginning installation, check the carton contents for the following items:



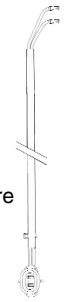
- Console
- Console Cable
- System Power Cable
- Extension Cable
- Sprayer Control Module
- Operator's Manual
- Optional: Remote Run/Hold Cable and Foot Switch

With standard set-up, included are 2-3 wire adapter cables and 1-2 wire adapter cable

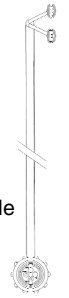


3 wire

With twin force set-up, included are 3-2 wire adapter cables and 3-3 wire adapter cables

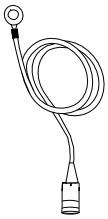


2 wire



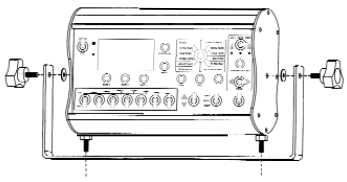
Optional Remote run/hold cable

Chassis Ground Wire



Heat Shrink Kit

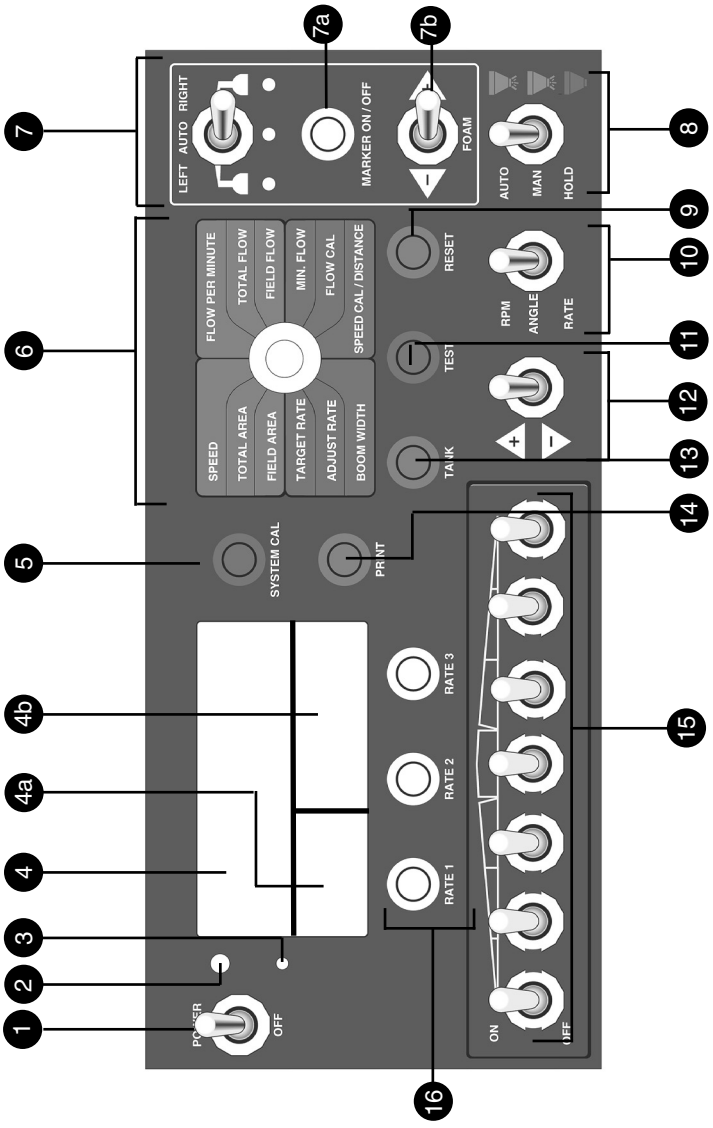
Mounting kit for console



Utilities CD

4.0 CONSOLE FUNCTIONS

This section gives a brief explanation of each button, switch and rotary switch position, and will help to familiarize you with the console and its operation.



1. Main POWER switch
2. Light SENSOR; senses ambient light, turns back lighting on/off
3. WARNING light
4. 4a 4b DISPLAY area; upper half displays application rate; lower left displays pressure; lower right displays rotary switch position data
5.
6. SYSTEM CAL button; used to enter system calibration mode
   ROTARY SWITCH positions:

RATES:

Speed – displays ground speed
Flow Per Minute – displays either total boom or individual nozzle flow per minute

COUNTERS:

Total Area – keeps a running count of total area
Total Flow – keeps a running count of total flow
Field Area – keeps a running count of field area
Field Flow – keeps a running count of field flow

CALIBRATION:

Target Rate – target application rate (GPA/LPH)
Min Flow – minimum gallons (liters) per minute
Adjust Rate – on-the-go adjustments to target rate when operating in AUTO mode
Flow Cal – flow meter calibration value (PPU)
Boom Width – enter the working width for each of your boom sections
Speed Cal / Distance – enter Speed Cal value in UPP; will also display accumulated distance travelled

7. FOAM MARKER control:
   LEFT/AUTO/RIGHT switch – controls which side is currently applying foam
7a. MARKER ON/OFF – turns foam marker control system on or off
7b. FOAM ADJUST – increases or decreases the foam rate
8. MASTER switch; determines in which mode the user is currently operating
9. RESET button – clears the selected counter

10. MODE switch: (twin force only)
    - RPM – RPM of fan is displayed
    - ANGLE – displays slot angle settings
    - RATE – displays application rate
11. TEST button – used to enter test speed mode
12. ADJUST switch – used to adjust various settings or rates
13. TANK button – displays the amount of material remaining in tank
14. PRINT button – allows user to print field counter data
15. BOOM switches – on/off control for each boom section
16. RATE buttons – selects a preset target application rate for each button.

5.0 OPERATION OF THE HARDI® MUSTANG 3500

❶ POWER SWITCH

In the ON position, the power switch controls 12-volt power to the entire system. In the OFF position, there will be no drain to the vehicle's electrical system.

Start-up of the HARDI® MUSTANG 3500

Upon start-up, the console will briefly (approximately three seconds) display the software versions that are programmed into the console and sprayer control module.

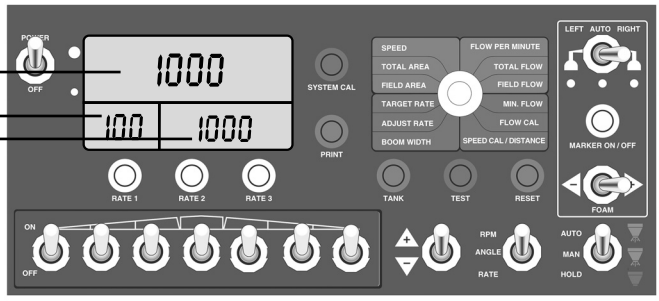


Fig. 5.1

Upper half displays console main program version (flash 1)

Lower left displays Spray Control Module program version (flash 3)

Lower right displays console display program version (flash 2)

2 LIGHT SENSOR

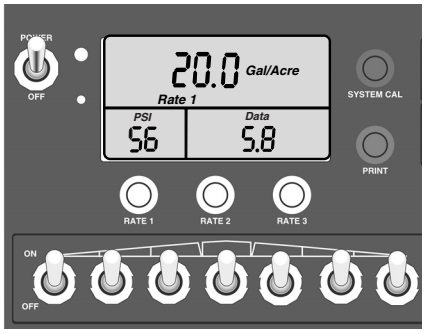
This sensor automatically turns the back lighting for the front panel on or off as the lighting conditions dictate.

3 WARNING LIGHT

The console is equipped with a RED warning light. The light will automatically turn on and flash when the actual application is plus or minus 10 percent of the calibrated target rate. The RED warning light will also be flashing when calibration mode is active on the console.

4 DISPLAY AREA

During normal operation, the console will display pressure in the lower left corner of the display (if installed), application rate in the upper half of the display and the selected rotary switch position data in the lower right of the display. For example, in the figure below, the upper display tells the operator that the actual target RATE 1 is 20.0 GPA. The lower left display tells the operator that their pressure is at 56 PSI, and the lower right display tells the operator that their speed is currently 5.8 MPH, if the rotary switch is set to speed.



5 SYSTEM CAL BUTTON

To enter system calibration, toggle the Master switch to HOLD and turn the rotary switch to SPEED, then press and hold the SYSTEM CAL button and turn the power switch ON. Release the SYSTEM CAL button when the console displays SYS.

Upon entering SYSTEM CAL, the display will read “SYS” and the calibration indicator will be lit. Any changes to the factory-preset values can be made while in SYSTEM CAL. Changes will take effect as soon as SYSTEM CAL is exited. To exit SYSTEM CAL, press the SYSTEM CAL button. See Calibration section for more information.

6 ROTARY SWITCH POSITION

During normal operation, you can view any one of six monitored functions in the lower right portion of the display by turning the rotary dial to the appropriate position. The GREEN positions are Operational positions and the RED positions are Calibration positions. The following describes the function of each Operational position. The Calibration positions are discussed in Chapter 7: Calibration.

SPEED:

Displays the ground speed in miles (kilometers) per hour.

FLOW PER MINUTE:

Displays the actual gallons (liters) per minute being applied by the sections turned on. **OR** if the number of nozzles is entered in System Cal, then this position will display flow per nozzle in ounces per minute (liters per minute).

TOTAL AREA:

Displays the area covered since the counter was last reset to zero. This counter does not accumulate area when the console is in HOLD or if all boom section switches are turned off. If this counter is reset TOTAL FLOW will reset as well.

FIELD AREA:

Displays the area covered since the counter was last reset to zero. This counter does not accumulate area when the console is in HOLD or if all boom section switches are turned off. If this counter is reset FIELD FLOW will reset as well.

There are 9 field counters (F1-F9). Only the active counter will reset. To change active counter, console must be in HOLD and rotary switch in either FIELD AREA or FIELD FLOW. The lower left display area will display F1-F9. To change use Adjust switch.

TOTAL FLOW:

Displays the total gallons (liters) applied since the counter pair was last reset to zero. If this counter is reset TOTAL AREA will reset as well.

FIELD FLOW:

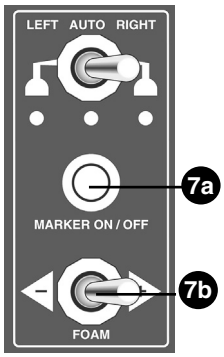
Displays the total gallons (liters) applied since the counter was last reset to zero. If this counter is reset FIELD AREA will reset as well.

7 FOAM MARKER CONTROL

The area on the far right of the control panel, outlined with a yellow border, is the Foam Marker Control area. This area is broken down into three sections, each explained here:

LEFT/AUTO/RIGHT SWITCH:

Moving the switch to the left activates the LEFT foam marker. Moving the switch to the right activates the RIGHT foam marker. Moving the switch to the center position tells the controller to automatically determine which marker will distribute foam. The middle AMBER colored LED indicates marker is ON. The RED colored LED below the dropper indicates which side is ON. **NOTE: If the switch is in the center (AUTO) position on start-up, the marker is set to start distributing foam on the left side. When in AUTO marker side changes automatically when the operator transitions the master switch from AUTO to HOLD or MAN to HOLD. Foam marker will NOT turn on if the Master switch is in HOLD or if the console is in rHold.**



7a MARKER ON/OFF BUTTON:

To activate the Foam Marker in AUTO mode, press the Marker On/Off button momentarily. To activate the foam marker in Manual mode, press and hold the Marker On/Off switch button for three seconds; when in Manual mode, the amber LED will flash. In Manual mode, the Auto position of the Left/Auto/Right switch turns the foam OFF.

7b FOAM ADJUST SWITCH:

When the Foam Marker Control is active, moving the switch to the left decreases foam rate. Moving the switch to the right increases the foam rate. When the foam switch is toggled, the lower right area of the console display shows a percentage value between 0-100% indicating the foam drop rate: 0%=min. 100%=max.

