

Synchro™

Spray Application

Operator Manual



Thank you for your business!

At CapstanAG, our goal is to redefine the way people do their chemical application. Our PWM control systems have been setting the bar for maximum productivity for more than 20 years. Our focus on performance, support, and education have dramatically changed the landscape of agricultural chemical application.

CapstanAG specializes in creating proprietary systems for the agricultural industry, primarily focusing on chemical and fertilizer applications. Our inventive process involves research, engineering, design, and lab and field testing.

Service Contact Information

If a problem occurs with your system that cannot be corrected with the information in this manual, please contact your dealer for service and technical assistance. If further assistance is needed, contact CapstanAG.

System Purchased: _____

Dealer: _____

Contact: _____

Phone: _____

Address: _____

City,State/Province, Zip: _____

Factory Service/Repairs

CapstanAG

4225 S.W. Kirklawn Ave. | Topeka, KS 66609

Hours: 8:00 a.m. to 4:00 p.m. CST

Toll-free number: (855) 628-7722 | Fax: (785) 232-7799

CapstanAG.com | CapstanAG.ca

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Chapter 1: Safety

Signal Words



DANGER: Indicates an imminent hazard which, if not avoided, will result in death or serious injury. This signal word is limited to the most extreme situations, typically for aircraft components that, for functional purposes, cannot be guarded.



Warning: Indicates a potential hazard which, if not avoided, could result in death or serious injury, and includes hazards that are exposed when guards are removed. It may also be used to alert against unsafe practices.



CAUTION: Indicates a potential hazard which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

Important: This is used to draw attention to specific information that is necessary for the operation, setup, or service of the system.

Note: This is used for additional information that can help understand or operate the system.

Emergency Safety

Fire extinguishing systems must meet the applicable OSHA requirements, and all users of portable/ fixed fire suppression equipment must know the types, limitations, and proper uses of this equipment; including hazards involved with incipient stage firefighting.

Keep emergency numbers for doctors, ambulance service, hospital, and fire department near your telephone.

Know the location of fire extinguishers and first aid kits and how to use them.

Examine the fire extinguisher and service the fire extinguisher regularly.

Follow the recommendations on the instructions plate.

Very small fires can be put out (extinguished) with a fire extinguisher. Use an appropriate method to extinguish a fire (water for paper fires, and chemical extinguishers for electrical or chemical fires).

Personal Protective Equipment

Wear close-fitting clothing and the correct personal protective equipment (PPE) for the job. See the specific chemical manufacturer documentation or other information for correct PPE.

Pressurized Fluid Lines

Do not heat by welding, soldering, or using a torch near pressurized fluid lines or other flammable materials. Pressurized lines can accidentally burst when too much heat is present.

Chemical Safety

Chemicals used in agricultural applications can be harmful to your health and/or the environment if not used correctly. Always follow all label directions for effective, safe, and legal use of agricultural chemicals.

Battery Safety

Use the procedure in the appropriate agricultural equipment manual for connecting, disconnecting, and jump-starting the machine's battery.

Keep sparks and flames away from the battery. Battery gas can explode and cause serious injury. Do not smoke in the battery charging area.

Remove jewelry, which might make electrical contact and create sparks.

Chapter 2: Warranty

Limited Warranty

What does the Limited Warranty cover?

The ultimate purchaser/user (“you”), by acceptance of seller Capstan Ag Systems, Inc.’s, (“our,” “we,” or “us”) product, assume all risk and liability of the consequences of any use or misuse by you, your employees, or others.

All replacement components furnished under this warranty, but shipped before the failed component is returned for evaluation, will be invoiced in the usual manner and warranty adjustments will be made after the component claimed to be defective has been returned to and inspected and deemed defective by us at our factory.

Upon determining that a component has failed under warranty, the repaired component or replacement component, furnished under this warranty, will be shipped at our expense, to your location. We will credit you an amount equal to the incoming freight you paid. We shall not be responsible for installation costs. (You shall be responsible for all customs and brokerage fees for all international transactions.)

If the component does not prove to be defective, you shall be liable for all freight, inspection, and handling costs. In no event will any claim for labor or incidental or consequential damages be allowed for removing or replacing a defective product. Warranty will be denied on any component which has been subject to misuse, abuse, accidents, or alterations, or to improper or negligent use, maintenance, storage, transportation, and handling.