8 AUTO/MAN/HOLD SWITCH or MASTER SWITCH

This MASTER switch will change the control status of the system from fully automatic control (“AUTO”), manual control (“MAN”), or HOLD.

During normal operation, when the MASTER switch is in AUTO, the console adjusts the regulating valve to maintain the desired application rate. For example, as speed increases, pressure will increase automatically in order to maintain the desired application rate. As speed decreases, pressure decreases.

During normal operation, when the MASTER switch is in MAN, the application rate will not be maintained by the console automatically. Using the ADJUST switch while in MAN allows the operator to increase or decrease the flow or pressure manually as needed.

During normal operation, when the MASTER switch is in HOLD, all section valves are turned off, (spraying will stop) and area, distance and flow will stop accumulating and foam marker will stop. For example, when turning on end rows, place the MASTER switch in HOLD.

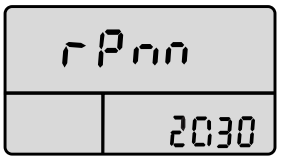
9 RESET BUTTON

The RESET button is used to clear a selected counter. To do this, simply turn the rotary dial to any of the counter positions (Total Area, Field Area, Total Flow, Field Flow, or Distance), and press and hold the reset button for one second. **IMPORTANT:** when clearing field area, field flow is cleared as well. The same holds true for total area and total flow.

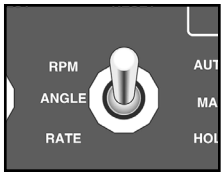
10 MODE SWITCH (TWIN FORCE CONSOLE ONLY)

TWIN FORCE SWITCH:

RPM Position – In this position, fan speed can be adjusted. To do this, place the switch in the RPM position, and use the “adjust” switch to increase or decrease the fan speed. The console will not allow fan speed greater than 3200 RPM.The console will show “fan RPM” in the lower right while in this mode, and RPM will be displayed in the upper half of display indicating the mode the user is in. If the PTO is disengaged and hydraulic flow to the Fan motor stops, causing Fan RPM to read 0, the system will automatically take the hydraulic pump output to the lowest setting.



ANGLE Position – This position is used to adjust the slot angle. To do this, place the switch in the ANGLE position, and use the "adjust" switch to increase or decrease the slot angle.



There are 3 modes of operation for the Slot Angle feature on the HARDI® Mustang 3500: Manual, Preset and Auto.

WHEN ENTERING THE SLOT ANGLE MODE: if the user places the Mode Switch in the Angle position, the top half of the LCD reads AnglE and either RATE 1, 2, or 3. The lower left reads a number between .0 and 12.0 and the lower right display reads either Auto or PrSEt (preset).

MANUAL MODE: To operate the Slot Angle manually, simply place the Mode Switch in ANGLE and the Rotary Switch in any green (operational) position, using the Adjust Switch, manually change the Slot Angle to the desired position.

PRESET MODE: To operate the Slot Angle in the Preset Mode, toggle the MODE SWITCH to the ANGLE position and the ROTARY SWITCH to any green position (the lower right area of the display must read PrSET).

- If the RATE 1, 2 or 3 button is pressed, the Slot Angle will transition to the associated preset value. The value in lower left display represents the time in seconds the Slot Angle actuators will run from the zero point. If the value in RATE 1 is set to 2.5 and the Rate 1 button is pressed, the Slot Angle will run forward for 12 seconds and then rearward for 2.5 seconds.

- If the value in Rate 2 is set to 4.7 and the RATE 2 button is pressed, the Slot angle will run forward for 12 seconds and then rearward for 4.7 seconds.

- If the value in Rate 3 is set to 6.2 and the RATE 3 button is pressed, the Slot Angle will run forward for 12 seconds and then rearward for 6.2 seconds. To adjust the preset value the Mode Switch must be in the ANGLE position, the Master Switch in HOLD and the Rotary Switch in any calibration (red) position, to adjust, select the associated RATE button and adjust the value using the Adjust Switch.

AUTO MODE: To toggle the Angle Mode between AUTO and PRESET, toggle the mode switch to ANGLE and the MASTER switch to HOLD and the ROTARY switch to any calibration position. By then pressing the RESET button, the Angle mode will toggle between PRESET and AUTO, In the AUTO mode, the Slot Angle will automatically change from the RATE 1 preset position to the RATE 3 preset position on a MASTER SWITCH transition from AUTO to HOLD or on a REMOTE HOLD (foot switch) transition. To adjust the preset values in the lower left display area place the mode switch in ANGLE and the MASTER switch in HOLD and the ROTARY switch in any calibration position, then press the associated RATE button and adjust the value using the ADJUST switch. In the AUTO mode, the Slot Angle will run to the zero point (12 seconds forward) and then to the PRESET value every other time the MASTER switch is toggled from AUTO to HOLD.

SAFETY FEATURE: To immediately stop Slot Angle movement in either AUTO or PRESET mode turn the ROTARY SWITCH to any calibration position.

11 TEST BUTTON

The TEST button is used to enter the Test Speed mode when calibrating the system. Refer to Pre-field System Checkout for more information on Test Speed and using the TEST button.

12 ADJUST SWITCH

The "+/–" (ADJUST) switch serves many functions within the system, and can be used within Calibration and Operation (AUTO and MAN).

During normal operation, when the master switch is in automatic (AUTO) and the rotary dial is not in a calibration position, each toggle of the switch will increase or decrease the target application rate by the amount of the calibrated ADJUST RATE.

During normal operation, when the master switch is in manual (MAN), toggling the ADJUST switch will increase or decrease the application rate by closing or opening the regulating valve (control valve).

TANK BUTTON

13 This button is used to check the volume remaining in the tank. To do this, turn the rotary dial to any of the six operational positions (top half), and press and hold the TANK button. The top half of the display will show the volume remaining in the tank. When the TANK button is released, the display will revert back to the application rate.

The TANK button can also be used to enter a volume into the tank counter. To do this, press and hold the TANK button and toggle the "ADJUST" switch

up to the “+” position. This sets the tank counter at its maximum (determined by tank size in System Calibration, see Chapter 8: Calibration).

To enter a volume other than maximum, press and hold the TANK button and toggle the “ADJUST” switch up (“+”) first to set the maximum, then down (“–”). This will cause the counter to count down slowly. (Toggling to “+” will again set the counter at its maximum.)

NOTE: A tank volume can be entered even if tank size is “OFF” in System Calibration, but it will increase slowly with the “+” switch rather than instantly going to maximum.

14 PRINT BUTTON

This button is used to print a data list using a HARDI® printer. To do this, place the console in HOLD, and press the PRINT button.

15 BOOM SECTION SWITCHES

The boom switches on the console are designed to start and stop the flow of material through each individual boom section switch you have programmed. The console accumulates area based on the calibrated boom section widths. When an individual boom section is turned off, the respective width is subtracted from the total width to accumulate area based on the new active application width. If a boom section switch is turned on, its respective section valve should be on. If a boom section switch is turned off, its respective section valve should be off. No valves should be on if the console is in HOLD, or in AUTO while speed is zero.

16 RATE BUTTONS

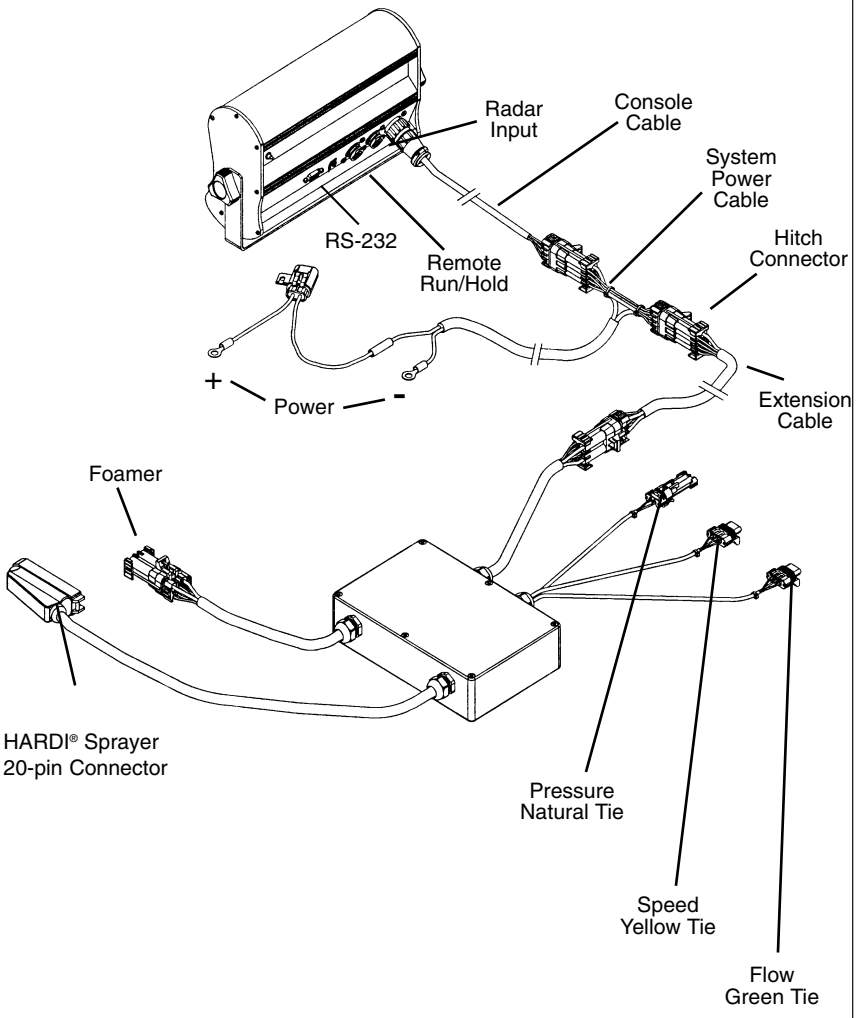
The RATE buttons serve many functions within the system, and can be used within Calibration and Operation (AUTO and MAN). The RATE buttons allow you to quickly select an alternative pre-programmed rate. They can be used in several different ways.

While in operation, the RATE buttons are used to select which pre-programmed rate you will use during application. For example, RATE 1 could be set at a low-end rate (e.g. 8 GPA), RATE 2 at a mid-range rate (TARGET, e.g. 10 GPA), and RATE 3 a high-end rate (e.g.12 GPA).