Our liability under this warranty, or for any loss or damage to the components whether the claim is based on contract or negligence, shall not, in any case, exceed the purchase price of the components and upon the expiration of the warranty period all such liability shall terminate. The foregoing shall constitute your exclusive remedy and our exclusive liability.

The terms of this warranty do not in any way extend to any product which was not manufactured by us or one of our affiliates.

While necessary maintenance or repairs on your CapstanAG product can be performed by any company, we recommend that you use only authorized CapstanAG dealers. Improper or incorrectly performed maintenance or repair voids this warranty.

The foregoing warranty is exclusive and is in lieu of all other warranties expressed or implied. We shall not be liable for any incidental or consequential damages resulting from any breach of warranty.

Your exclusive remedy for breach of warranty shall be repair or replacement of defective component(s): Provided, if the component(s) are incapable of being repaired or replaced, your exclusive remedy shall be credit issued, but such credit shall not exceed the purchase price of the components.

On any claim of any kind, including negligence, our liability for any loss or damage arising out of, or from the design, manufacture, sale, delivery, resale, installation, technical direction of installation, inspection, repair, operation of use of any products shall in no case exceed the purchase price allocable to the components.

In no event, whether as a result of breach of contract or warranty or alleged negligence, shall we be liable for incidental or consequential damages, including, but not limited to: personal injury, loss of profits or revenue, loss of use of equipment or any associated equipment, cost of capital, cost of substitute equipment, facilities or services, downtime costs, environmental damage, crop losses, or claims of customers of you for such damages.

What is the period of coverage?

We warrant to you that our products are free from defects in material and workmanship in normal use and service for a period of one year from date of purchase.

How do you get service?

Our obligation under this warranty shall be limited to the repairing or replacing at our option, the component which our inspection discloses to be defective, free of charge, return freight paid by us, provided you: (i) Notify us of defect within thirty (30) days of failure; (ii) Return the defective component to us, freight prepaid; (iii) Complete the Owner Registration Form and returned it to us; and (iv) Establish that the product has been properly installed, maintained and operated in accordance with our instructions or instructions contained in our operations or maintenance manuals and within the limits of normal usage.

Any claim for breach of our warranty must be in writing addressed to us and must set forth the alleged defect in sufficient detail to permit its easy identification by us. All breach of warranty claims must be made within thirty (30) days after expiration of the warranty period, which is applicable to the defective product. Any breach of warranty claim not timely made will not be honored by us and will be of no force and effect. Any component that needs to be repaired or evaluated for warranty has to be authorized before return. Contact the factory (785-232-4477) to get a Return Materials Authorization (RMA #). This helps to track the part coming into the factory for repair or replacement.

Before returning any component to the factory, clean the component as well as possible to remove any dirt or chemical residue. Components received at the factory that are not clean will be returned and warranty denied.

After receiving your RMA #, package the part, making sure to include the RMA #, customer's name, your address and phone number and description of problems or failure. Then ship to:

Capstan Ag Systems, Inc.

Attn: Warranty/Repair

4225 SW Kirklawn Ave.

Topeka, KS 66609

Phone: (785) 232-4477 | Fax: (785) 232-7799

Hours: 8 am to 4:30 pm CST

How does state law relate to this Limited Warranty?

Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you.

Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.¹

¹ Rev. Date 7/15/2014

Chapter 3: Introduction

This Manual

This manual includes operation, maintenance, and installation information for the system you purchased.

Make sure that all personnel have read this manual and that they thoroughly understand the safe and correct operation and maintenance procedures. Failure to do so could result in personal injury or equipment damage.

This manual should be considered a permanent part of your system and should remain with the system at all times and when you sell it.

Right and left sides of the system are determined by facing the direction of forward travel of the machine on which the system is installed.

The information, screenshots, and other illustrations were correct at the time of publication. Changes can occur without notice.

This manual contains important information on how to safely and correctly install, operate, and maintain CapstanAG products. These instructions will help keep personnel safe, reduce downtime, and increase the reliability and life of the equipment, its components, and related systems.

Review the safety information in the manual(s) from the Original Equipment Manufacturer (OEM).

Follow the instructions (in this manual) and in the OEM manual(s) for each step, to make sure that work conditions in and around the OEM equipment are safe.

It is important for all individuals working with chemicals to understand the potential risks, necessary safety precautions, and proper response in the event of accidental contact.

Review the OEM manual(s) for chemical safety information.

Read, understand, and review the procedures in this manual and OEM manual(s). Use the Safety Data Sheets (SDS) and the required Personal Protective Equipment (PPE) for hazardous chemicals.

Please keep this manual and all enclosed documentation in an accessible location known to all operators, installation, and maintenance personnel.

If you do not understand the CapstanAG equipment after reading this manual, please obtain the proper training before working with equipment, to make sure that your own safety, as well as your co-workers' safety, is maintained.

Do not attempt to operate any equipment or system until you completely understand why, when, and how it operates. If you are uncertain after studying this manual, please contact CapstanAG.

System Identification

Write the system name, serial number, and other information down in the Service Contact Information on the inside cover of this manual. Your dealer will use these numbers when you order parts. File a copy of the identification numbers in a secure place off the machine.

If you are not the original owner of this machine, it is in your interest to contact your local CapstanAG dealer to inform them of this unit's serial number. Providing this information will help CapstanAG notify you of any issues or product improvements.



Figure 1:

The Synchro™ system serial number (1) is located on the controller (2).
The serial number is used as the name of the controller Wi-Fi network.

Chapter 4: Installation

Prepare for Installation

If the CapstanAG system has been installed on the sprayer, continue with this manual.

If the CapstanAG system has not been installed yet, go to the Synchro™ Installation Guide for correct installation procedures.



CAUTION: Before installation, operation, or service to the system, read and understand the machine's operator manual and the system operator manual. Chemical residue may be present on/in the equipment. Use the correct personal protective equipment.

Important: Do not attach the harnesses with cable ties until the test of the system is complete.

Connect the machine with the system to a tractor

1. Connect the tractor to the sprayer.
2. Make sure the Synchro™ system has 12 V DC power.
3. Make sure that the cab box harness is connected.

System Dry Test



Figure 2:

1. Make sure that the sprayer is off.
2. On the cab box (1), toggle the red **Synchro** switch (2) to **ON**.
The LED (3) in the switch will illuminate.
The system should come with an active profile from the factory.
3. Toggle the **L** switch (4) to **ON**.
The LED (5) in the switch will illuminate.
4. Make sure that you can hear the nozzles click on the left side of the machine.
5. Toggle the **L** switch to **OFF**.
The LED in the switch will not illuminate.
6. Toggle the **R** switch (6) to **ON**.
The LED (7) in the switch will illuminate.
7. Make sure that you can hear the nozzles click on the right side of the machine.
8. Toggle the **R** switch to **OFF**.
The LED in the switch will not illuminate.
9. Start the system wet test.

System Wet Test



Figure 3:

1. Use water to pressurize the system.
2. On the cab box (1), toggle the red **Synchro** switch (2) to **ON**.
The LED (3) in the switch will illuminate.
The system should come with an active profile from the factory.
3. Toggle the **L** switch (4) to **ON**.
The LED (5) in the switch will illuminate.
4. Make sure that all of the nozzles spray on the left side of the machine.
5. Do a check for leaks and repair as necessary.
6. Toggle the **L** switch to **OFF**.
The LED in the switch will not illuminate.
7. Toggle the **R** switch (6) to **ON**.
The LED (7) in the switch will illuminate.
8. Make sure that all of the nozzles spray on the right side of the machine.
9. Do a check for leaks and repair as necessary.
10. Toggle the **R** switch to **OFF**.
The LED in the switch will not illuminate.
11. If the system test fails, see the troubleshooting chapter in the operator manual.
12. If the system test passes, attach the harnesses with cable ties.
Note: Make sure that you route the harnesses where damage is minimized. Make sure that the harnesses are not exposed to impact or debris.
Note: Make sure that you avoid pinch points, or other sharp edges that can cause damage.
13. Installation is now complete and the system is ready for operation.
See the quick start guide and/or the operator manual for system operation.

Chapter 5: Operation

Website

The website, <https://orchard.capstanag.com>, is where you build or change profile information for your sprayer.