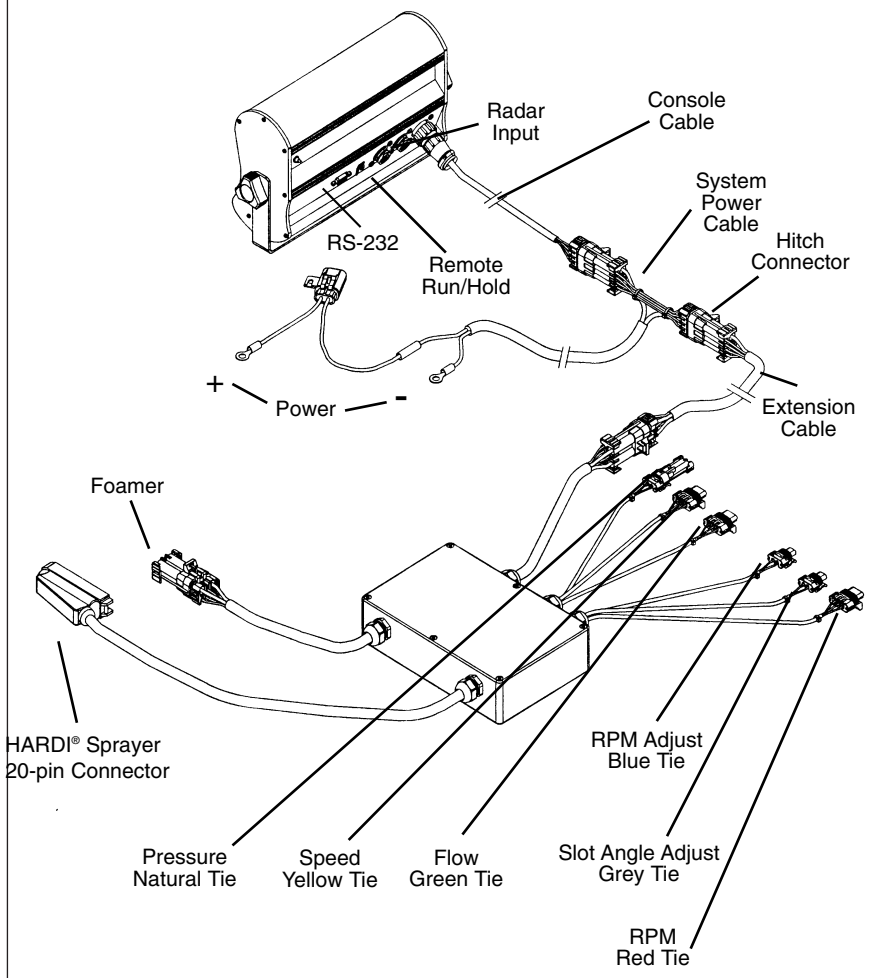
Another example might be this: If you are using triple nozzle bodies with different nozzle installations, you could pre-program the HARDI® MUSTANG 3500 for each specific nozzle. This will save time when changing nozzles for each specific application.

The Rate buttons are also used in calibration. See Chapter 8; Calibration.

System Overview of the HARDI® MUSTANG 3500 (NOT for Twin Force)



System Overview of the HARDI® MUSTANG 3500 (for Twin Force operation)



6.0 INSTALLATION

Mounting the Display Console

Select a mounting location which seems most workable, and that best fits your needs. It should be convenient to reach and highly visible to the operator. DO NOT INSTALL IN A POSITION THAT OBSTRUCTS THE VIEW OF THE ROAD OR WORK AREA.

Place the mounting bracket in the selected location, mark holes, drill 1/4" (7mm) holes and mount bracket with bolts, lockwashers and nuts provided. (If bolts are not practical, use self-tapping screws.) See Figure 7.1.

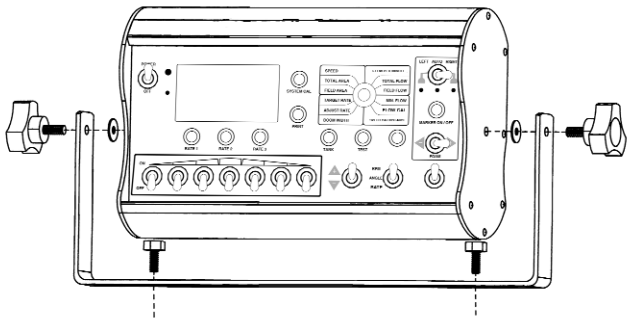


Fig. 7.1

A chassis ground wire is provided to reduce electrical interference. This wire is connected to the male terminal on the back of the console and then to a good chassis ground point.

Place the console in the “U” bracket and install the console knobs through the bracket, placing a rubber washer over the threaded stud. Position console to proper viewing angle and tighten the knobs securely. See Figure 7.1.

Electrical Installation

The HARDI® MUSTANG 3500 must be connected to a 12-volt DC electrical system. Power is connected directly to the battery, or other 30 AMP power outlet. The HARDI® MUSTANG 3500 has an ON/OFF switch on the console to turn the power off when the system is not being used.

Locate the system power cable. Connect the blue ground wire to a good frame ground, be sure there is good metal-to-metal contact. See Figure 7.3. Route the power cable from the battery to the back of the tow vehicle. In routing cable to battery, avoid areas where the cable may be subjected to abrasion or excessive heat. Connect the ORANGE wire (hot) to the positive battery terminal.

Your HARDI® MUSTANG 3500 is equipped with an electronic memory which does not require a constant supply of power to retain daily totals or calibration values. The advantage with this type of memory is that it conserves battery power and will not discharge the vehicle's battery when the power switch is off.

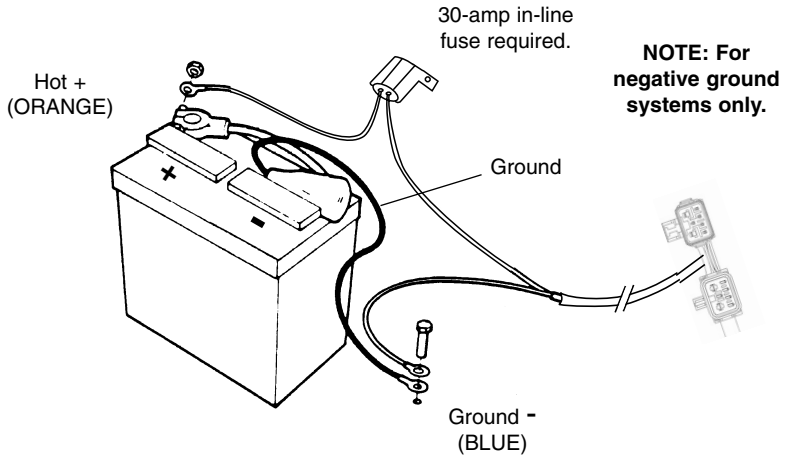
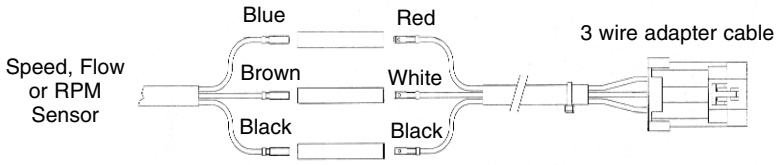


Fig. 7.3

Speed, Flow and RPM Transducer Installation

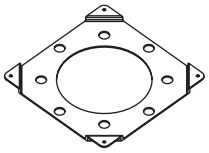
The HARDI® Mustang will work with either the magnetic speed transducer or proximity speed transducer. **DO NOT USE MAGNETS WITH THE PROXIMITY TRANSDUCER.** Wiring remains the same for either speed transducer. For magnetic transducers, the sensor needs to be placed 5-7 mm from the magnet. For proximity transducers, the sensor needs to be placed 1.5-3 mm from the magnet mount bracket **(NO MAGNETS USED).**

Route the speed sensor cable to the HARDI® Sprayer Control Module. Mate the wires as shown below. Be sure to slide a piece of heat shrink tubing over each individual wire before mating. Then shrink tubing by applying heat evenly along tube. Plug the adapter cable into Sprayer Control Module speed input pigtail with Yellow Cable Tie. **DUPLICATE THIS FOR FLOW, AND RPM SENSOR INTERFACE.**

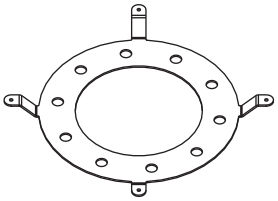


For old infield sprayers, a magnet mount bracket may be required:
10587803 – Magnet Mount Bracket 8-bolt
16020203 – Magnet Mount Bracket 10-bolt

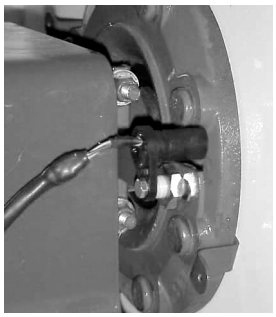
Note: the magnet mount brackets are used with both types of speed transducers even though magnets are not used with the proximity speed transducer.



10587803



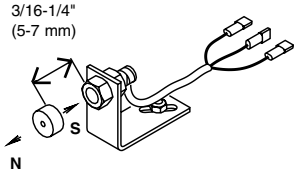
16020203



Proximity speed transducer

3 WIRE ADAPTER CABLE WIRE COLOR CODE

Wire color	Connection for transducer
WHITE	12V supply
BLACK	Ground
RED	Signal



SPEED, HALL- EFFECT, AND PROXIMITY SENSOR CABLE WIRE COLOR CODE

Wire color	Connection for transducer
BROWN	12V supply
BLACK	Ground
BLUE	Signal

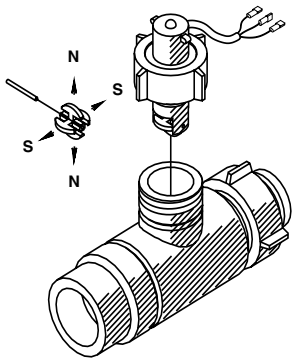
RPM SENSOR CABLE WIRE COLOR CODE

Wire color	Connection for transducer
BROWN	12V supply
BLACK	Ground
BLUE	Signal

FLOW TRANSDUCER CABLE WIRE COLOR CODE

Wire color	Connection for transducer
BROWN	12V supply
BLACK	Ground
BLUE	Signal

Note: Route the cables from the module to the sensor location hiding all excessive cable under the sprayer frame.



Installing Pressure Transducer

The optional pressure transducer is installed in one of the section feed hoses. A 3/4" tee (#322048) is installed in a convenient place in the hose (between the control and the boom). In a 3-feed boom, install the pressure transducer on the center hose. In a 4-feed or higher boom, install the pressure transducer on one of the center hoses (whichever is closest to the control). Thread the pressure transducer onto the tee. Route the cables back to the HARDI® Sprayer Control Module and plug the two wires into the appropriate terminals.

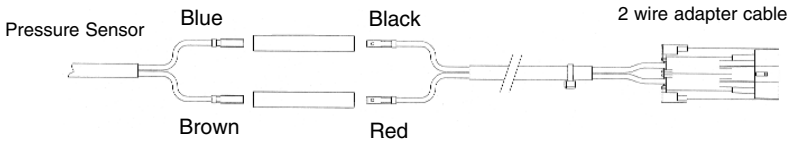
ADAPTER CABLE COLOR CODE

Wire color	**DESCRIPTION**
RED	+12V supply
BLACK	Signal

PRESSURE TRANSDUCER COLOR CODE

Wire color	**DESCRIPTION**
BROWN	+12V supply
BLUE	Signal

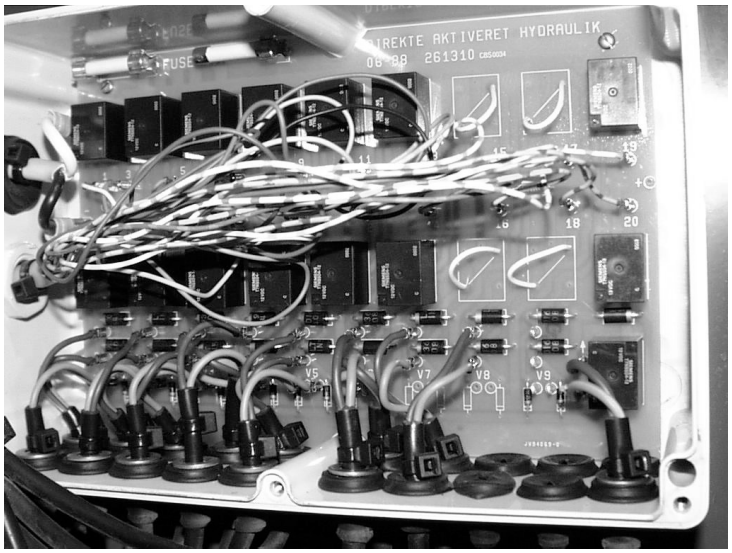
Route the Pressure Transducer Cable to the HARDI® Sprayer Control Module. Mate the wires as shown below. Be sure to slide a piece of heat shrink tubing over each wire before mating. Then shrink tubing by applying heat evenly along tube. Plug adapter cable into Sprayer Control Module pressure input, pigtail with Natural colored tie.



Installation: Twin force

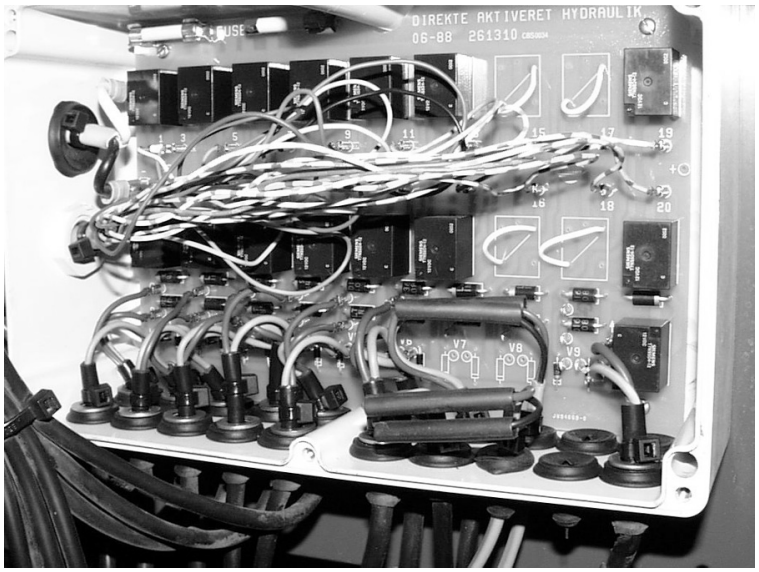
RPM and Slot Angle Adjust

First locate the electric over hydraulic control box at the back of the sprayer and remove cover. Locate the two cables coming from adjacent box connecting to V7 (slot angle) and V8 (RPM adjust), see picture below.



Electric over hydraulic junction box for twin force located on inside of twin force center section.

Route the two supplied 2-wire 25 foot adapter cables from the Sprayer Control Module to the electric over hydraulic control box. Be sure to mark the cables at the fling lead end with colored ties provided. Blue tie for RPM and gray tie for slot angle. At the electric over hydraulic control box, insert both adapter cables into hydraulic control box through separate spare rubber gromets at the bottom of hydraulic control box. Be sure to strain relief similar to other incoming cables. Pull the brown and blue wires at V7 from the board (slot angle adjust) and mate them with the slot angle adjust wires, red to blue and black to brown. Be sure to slide a piece of heat shrink over wires before mating.



Electric over hydraulic junction box for twin force located on inside of twin force center section.

Follow this procedure again for the RPM adjust at V8. Test for correct operation of slot angle adjust and RPM adjust before sealing heat shrink. Shrink tubing by applying heat evenly along length of tubing. Replace cover on hydraulic box.

7.0 CALIBRATION

In this chapter, we will help you calibrate your system specifically for your liquid application needs. Follow these procedures carefully to make sure you are properly prepared before you get to the field.

A Software Utility package is provided with each system. If you have access to a PC with CD drive, this software can be easily loaded onto a PC or Pocket PC. The Utility Software includes a calibration “wizard” that directs the operator through the MUSTANG calibration process and automatically sets up calibration for various types of systems. If the PC is connected to the MUSTANG, the calibration parameters can be downloaded directly to the MUSTANG, or the calibration settings can be printed out and entered into the MUSTANG manually. The Utility Software also provides the ability to reprogram the MUSTANG with program upgrade files provided by HARDI® via e-mail (or on floppy disk). See the Compact Disc you received with your MUSTANG Automatic Rate Controller.

A 9-pin RS-232 cable is used to connect the HARDI® MUSTANG 3500 to a PC, not Null Modem. The HARDI® MUSTANG 3500 must also be connected to a 12-volt DC power source in order to communicate with the PC.

We’ll begin with the System Calibration section.

Entering SYSTEM Calibration Values

The HARDI® MUSTANG 3500 has a number of control functions which are preset at the factory (See Factory Calibration Chart on page 51). In some cases, however, it may be necessary to change one or more of these settings to enhance performance or meet special operational requirements. To make these changes, you need to enter System Calibration. To enter System Calibration:

1. Turn the power switch OFF.

2. Place the AUTO/MAN/HOLD switch in the HOLD position.

3. Place the Rotary switch in the SPEED position.

4. While pressing the SYSTEM CAL button, turn the power switch ON.

   NOTE: The console will display “SYS” (SYSTEM) and “Cal” in the upper display window. The warning light will flash. See Figure 8.1.

Exiting System Calibration

5. When all necessary changes have been made, exit SYSTEM CAL. To do this, press the SYSTEM CAL button. All changes are immediately saved to memory.

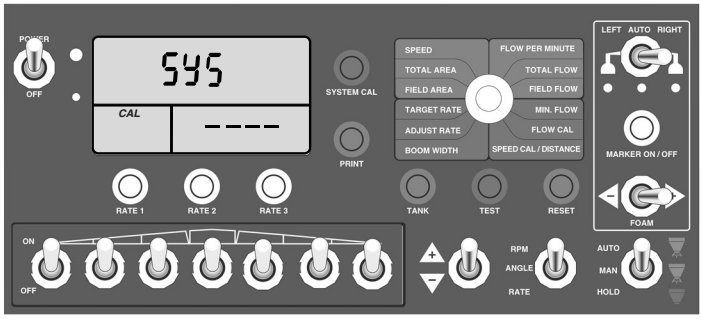
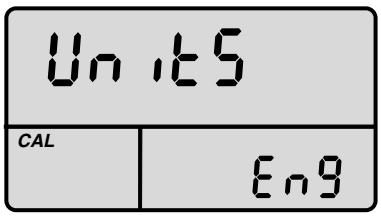


Fig. 8.1

Units (Default setting = 'Eng')

This “System Cal” position is used to select the units of measure for the system. The units of measure determine how data is displayed and how volume, distance and area calculations are made. Use the ADJUST switch to select the desired units of measure for the system.

Dial position: **Display will read:**



EnG = American English
mEt = Standard metric

UNITS OF MEASURE CHART

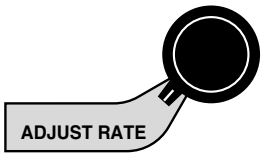
	ENGLISH	METRIC
AREA	Acres	Hectares
VOLUME	Gallons	Liters
SPEED	Miles/Hr.	Kilometers/Hr.
DISTANCE	Feet	Meters
PRESSURE	Pounds/Sq. In.	Bar
FLOW PER MINUTE	Gallons/Min.	Liters/Min.
SPRAY RATE	Gallons/Acre	Liters/Hectare

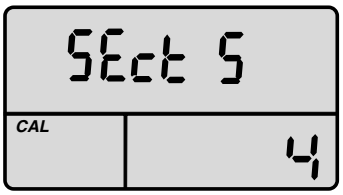
Flow Per Minute may optional show **ounces/min** (See "Tips" section of System CAL on page 31.

Sections (Default setting = factory preset)

The SYSTEM CAL position is used to set the number of sections the sprayer has. This number can be set to 3-7. This number is set at the factory, the operator should not need to adjust this setting.

Dial position: **Display will read:**





Dial position: **Display will read:**

Tips (Default setting = '0)

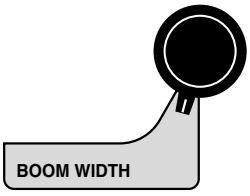
This SYSTEM CAL position is used to determine which type of Flow rate is displayed in the Flow Per Minute rotary position:

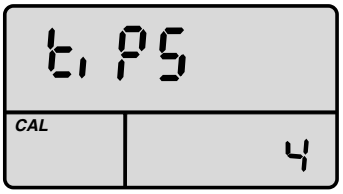
A) Flow for the entire boom - Flow Per Boom
When TIPS = 0
Gallons per minute (Liters per minute) is displayed for the entire boom

B) Flow for individual sprayer tip - Flow Per Nozzle
When set to a nonzero value (TIPS = typically 24-73) depending on boom size MAX ounces 6553.5 per minute

NOTE: It is very important to ensure that the total number of spray tips is entered or else the **Flow Per Nozzle** rate will be incorrectly calculated.

Dial position: **Display will read:**

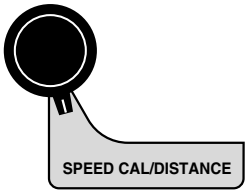


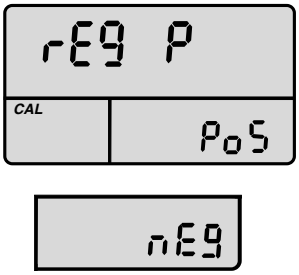


Regulation Polarity (Default setting = POS)

This SYSTEM CAL position can be used, if necessary, to change the polarity of the pressure regulation valve. The default setting (POS) should correct for most installations.

Dial position: **Display will read:**



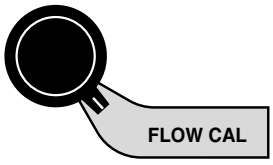


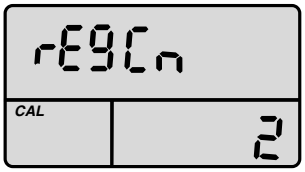
Regulation Constant (Default setting = 2)

This SYSTEM CAL position is used to make adjustment to how aggressive the regulation valve is allowed to operate when in AUTO mode. The default setting (2) should be correct for most installations.

A setting of "1" is the most aggressive, "8" is the least aggressive. If regulation valve tends to overshoot the target, increase this number. If more performance is required (response speed), decrease this valve

Dial position: **Display will read:**





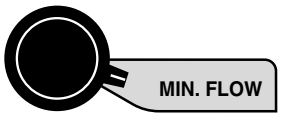
Sprayer Type (Default setting = Evc)

This SYSTEM CAL position is used to select the sprayer type, which controls the behavior of the section valves based on whether or not the system contains a MAIN vavle.

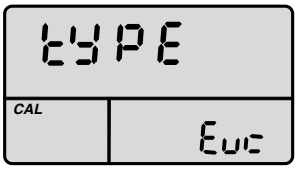
"EC": If the sprayer system has a MAIN on/off valve select "EC". With this setting, when console is put into HOLD, only the MAIN valve will shut off, the individual section valves are left alone.

"EVC": If MAIN valve is not present, select the "EVC". With this setting, when the console is put into HOLD, all section valves will be turned off.

Dial position:



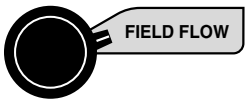
Display will read:



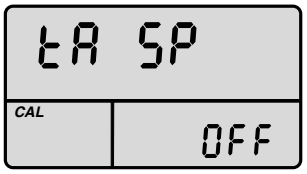
Tank Alarm Set Point (Default setting = OFF)

This SYSTEM CAL position is used to SET the audible alarm to alert the operator when the tank has reached this preset level. SET this value to the desired level in gallons (liters). NOTE: When the alarm activates, press the TANK button to shut off.

Dial position:



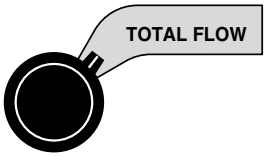
Display will read:

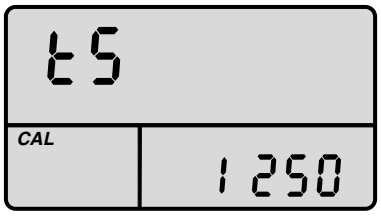


Tank Size: (Default setting = OFF)

This SYSTEM CAL position is used to set the value for the volume size of the main product tank. Adjust the value to match the volume size in gallons (liters).