Figure 4:

The system configuration interface includes:

Item	Name	Description
(1)	Profile Name	Name the profile for the sprayer
(2)	Download Profile	When all of the information is correct (no red errors showing), click Download Profile . If the download profile icon is not shown the system parameters are not met.
(3)	Rate (gpa)	The rate of application of product (in gallons per acre)
(4)	Speed (mph)	Enter the speed the machine will be moving when product is applied (in miles per hour) Note: It is the responsibility of the operator to maintain this speed.
(5)	Row Spacing (feet)	The distance between the rows (in feet)
(6)	Pressure (psi)	The force at which you want to spray (in pounds per square inch) Note: It is the responsibility of the operator to maintain this pressure.
(7)	Density (lbs/gal)	Water is equal to 8.33 (in pounds per gal)

Item	Name	Description
(8)	Frequency (Hz)	If the system has one tip per valve use 10 Hz. If the system has multiple tips per valve use 3 Hz. For additional information, contact your CapstanAG representative for specific settings.
(9)	Change Flow Distribution	Allows you to change the flow nozzle by nozzle This is how to change nozzles from all being equal if the tips are different sizes.
(10)	Flow %	Enter the desired percentage of total flow per nozzle to apply the amount of product as desired for the field and/or crop. A nozzle error message will show and the visual representation of the nozzle will change to red when the flow is outside of the system parameters. Adjust the nozzle flow, change the tip size, or change the pressure to remove the error.
(11)	Multiple Tip Sizes	Put a checkmark in the box and a Tip Size column will show on the right side of the screen.
(12)	Tip Size	Enter the tip sizes in the additional spaces that show on the screen, i.e. #8 tip = 0.8 gpm @ 40 psi. See the correct tip chart for the correct information. This number reflects the sum of tips if multiple tips per nozzle. i.e. splitter with three tips—one #8 and two #3 = #14
(13)	Show Nozzle Duty Cycle	Put a checkmark in the box and a Duty Cycle column will show on the right side of the screen.
(14)	Duty Cycle	This is information only. You cannot change the duty cycle values in the location.
(15)	Visual representation of the sprayer	As the information changes on this screen the graphic will change to show how the sprayer will operate. Nozzle color indicates: <ul style="list-style-type: none"> • Gray—nozzle off • Green—nozzle on and the settings are within the system parameters • Red—not within system parameters and changes must be made for the system to function <p>Note: The nozzle line length is proportional to the flow. i.e. the longer the line the greater the flow.</p>
(16)	Master Switches	A Nozzle # icon that is green will spray. A Nozzle # icon that is gray is off and will not spray.
(17)	Invert Nozzle Order	Put a checkmark in the box to invert the nozzle order. Nozzle #1 on the valve harnesses must be closest to the controller.
(18)	Nozzle Order Numbers	Nozzle 16 will show at the top of the sprayer and Nozzle 1 will be at the bottom if the Invert Nozzle Order is selected. Otherwise Nozzle 1 will show at the top of the sprayer.

Make a profile on the Internet

A profile can be made on a computer or mobile device such as a tablet or phone that is connected to the internet. If you are using a device that is not portable, you will need to be able to transfer the profile to a portable device like a tablet, phone, or laptop computer.

1. Go to <https://orchard.capstanag.com>.
2. Enter the correct information for your sprayer.
See the [Website](#) information for more information on the website.
3. Make sure that you have given your profile a name.

4. Click on **Download Profile**.

The profile is now downloaded to your device. If you are using a device that is not portable, you will need to move the profile to a portable device like a tablet, phone, or laptop computer or to virtual storage location (DropBox, Google Drive, email, etc.).

You are now ready to transmit the profile.

Note: Once a profile is transmitted to the controller it cannot be deleted. However, a profile can be overwritten by another file with the exact same name.

Make a Profile on the Controller Wi-Fi

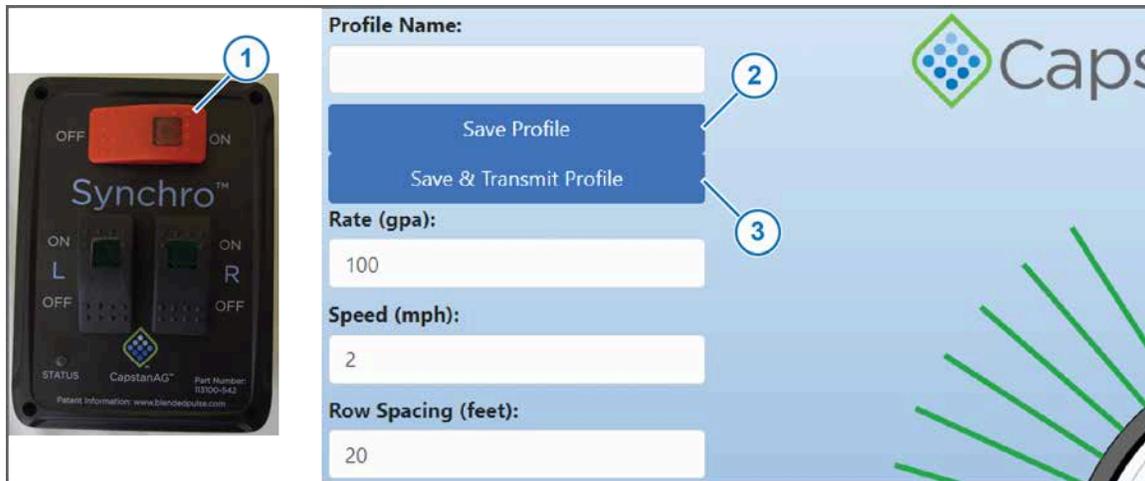


Figure 5:

1. On the machine/sprayer, toggle the red **Synchro** switch (1) to on. The light on the switch will illuminate.
2. On your device, connect to the **SNCHRO 209XXXX WI-FI**. The **XXXX** shown above will be the last 4 digits of the controller serial number. There is no password for this Wi-Fi connection.
3. Go to 192.168.0.1/generate.html.
4. Enter the correct information for your sprayer. See the [Website](#) information for more information on the website.
5. Make sure that you have given your profile a name.
6. Click on **Save Profile** (2) or **Save & Transmit Profile** (3).
 - **Save Profile**—saves the profile to the controller
 - **Save & Transmit Profile**—saves the profile to the controller and automatically takes you to the transmit page.

You are now ready to transmit the profile.

Note: This does not save the profile you to device.

Note: Once a profile is transmitted to the controller it cannot be deleted. However, a profile can be overwritten by another file with the exact same name.

Transmit a Profile



Figure 6:

1. On the machine/sprayer, toggle the red **Synchro** switch (1) to on. The light on the switch will illuminate.
2. On your device, connect to the **SNCHRO 209XXXX WI-FI**. The **XXXX** shown above will be the last 4 digits of the controller serial number. There is no password for this Wi-Fi connection.
3. Open a web browser and go to 192.168.0.1/transmit.html. The top line (3) will always show the active profile. This is the profile that will spray when the system is turned on.
4. If you have made a new profile, click **Choose File** (4) and find the correct profile. The selected file name will show on the screen.
5. To load a saved profile, click on the **Or select a stored profile** drop down menu (5) to select desired profile to load.
6. Click **Transmit Profile** (6).

As the profile is sent to the controller, **Profile transmission started.** will show on the screen. When the transmission is successful a green **Profile transmitted successfully.** will show.

This profile is now the active profile on the controller, and will stay active until another profile is transmitted to the controller.

Once transmitted, profile is stored on controller, and available to reload at a later date.

Note: Once a profile is transmitted to the controller it cannot be deleted. However, a profile can be overwritten by another file with the exact same name.

Note: The settings for the selected profile will be show on the screen (7).

7. If there is any red text on the screen, an error in the transmission communication has occurred. Move closer to the controller and click **Transmit Profile** again.
8. You are now ready to spray.

Spray with the CapstanAG System



Figure 7:

1. Get the sprayer ready for operation.
2. On the cab box (1), toggle the red **Synchro** switch (2) to **ON**.
The LED (3) in the switch will illuminate.
3. To start the left side of the machine, toggle the **L** switch (4) to **ON**.
The LED (5) in the switch will illuminate.