Dial position: **Display will read:**





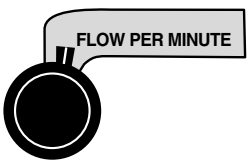
Filter: (Default setting = 1)

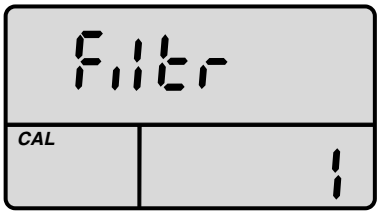
This SYSTEM CAL position adjusts the amount of filtering used to display the Application Rate value shown in the UPPER display window (gallons/acre) and Flow Per Nozzle value shown in lower right (ounces/minutes).
• Flow Per Nozzle is only displayed when "TIPS" is a nonzero number. If TIPS is set to 0. then the Flow Per Boom = gallons/minute (liters/minute)

The filtering only affects the amount of averaging and response time applied to the displayed values. All calculations and control elements of the electronic console uses the "raw" or the instantaneous values.

If filter is set to OFF, then all of the displayed values are shown "raw" or instantaneous. This can be used to help diagnose/troubleshoot system problems which could be causing flowmeter instability.

Dial position: **Display will read:**





Exiting System Calibration

Upon completion of the special calibration process, exit special calibration by simply pressing the SYSTEM CAL button. Proceed with Standard Liquid Calibration before beginning operation.

Before beginning operation, refer to Test Speed and Pre-field System Checkout on pages 37 and 38. This will confirm your calibration settings, nozzle selection and overall system performance.

Entering STANDARD Calibration Values

Once in calibration mode, you may change any one, all or none of the values, in any order. To enter calibration mode, simply turn the rotary selector to the desired calibration position. Use the ADJUST switch to adjust values. Calibration positions are identified as RED with white type (lower six positions).

Entering Standard Calibration

To enter calibration, proceed as follows:

1. Place the AUTO/MAN/HOLD switch in HOLD.
2. Turn the rotary dial to any of the six (RED) calibration positions. The console will display CAL and the warning light will flash. See Figure 8.2.

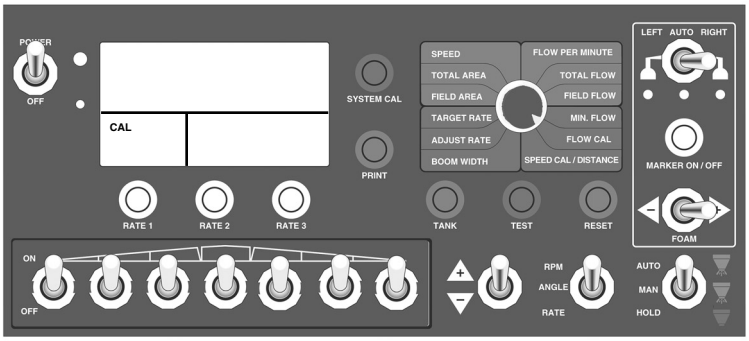
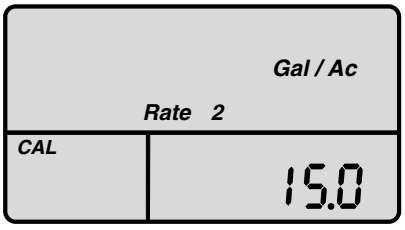


Fig. 8.2

Target Rate

This position is used to enter the value for the desired target application rate in GPA or LPH. Up to three rates can be programmed from 0.1 to 6553.5. Press RATE 1 to enter your first rate, RATE 2 to enter your second rate, and RATE 3 to enter your third target rate. Use the ADJUST switch to adjust the value displayed to the desired rate.

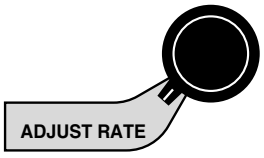
Dial position: **Display will read:**

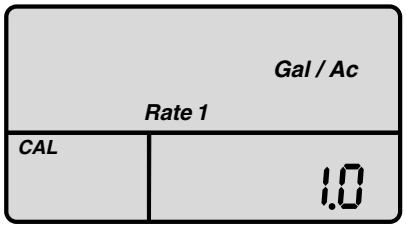


Note: If you will not be using the adjust rate feature, set the value to zero (0). This will help to prevent any accidental target rate changes.

Adjust Rate

Enter the value for the desired amount of change in GPH/LPH to be used for making on-the-go rate adjustments when operating in AUTO. You may set an adjust rate value for each target rate. Press RATE 1 to enter the adjust rate for Rate 1, press RATE 2 to enter the adjust rate for Rate 2, and press RATE 3 to enter the adjust rate for Rate 3. Use the ADJUST switch to adjust the value displayed to the desired rate.

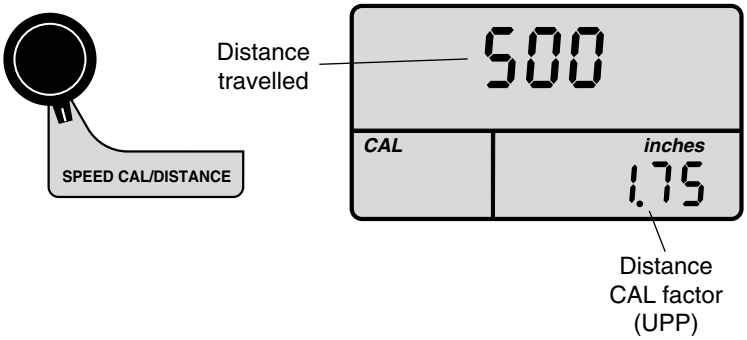




Speed Cal/Distance

This position is used to calibrate the speed transducer for accurate speed, distance and area measurement. When this position is selected, the display will show the Distance Cal value and the distance travelled. Either one may be used to calibrate for speed and distance measurement. (If using radar, enter factory calibration number.)

Dial position: **Display will read:**



Determining Distance/Cal Factor (UPP)

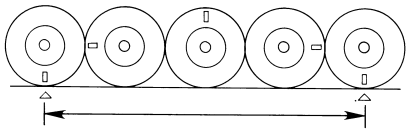
For the console to calculate the correct speed and measure distance and area accurately, the circumference of the sensor-equipped wheel must be determined. Determine the circumference of the sensor-mounted wheel, to the nearest tenth of an inch (thousandth of a meter), with the following method:

Mark the tire with a piece of chalk and measure the distance travelled on the ground for one complete revolution. See Figure 8.3. For improved accuracy, it is recommended to perform this function in field conditions, (with tank half-full), measure several revolutions, and take the average.

Divide the measured revolution by the number of magnets installed.

Divide the measured revolution by the number of magnets installed. Divide the result by two to get your starting UPP value. Once calibration of the system is complete,this number should be fine-tuned for optimum accuracy. Please refer to Fine-Tuning Speed/Distance Calibration Value on page 54.

Fig. 8.3

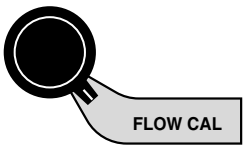


To determine circumference, measure the distance of one complete wheel revolution and divide by the number of magnets installed. Divide the result by two.

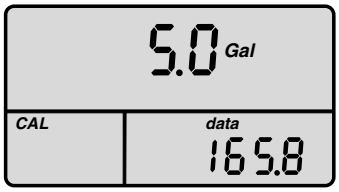
Flow Cal

This position is used to enter the flow cal number. It represents the number of pulses per gallon (PPU) for that particular flowmeter. The same value is used for both English and Metric. Use the ADJUST switch to enter this value. For pressure-based control (no flow meter installed), enter zero (0.0) as the flow meter calibration value. Please refer to Fine-Tuning Flow Transducer Calibration Value on page 56.

Dial position:



Display will read:



Theoretical Flow Meter Calibration (PPU)

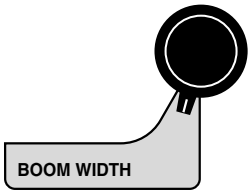
Control	Flow	Part #	Code	Orfice	PPU
EC	2-30 GPM	842020	White	13.5 mm	890.0
EC	4-70 GPM	842088	Black	20.0 mm	450.0
EC S67	2-30 GPM	842081	1 groove	13.5 mm	970.0
EC S67	4-70 GPM	842082	no groove	20.0 mm	450.0
EC S67	4-160 GPM	842228	2 groove	36.0 mm	950.0
ESC	2-30 GPM	842021	1 groove	13.5 mm	800.0
ESC	4-70 GPM	842098	2 groove	20.0 mm	450.0
EVC	2-30 GPM	842191	1 groove	13.5 mm	910.0

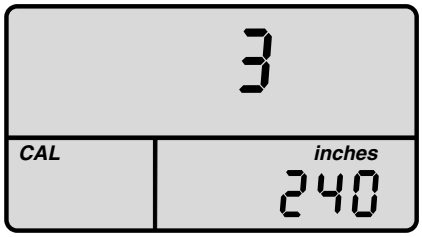
THESE ARE STARTING POINTS ONLY. FLOW MUST BE CALIBRATED!

Boom Width

Enter the working width, in inches (meters), for the boom section currently shown on the display. Use the ADJUST switch to adjust the displayed value to the correct width for the boom number (in the top display). Turn all booms off, display will read SELEC. Begin with the farthest right boom switch and work your way left, repeating this procedure for each boom section. **A value of "0" (.000) must be entered for any unused boom section.**

Dial position: **Display will read:**





Setting Individual Boom Width

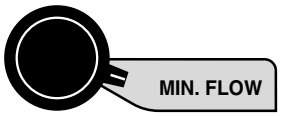
In order to accurately measure the number of units applied per acre, it is important to determine the correct "working" width. The working width is the width of ground being affected by any operation. This should be measured to the **nearest inch** (thousandth of a meter).

Your working width will be the number of nozzles on that boom section times the nozzle spacing in inches (mm). For example, if you have 7 nozzles spaced at 20 inches, the working width is 140 inches.

ADDITIONAL BOOM WIDTH FEATURE:

To adjust the constant pressure distribution valves, first toggle the master switch to MAN and the rotary switch to Non-Cal position and using the adjust switch, adjust the pressure regulating valve to your target application pressure. After reaching target pressure, rotate rotary switch to boom width position. After 5 seconds the output to each distribution valve will be electronically isolated allowing the distribution valve to be operated manually to adjust bypass to maintain constant pressure when distribution valve is turned off.

Dial position: **Display will read:**



Minimum Flow

The purpose of this calibration parameter is to set the minimum recommended flow rate for the spray boom and nozzles. Once set, the system will prevent the actual flow rate from going below the recommended minimum rating. You may set a minimum flow rate for each target rate.

Calculating minimum flow value:
Determine from your tip chart what your nozzle's minimum gallon per minute (liters per minute) rating is at their minimum recommended pressure. Do not use the gallon per minute of your actual application rate. For example, if the minimum flow rate per nozzle is .22 GPM at their minimum pressure and your spray boom has 20 nozzles (all sections), the minimum flow value is 4.4 (.22 x 20 = 4.4). The system will not apply at a rate lower than this value when spraying in AUTO.

Entering minimum flow values:
Each target rate may have a different setting for minimum flow. Press the RATE 1 button. The lower right portion of the display will show the minimum flow value. Use the ADJUST switch to adjust the displayed value to the calculated minimum flow rate value for the nozzles used for Rate 1.

Repeat the procedure for RATE 2 and 3. If the same nozzles are being used for Rate 2 and Rate 3, enter the same minimum flow value for those target rates. If different nozzles are being used, refer to nozzle manufacturer's Tip Chart.

Repeat the procedure for RATE 2 and 3. If the same nozzles are being used for Rate 2 and Rate 3, enter the same minimum flow value for those target rates. If different nozzles are being used, refer to nozzle manufacturer's Tip Chart.

APPLICATION NOTE: In certain situations when spraying in AUTO, your ground speed may be slow enough to result in an over-application error. In other words, based on ground speed, the actual flow rate for your application is below the calibrated minimum. Remember, in AUTO, the system will not allow the flow rate to drop below the calibrated minimum.

Control Type:

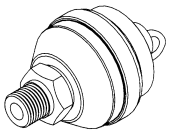
The following chart shows which values must be entered for each of the three control types offered in the HARDI® Mustang 3500.

Control Type	Flow Cal	Min Flow	Min Pressure
Flow	Y	Optional	N
Pressure	N	Y	Y
Hybrid	Y	Y	Y

Hybrid is defined as pressure based control with flow verify.

Pressure Sensor Zeroing

If your system is using an electronic pressure transducer, you must zero the pressure sensor. This procedure sets the zero point of the transducer. Until the pressure sensor is zeroed, the pressure display will be blank.



PROCEDURE:

1. Make sure the pressure transducer is installed with ZERO pressure (no pressure) present.
2. Place the AUTO/MAN/HOLD switchin HOLD.
3. Press and hold the SYSTEM CALbutton while toggling the ADJUST switch to "–".

NOTE: The pressure must be re-zeroed if a new transducer is installed. The pressure transducer can be turned OFF by loading factory defaults. See "Loading Factory Defaults", page 43.

Standard Factory-Loaded Calibration Values

Standard Cal	Purpose	Default Values	
		English	Metric
Target RATE 1	Application rate	20.0 gallons/acre	200.0 liters/hectare
Target RATE 2		20.0 gallons/acre	200.0 liters/hectare
Target RATE 3		20.0 gallons/acre	200.0 liters/hectare
Adjust RATE 1	Amount of increase or decrease per +/– press (During AUTO control)	1.0 gallons/acre	2.0 liters/hectare
Adjust RATE 2		1.0 gallons/acre	2.0 liters/hectare
Adjust RATE 3		1.0 gallons/acre	2.0 liters/hectare
Boom 1 Width	Area and application rate	120 inches	3.048 meters
Boom 2 Width		120 inches	3.048 meters
Boom 3 Width		120 inches	3.048 meters
Boom 4 Width		120 inches	3.048 meters
Boom 5 Width		120 inches	3.048 meters
Boom 6 Width		120 inches	3.048 meters
Boom 7 Width		120 inches	3.048 meters
Distance UPP	Speed, distance, area, rate	1.75 inches/edge	0.044 meters/edge
Flowmeter PPU	App. rate, flow rate	155.0	155.0
Min Flow 1	Lowest allowable flow rate in AUTO	0.0 gallons/minute	0.0 liters/minute
Min Flow 2		0.0 gallons/minute	0.0 liters/minute
Min Flow 3		0.0 gallons/minute	0.0 liters/minute

System Cal	Purpose	English	Metric
Units	Select units of measure	Eng	Met
Section	Number of sections sprayer has	3	3
Tips	Type of flow rate	0	0
Regulation Polarity	Change polarity of pressure regulation valve	Pos	Pos
Regulation Constant	Adjust aggressiveness of regulation valve	2	2
Type	Select sprayer type	Evc	Evc
Tank Set Point	Set alarm	Off	Off
Tank Size	Set value of volume size of main tank	Off	Off
Filter	Adjusts amount of filtering used in displays	1	1

Loading Factory Defaults

To load factory defaults, do the following:

1. Turn the rotary switch to the SPEED position.
2. Put the AUTO/MAN/HOLD switch in HOLD.
3. Hold the appropriate RATE key and the “+” switch during power-up.
   RATE 1 = English
   RATE 2 = Metric

NOTE: Loading factory defaults also clears total counter pair and F1field counter pair, and blanks the pressure display.

Exiting Standard Calibration

Upon completion of the calibration process, exit calibration by simply turning the rotary dial to any function other than the calibration functions (RED boxes with white type).

Before beginning operation, refer to Test Speed and Pre-field System Checkout on pages 43 and 44. This will confirm your calibration settings, nozzle selection and overall system performance.

About Test Speed

Test speed is a built-in ground speed simulator that is used in performing pre-field checks. When a typical operating speed is entered, the HARDI® MUSTANG 3500 will respond as if you were actually driving that speed. It allows you to simulate your spraying application with plain water, while remaining stationary, so that you can make certain that all of the equipment is operating properly and that your sprayer can actually perform the intended application. Test Speed will not accumulate distance or area.

Pre-field System Checkout

Before beginning actual spraying, perform the following “pre-field” procedure to ensure that your valve settings, nozzle selection and desired speed range will allow the HARDI® MUSTANG 3500 to provide the required application control. This procedure should be repeated for each new nozzle selection and/or application rate. By performing all of the steps listed below, you are setting up your system to allow the HARDI® MUSTANG 3500 to perform at optimum levels.

NOTE: Most nozzles will maintain a good pattern over a maximum speed range of two to one. (For example, if your maximum speed is 12, your minimum speed shouldn’t go below 6.)

Make sure you fill your sprayer tank with clean water. DO NOT use chemicals until the entire system is completely checked out and operating properly.

The MASTER switch reference in this procedure is the lower right switch labeled AUTO/MAN/HOLD.

1. Start vehicle and bring pump up to normal operating RPM. Make sure pressure does not exceed safe operating limits for your system.

2. Put the master switch in HOLD. Turn rotary switch to the SPEED position. Press the TEST button for three seconds. Use ADJUST switch to enter maximum application speed. The top display will read “TEST” and CAL will flash in the lower left display indicating TEST SPEED mode.

3. Put the master switch in “MAN” control mode; turn all active boom switches ON.

4. Turn rotary switch to FLOW PER MINUTE and hold ADJUST switch in the "+" position until application rate stops increasing. For approximately 30 seconds. Display should read higher than the desired application rate.

CAN'T GET THERE? If you can't get to the desired application rate, a problem may exist with the pump, nozzles or other plumbing components. Please refer to your Sprayer Manual.

Now is a good time to confirm that GPA, GPM, MPH, WIDTH and PSI all coincide with the nozzle manufacturer's charts. PSI may be slightly higher than indicated by the charts due to pressure drop across the plumbing valve, nozzle diaphragm check valve, nozzle screens, etc…

5. With the master switch in HOLD, turn the rotary dial back to the SPEED position. Use the ADJUST switch to enter minimum application speed. (Remember, the minimum application speed is normally not less than half of the maximum application speed.)

6. Put the master switch in "MAN" control mode; turn all active boom switches ON.

7. Turn the rotary dial to the FLOW PER MINUTE position and hold ADJUST switch in the "–" position until application rate stops decreasing. The display should now read less than the desired application rate.

It is not normally a problem if the application rate goes all the way to zero when holding the "–" switch, as long as it goes back up when the "+" switch is held.

CAN'T GET THERE? If holding the "–" switch does not get the application rate to go below the target application rate, please refer to your Sprayer Manual.

8. Put the master switch in HOLD and turn the rotary dial to the SPEED position. Use the ADJUST switch to enter target application speed.

9. Put the master switch in AUTO and turn the rotary dial to any of the upper six operating positions except SPEED. The console should take control and lock on to your calibrated target rate.

If you calibrated your ADJUST RATE to zero (.0), disregard steps 10 and 11.

10. Toggle the ADJUST switch up once and release. The display will momentarily show the new target rate (target rate + adjust rate) and then lock on to that rate.

11. Toggle the ADJUST switch down twice and release. The display will momentarily show the new target rate (target rate – adjust rate) and then lock on to that rate.

If the application rate was correctly displayed during manual (MAN) operation, but registered too high in automatic (AUTO) control, the calibration value for MIN FLOW may be set too high.

To exit Test Speed mode, place the console in HOLD, turn the rotary dial to the SPEED position and press the TEST button for three seconds. At this point, the Pre-field System Check-out is complete.

8.0 TROUBLESHOOTING

All HARDI® MUSTANG 3500 consoles and Sprayer Control modules are tested prior to packaging. Unless there has been damage in shipment, you can be confident that everything will be operational when you receive it.

However, if you do encounter a problem that appears to be related to equipment failure, PLEASE DO NOT OPEN THE CONSOLE OR SPRAYER CONTROL MODULE. Your system is protected by a warranty, and HARDI® will gladly correct any defect.

Many problems are the result of mistakes in installation or operation. Before returning any parts for service, carefully check your installation and review the operating instructions. For easy-to-follow guidelines, refer to the troubleshooting section which follows.

Console Appears Dead
Using your test light, check for 12 volts at the power source. Also check for damaged power cable or reversed terminals. (Console requires 12 volts for proper operation.)

Speed is Always Zero or Erratic
Check for properly calibrated wheel circumference.

Review speed sensor installation. Check for proper mounting, alignment and spacing of speed sensor in relationship to magnet assembly. Distance between sensor and magnet must not exceed 1/4". Make sure magnet polarities are all south pole. Also check cable for breaks or incomplete connection.

For more suggestions/solutions to speed problems, see page 37.

Area Count is Inaccurate
Implement width or wheel circumference was measured incorrectly or programmed incorrectly. Go back through the original procedures, make changes, and test for acre (hectare) count again. Verify accuracy with this formula:

Acres = Distance x Width in feet/43560
Distance Count is Inaccurate

Distance/Cal Factor (UPP) was incorrectly measured or entered. Review calibration, readjust and test.

No Readout of Gallons (liters), or Gallons (liters) per Minute
Check to see that the sprayer pump and equipment are operating properly. If liquid is moving through the line, check the flow sensor to be sure it is screwed all the way into the flowmeter.

Check to see that a FLOW CAL number has been entered. Also check cables for breaks or incomplete connections.

If the flowmeter is new or has not been used for a long period of time, the paddle wheel may be sticky. Flushing the system out with water should make the paddle wheel spin freely.

Flow rate may be too low to register a reading, or foreign material may be lodged in the flowmeter.

Total Liquid Used is Inaccurate

NOTE: Make sure the sprayer's flow return adjusting valves are set properly. See your sprayer's operating manual for details, or see Appendix B for basic instructions.

This may result from an incorrectly entered FLOW CAL value. If the meter has been used frequently, wear may have changed the FLOW CAL value. See Fine-Tuning Flowmeter Calibration on page 56.

Confirm that the proper width has been entered for each boom section.

6553.5 Message Displayed in Rate Mode
If this number appears when your equipment is standing still, it indicates that the boom valves are open or not completely closed and liquid is passing through the system.

NOTE: 6553.5 may also temporarily appear when valves are closed if liquid is sloshing back and forth through the flowmeter, or if a portion of the line drains out. In this case, no corrective action is required.
If this message appears when you are in motion with the sprayer on, it indicates that speed sensor impulses have been lost.

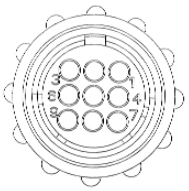
Displayed Measurements Do Not Make Sense
The console may be in the incorrect measurement mode (English or Metric Units). See page 30 for details.

Display Reads "OFL"
Speed Cal/Distance, Total Area, Sub Area and Total Flow will read OFL when they have exceeded their maximum count. Reset to zero to resume counting. Add maximum count of each counter.

Display Reads "rHOLD"
When the display reads "rHOLD," the console is in remote hold. Check for proper installation of optional remote run/hold foot switch.

Display Reads "BAD CAL"
Press RESET to clear, then verify all calibration parameters are correct. If message returns, load factory defaults. If problem persists, consult factory.

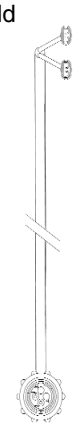
CHECKING INDIVIDUAL COMPONENTS



Console Power Cable:
Using a voltmeter, test for voltage between pins 2 and 3 at the 9 pin connector of the console power cable. If voltage test fails, check fuse on system power cable.

Remote Run/Hold Input: Toggle the master switch to MAN. Connect the remote Run/Hold cable to the back of the console. Shorting the terminals at the end of Run/Hold cable together should cause the display to read rHold (remote hold). If not, check for cut or pinched wires.

Run/Hold Cable



Speed Input: Turn the rotary dial to the speed position and disconnect the speed sensor (yellow tie) from SCM. Check for 12 volts between pins B (white) and C (black) of the speed input cable (yellow tie). Using a clip lead or other jumper wire (such as a paper clip bent in a "U"), rapidly short together pins A (red) and C (black) of the 3-pin connector several times. The console should respond with some speed reading. If

not, check for cut or pinched wires.

TESTING THE SPEED TRANSDUCER:

Wire connections: BROWN wire to positive of 12V battery
BLACK wire to negative
BLUE wire to positive lead of multimeter

1. Connect negative lead of multimeter to negative post of 12V battery
2. Set multimeter to DC volt
3. Bringing the south pole of a magnet to a distance of 3/16" (5-7mm) from the transducer will register 0.3 +/- 0.1 volt
4. Removing the magnet will register 7.0 +/- 1.0 volt

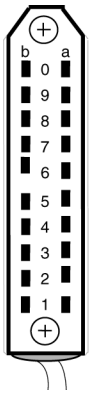
TESTING THE FLOW TRANSDUCER:

Wire connections: BROWN wire to positive of 12V battery
BLACK wire to negative
BLUE wire to positive lead of multimeter

1. Make sure the rotor turns freely.
2. Each vane in the rotor has a magnet in it with the pole facing out Check that the 4 magnets are in place.
3. Check every second magnet has the same pole orientation so the rotor magnets are N - S - N - S.
4. Connect negative lead of multimeter to negative post of 12V battery.
5. Set multimeter to DC volt.
6. By turning the mill wheel slowly, this will register approx. 8.0 +/- 1 volt with the diode on and 0.3 +/- 0.1 volt with the diode off with every second magnet.

Flow Input: Turn the rotary dial to the flow rate position and disconnect the flow sensor (green tie) from the SCM. Check for 12 volts between pins B (white) and C (black) of the main harness flow input (green tie). Using a clip lead or other jumper wire (such as a paper clip bent in a “U”), rapidly short together pins A (red) and C (black) of the 3-pin connector several times). The console should respond with some flow per minute reading. If not, harness may be defective. Check for cut or pinched wires.

RPM Input: (Twin Force): Toggle the MODE switch to RPM and disconnect the RPM sensor (yellow tie) from SCM. Check for 12 volts between pins B (white) and C (black) of the RPM input cable (red tie). Using a clip lead or other jumper wire (such as a paper clip bent in a "U"), rapidly short together pins A (red) and C (black) of the 3-pin connector several times. The console should respond with some RPM reading. If not, check for cut or pinched wires.

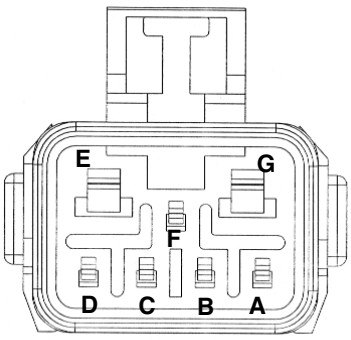


7 - Section	6 - Section	5 - Section	4 - Section	3 - Section
No Connection	No Connection	No Connection	No Connection	No Connection
Regulating Valve	Regulating Valve	Regulating Valve	Regulating Valve	Regulating Valve
Main On/Off	Main On/Off	Main On/Off	Main On/Off	Main On/Off
Section 7				
Section 6	Section 6	Section 5	Section 4	
Section 5	Section 5	Section 4	Section 3	Section 3
Section 4	Section 4	Section 3		Section 2
Section 3	Section 3	Section 2	Section 2	Section 1
Section 2	Section 2	Section 1	Section 1	
Section 1	Section 1			

Pressure Sensor:
The only way to field test the pressure sensor is to connect it to a known working console, apply pressure and verify the correct pressure reading on the console display.

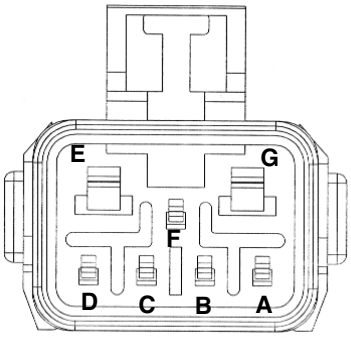
The pressure sensor is a 145 PSI (10 bars), 4-20 mA (industry standard).

Power/Serial I/O Connector Leading to Sprayer Control Module:
Using a voltmeter VM, check for +12V between G an E. If no voltage present, check power cable fuse**.**



Foam Marker Output from Sprayer Control Module:
Enable the foam marker at the console by pressing the marker On/Off button and toggle the Left/Auto/Right switch to the right. Place the Master switch in MAN and toggle at lease one section on.

Using a voltmeter VM, check for +12V between G and E. With the negative lead touching G and positive to E. Keep the negative lead touching G and touch the positive lead to D - should be a +12V. With the negative lead remaining on G, and a jumper (a paper clip works well) between G and C, touch the positive lead to F. It should measure between 5.8 and 6.8 volts. If foam rate is set to 0, it will be closer to 6.8 volts, if set to 100, measurement will be closer to 5.8 volts. Remove jumper. With the negative lead remaining at G, touch the positive lead to A. This is a 2 hertz signal so a steady voltage reading will not be measured. However, pulsing should be visible on the VM if the foam rate is set to 50. Now toggle the Left/Auto/Right switch to the left and check for +12V at position B with the negative lead on G.



20 Pin Module Connector Troubleshooting:

To test outputs at 20 pin connector, use a voltmeter (VM). Set the meter to read voltage and voltage scale to 20 volts or greater. Insert negative lead into A side of 20 position connector at Sprayer Control Module. Insert positive lead into B side of connector. For section valve output, Main On/Off Valve or Pressure Regulating Valve in question.

To test section valve outputs, place the Master switch in Man and toggle the section switch on. The VM should read approximately +12V, toggling the section switch off the VM should read approximately -12V. If section valve output tests good but valve does not operate, check for broken connection between connector and valve. If section test fails, be sure to check number of sections setting in System Cal.

To test the MAIN ON/OFF valve, place the master switch in MAN, the VM should read approximately +12, with the master switch in HOLD the VM should read -12V. If MAIN ON/OFF valve output test checks is good - but valve does not operate,check for broken connection between connector and valve.

To test the pressure regulating valve output, place the switch in MAN. While holding the adjust switch in the "+" position, the VM should read -12V. While holding the adjust switch in the "-" position, the VM should read =+12V.

If nEg was selected in System Cal under rEgP, then voltage test will be opposite of aforementioned. If pressure regulating valve output tests good but the valve does not operate, check for broken connection between connector and valve.

APPENDICES

APPENDIX A: FINE-TUNING SPEED CAL / DISTANCE CALIBRATION VALUE

This procedure is used to verify the calibration of the system. In order to achieve accurate measurements, each step in this fine tuning procedure should be performed as precisely as possible.

Preparation:

- Once the system is fully installed and calibrated, select a straight tract of ground that is similar to your actual field conditions and as level as possible.

  NOTE: Using a course with a different ground surface, such as a hard-surface road, will result in different readings than exact field conditions.

- Measure a distance of 1000 feet (300 meters). Clearly mark the beginning and end points with flags or something highly visible to the operator.

Procedure:

1. Place the console in HOLD. The display will read HOLD. Turn the rotary dial to the “SPEED/CAL DISTANCE” position. Be sure the display shows “0.” If not, reset the distance counter by pressing and holding “RESET” until the display returns to 0.

2. You are now ready to drive the measured course. Pick a location on the vehicle to use as a marker for starting and stopping the distance counting function (e.g. door handle, mirror, step). You should begin to drive the course well ahead of the starting flag and drive past the ending flag, using the AUTO/MAN/HOLD switch to start and stop the counting function. It is not recommended to start from a dead stop at the starting flag and stop at the ending flag.

3. Place the console in MAN when the marker on the vehicle passes the starting flag to activate the distance counting function. The console display numbers will increase, adding to the distance total as you drive. Drive the pre-measured course and place the console in HOLD when the marker on the vehicle passes the ending flag to stop the distance counting function. Stop the vehicle

in a safe and level area and continue with this procedure.

4. Toggle the ADJUST switch to adjust the upper display until it matches the actual distance traveled. This will also fine-tune the Distance Cal factor in the lower right display. See Figure below.

5. When the number shown on the display matches (as closely as possible) the actual distance driven, you have arrived at the correct calibration value.

To verify proper calibration, repeat the procedure a second time. Write down the Distance Cal Factor (UPP) number (lower right display) and keep it in a safe place. If the calibration values are ever accidentally changed, you can simply re-enter this number.

APPENDIX B: FINE-TUNING FLOW TRANSDUCER CALIBRATION VALUE

This procedure is used to verify and fine-tune the flowmeter calibration. **NOTE: Make sure the sprayer's flow return adjusting valves are set properly. See your sprayer's operating manual for details.**

Method 1:

1. Put enough water in the sprayer tank to perform this test. (Preferably 100 gallons or more. The larger the volume of water used, the more accurate the calibration.)

2. Start the sprayer pump, and with the Master Switch in HOLD, turn on all section valves. Place the Master Switch in MAN and run enough water to purge all air from the lines. Turn off section valves by placing the Master Switch in HOLD, but leave pump running.

3. Turn the rotary dial to the FLOW CAL position. Press and hold the RESET button until the display reads 0.

4. Place the Master Switch in MAN, and run a known amount of water (preferably 100 gallons or more).*

5. Place the console in HOLD to turn off section valves. Compare the console's TOTAL FLOW reading (top display) with the known amount of water run. If the two amounts are within one or two percent, no fine-tuning is required and you may continue set-up. If the two amounts are more than one or two percent different, continue with the next step.

6. Toggle the ADJUST switch to adjust the upper display until it matches the actual amount run. This will also fine-tune the Flow Cal factor (PPU) in the lower right display.

To verify proper calibration, repeat the procedure a second time. Write down the new Flowmeter Calibration value (lower right display) and keep it in a safe place. If the calibration values are ever accidentally changed, you can simply re-enter this number.

* The most accurate method to measure the volume of water run is to place a container under EVERY nozzle and add together the amount

from each nozzle. This assures that 100% of the water is collected and that all nozzles are spraying equally. It is important to perform this procedure at a flow rate similar to that which will be used in the field.

Method 2:

Check your Flow per Nozzle

If the total number of nozzles was entered into SYSTEM CAL, then the flow per minute position of the rotary switch displays flow per nozzle per minute in ounces per minute or liters per minute in metric. To verify accuracy of flowmeter calibration perform the following procedure:

1. Put enough water in the sprayer tank to perform this test, 100 gallons or more.
2. Start the sprayer pump, and with the master switch in HOLD, turn on all section valves.
3. Turn the rotary switch to Flow Per Minute position.
4. Toggle the master switch to MAN.
5. Using the adjust switch, adjust the pressure to your target pressure.
6. After 30 seconds, note the reading in the lower right area of the display. This is the flow per nozzle in ounces per minute or liters per minute, in metric.
7. Using a container with fluid ounce graduation markers, catch the flow at each nozzle for one minute, record each catch - add all of the catch tests together and divide the sum by the number of nozzles tested. If the result is less than 2% of the value displayed in flow per minute, do not change Flow Cal. If result is greater than 2%, adjust the Flow Cal number by that percentage. This is an inverse relationship, so if the catch test was 5% greater than displayed value, reduce the Flow Cal by 5%. After adjusting Flow Cal, it is strongly recommended to run catch test again to verify.

APPENDIX C: USING AN EXTERNAL PC TO CONTROL THE MUSTANG 3500

An external computer (PC or Pocket PC) running a Variable Rate Application (VRA) program can be used to remotely control the HARDI® Mustang 3500. An example of a VRA program which supports the Mustang 3500 is FarmWorks® "SiteMate". Note that the Mustang 3500 has the capability to accept the following remote commands from an external PC:

1) Change the current Target Application Rate (if PC sends any Target rate > 0)

2) Stopping the sprayer by placing the system in HOLD (if PC sends a Target rate of "0")

3) Remotely control individual boom sections (*only if VRA program provides the capability)

STANDARD VRA MODE OPERATION

Entering VRA Mode:

As soon as the Mustang 3500 receives the first initial target rate from the VRA program, the console enters "VRA mode". The following list describes differences between "normal" operation mode and "VRA mode": When VRA mode is activated:

• The "1", "2", or "3" icons which normally appear next to the "Rate" icon in the upper display, disappear, leaving just the "Rate" icon on. This indicates that the console is now in VRA mode.

• The Target Adjust feature is disabled.

• The console display always shows the actual application rate. If the user presses the Adjust switch, then the current target rate is shown for 2 seconds after which it reverts to showing actual application rate.

Exiting VRA Mode:

To return to normal operating mode, disconnect the serial cable from the PC, then cycle the power switch.

VRA OVERRIDE MODE

When the Mustang 3500 is being controlled by a VRA Application running on an external PC, the console also provides the capability to "override" the external computer if necessary. For example, in an emergency situation where a user needs to stop spraying, moving the console Master switch to "HOLD" overrides the current prescription being sent to the console by external PC. Likewise, if a user sees conditions where it is desirable to deviate

from the external PC's prescribed rate, there are two methods to override VRA mode, either Manual override or Automatic override.
Note that while in any form of "override" the console will continue to rreceive and store any new VRA Targets sent by the PC, but it will not use them until the user decides to re-enter VRA mode in which case the console will immediately be synchronized with the external PC and its currently prescribed application rate.

MANUAL OVERRIDE:

If the Master switch is moved to "MAN" the user can override the current prescribed VRA target rate by using the adjust switch to make the necessary adjustment to the application rate.
The user can also override a VRA "Hold" condition in a similar manner. The external VRA program places the console in Hold by send a Target of "0", which stops the sprayer. If the user sets the Master switch to "Man", it overrides the PC "Hold" condition (console displays "Phold") turning the sprayer back on and allowing the user to adjust the rate manually using the INC/DEC switch.
To return to VRA mode, move the Master switch back to "AUTO". The console display shows the current status prescribed by the PC, either a VRA application rate or "Phold".

AUTOMATIC OVERRIDE:

Pressing either the Rate 2 or Rate 3 key will override VRA mode, and instead allows the use of two alternative rates that still operate under automatic control.

Note the differences when in Automatic Override mode:

• The "Rate" icon is now followed by a "2" or "3" which indicates the VRA mode is not active (overridden).

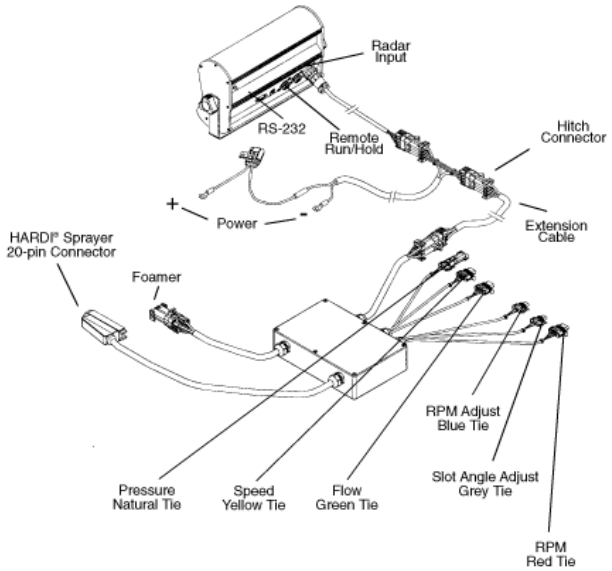
• The top display will shown any new user selected Target for 2 seconds (same as in normal operation).

• The Adjust switch functions as normal, to increase or decrease Target 2 or 3 by the "AdjustRate" amount.

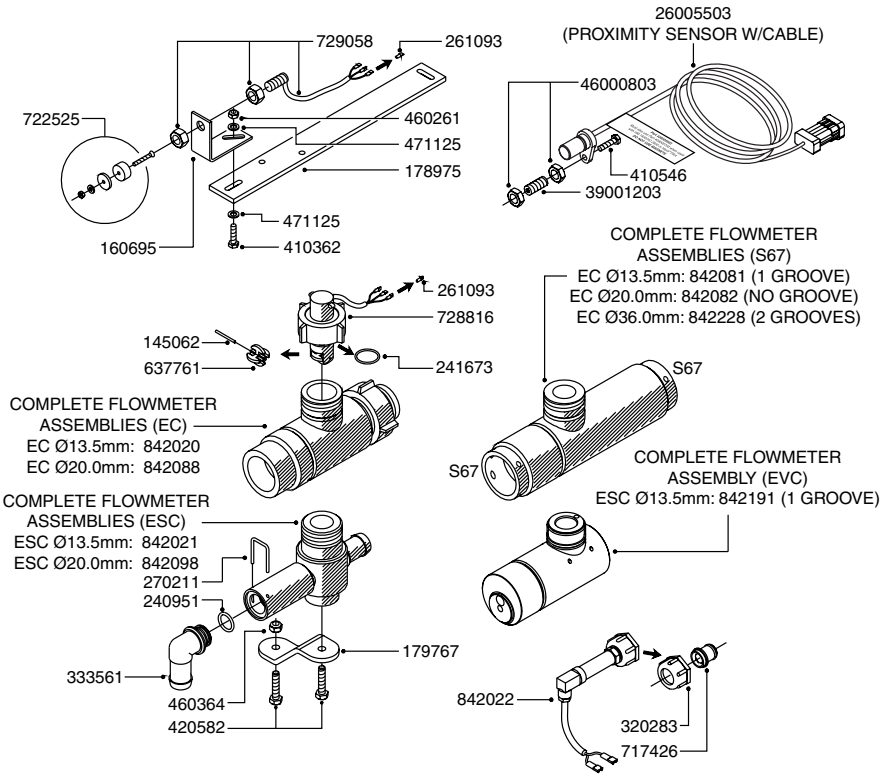
If the user presses the Rate 1 key the console will reactivate VRA mode and resume using the external PC's prescribed rate.

APPENDIX D: REPLACEMENT PARTS LIST

HARDI® Part #	Item Description
26002103	3500 3-section Console
26002203	3500 4-section Console
26002303	3500 5-section Console
26002403	3500 6-section Console
26002503	3500 7-section Console
26002603	3500 4-section Twin Force Console
26002703	7-section SC Module
26002803	4-section Twin Force SC Console
26002903	3500 Console Mount Kit
26003003	3500 Console Cable - 9 pin CPC to 7 pin Mixed
26003103	7-section SC Module Adaptor Cables
26003203	4-section Twin Force SC Module Adapter Cables
26001803	Power Cable
26003303	5' 7 pin Extension Cable
26003403	10' 7 pin Extension Cable
26001903	15' 7 pin Extension Cable
26003503	20' 7 pin Extension Cable
26003603	25' 7 pin Extension Cable
26003703	Console Run/Hold Adapter Cable
26003903	Mustang 3500 Utilities CD
26004403	Fast Switch for Run/Hold Adaptor Cable
67301603	Mustang 3500 Operator's Manual



TRANSDUCERS



WARRANTY POLICY AND CONDITIONS

HARDI® INC., 1500 West 76th Street, Davenport, Iowa, USA; 5646 W. Barstow, Fresno, California, USA; and 290 Sovereign Road, London, Ontario, Canada hereinafter called "HARDI®", offers the following limited warranty in accordance with the provisions below to each original retail purchaser of HARDI® new equipment of its own manufacturer, from an authorized HARDI® dealer, that such equipment is at the time of delivery to such purchaser, free from defects in material and workmanship and that such equipment will be warranted for a period of one year from the date of delivery to the end user providing the machine is used and serviced in accordance with the recommendations in the Operator's Manual and is operated under normal farm conditions.

1. This limited warranty is subject to the following exception:
   a) This warranty will be withdrawn if any equipment has been used for purposes other than for which it was intended or if it has been misused, neglected, or damaged by accident, let out on hire or furnished by a rental agency. Nor can claims be accepted if parts other than those manufactured by HARDI® have been incorporated in any of our equipment. Further, HARDI® shall not be responsible for damage in transit or handling by any common carrier and under no circumstances within or without the warranty period will HARDI® be liable for damages of loss of use, or damages resulting from delay or any consequential damage.

2. HARDI® cannot be held responsible for loss of livestock, loss of crops, loss because of delays in harvesting or any expense or loss incurred for labor, supplies, substitute machinery, rental for any other reason, or for injuries either to the owner or to a third party, nor can HARDI® be called upon to be responsible for labor charges, other than originally agreed, incurred in the removal or replacement of components.

3. The customer will be responsible for and bear the costs of:
   a) Normal maintenance such as greasing, maintenance of oil levels, minor adjustments, etc.
   b) Transportation of any HARDI® product to and from where the warranty work is performed.
   c) Dealer travel time to and from the machine or to deliver and return the machine from the service workshop for repair.
   d) Dealer traveling costs.

4. This warranty will not apply to any product which is altered or modified without the express written permission of HARDI® and/or repaired by anyone other than an Authorized Service Dealer.

5. Warranty is dependent upon the strict observance by the purchaser of the following provisions:
   a) That this warranty may not be assigned or transferred to anyone.
   b) That the Warranty Registration Certificate has been correctly completed by dealer and purchaser with their names and addresses, dated, signed and returned to the appropriate address as given on the Warranty Registration Certificate.
   c) That all safety instructions in the operator's manual shall be followed and all safety guards regularly inspected and replaced where necessary.

6. No warranty is given on second-hand products and none is to be implied.

7. HARDI® reserves the right to incorporate any change in design in its products without obligation to make such changes on units previously manufactured.

8. The judgement of HARDI® in all cases of claims under this warranty shall be final and conclusive and the purchaser agrees to accept its decisions on all questions as to defect and to the exchange of any part or parts.

9. No employee or representative is authorized to change this warranty in any way or grant any other warranty unless such change is made in writing and signed by an officer of HARDI® at its head office.

10. Any warranty work performed which will exceed $400.00 MUST be approved IN ADVANCE by the Service Manager.

11. Claims under this policy must be filed with HARDI® within thirty (30) days of work performed or warranty shall be void.

12. Parts requested must be returned prepaid within thirty (30) days for warranty settlement.

13. Warranty claims must be PROPERLY COMPLETED or they will be returned.

DISCLAIMER OF FURTHER WARRANTY

THERE ARE NO WARRANTIES, EXPRESSED OR IMPLIED, EXCEPT AS SET FORTH ABOVE. THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE DESCRIPTION OF THE PRODUCT CONTAINED HEREIN. IN NO EVENT SHALL THE COMPANY BE LIABLE FOR INDIRECT, SPECIAL OR CONSEQUENTIAL DAMAGES (SUCH AS LOSS OF ANTICIPATED PROFITS) IN CONNECTION WITH THE RETAIL PURCHASER'S USE OF THE PRODUCT.

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