Important: If the sprayer pump is on, toggling the boom switches may apply product. You can use the **L** (left) and **R** (right) side of the sprayer separately or together.

4. To start the right side of the machine, toggle the **R** switch (6) to **ON**.
The LED (7) in the switch will illuminate.
5. Operate the sprayer.

Important: Do not operate the system at 125 psi or more. Operating the system at this pressure will damage the plungers.

6. When you are done spraying, toggle the boom switch(es) and the **Synchro** switch off.
When the switches are off the LEDs will not be illuminated

Important: If any switch is ON the system will still pull a current that can drain the battery.

Note: If one or both boom switches are ON but the **Synchro** switch is OFF, the system will operate with a constant equal flow of product through all nozzles and not use the profile parameters. The sprayer will function as it would without the CapstanAG system. This can be used to flush the system out, or can be used to spray conventionally, especially during a failure.

Spray without the CapstanAG System (Manual Mode)

Spraying without the CapstanAG System can be used to flush the system out, or can be used to spray conventionally, especially during a failure.

Spray without using the CapstanAG system if necessary to complete a job when there is a failure in the system.

Do a check and fix the system failure(s) as soon as possible.



Figure 8:

1. On the cab box (1), toggle the red **Synchro** switch (2) to **OFF**.
The LED (3) in the switch will not illuminate.
 2. Toggle the **L** switch (4) to **ON**.
The LED (5) in the switch will illuminate.
 3. Toggle the **R** switch (6) to **ON**.
The LED (7) in the switch will illuminate.
 4. Operate the sprayer.
The sprayer will function as it would without the CapstanAG system.
The system will now operate with a constant equal flow of product through all nozzles and not use the profile parameters.
 5. When you are done spraying, toggle the boom switch(es) off.
When the switches are off the LEDs will not be illuminated.
- Important:** If any switch is on, the system will still pull a current that can drain the battery.

Chapter 6: Maintenance

Service the System



CAUTION: Before operation or service to the system, read and understand the machine’s operator manual and the system operator manual. Chemical residue may be present on/in the OEM equipment. Use the correct personal protective equipment.

Before servicing the system or plumbing components, release the pressure and empty any product from the system and liquid delivery lines.

Jump Start, Weld On, or Charge the Machine

If jump starting the machine, make sure that you disconnect the system power harness or remove the fuses.

If charging the machine’s batteries or welding on the machine, trip the circuit breaker.

Recommended Guidelines for Maintenance/Service

When servicing a system, it is recommended to do these:

- Do the baseline service checks and verify the original setup values in this manual.
- Identify individual performance problems. Evaluate possible causes and corrections for performance issues.
- Troubleshoot individual components and replace, if needed.

Important: The primary service tool will be a voltmeter that can measure voltage and resistance (ohms).

Maintenance Service Interval

Type of Service	Initial System Setup	Daily	Yearly/ Seasonally
Baseline Evaluation	X		X
Inspect the System		X	
Clean the System		X	
Clean the Strainers and Screens		X	
Clean the Nozzle Valves and Inspect the Plungers			X
Storage of the System			X

Details for each of these procedures are following in this section of the manual.

Baseline Evaluation Process

1. Do a check for loose hoses, mounting hardware, and other components. Tighten if necessary.
2. Inspect the hoses for cuts, nicks, or abrasions before each use. Replace any damaged hoses immediately.
3. Make sure that the voltage readings are correct.
4. Make sure that the correct tip size is used for the application.
5. Make sure that the liquid product plumbing and the strainer(s) are clean.
6. Do a like component swap test to see if the failure follows the component.
7. Do a check for damaged or missing decals. Replace if necessary.
8. Repair or replace any damaged components.
9. Do the system tests.

See the system testing information in this manual, [System Dry Test](#).

Inspect the System

- Inspect the hoses for cuts, nicks, or abrasions before each use. Immediately replace any damaged hoses.
- Make sure that the strainers are clean.
- Make sure that all hoses and wiring are secure.
- Do a check for loose hoses, mounting hardware, and other components. Tighten if necessary.
- Do a check for damaged or missing decals. Replace if necessary.

Clean the System

- Thoroughly clean the system after each use.
- Flush the system with water. Do not store with chemical. Damage may occur to the internal valves.
- Avoid high-pressure spray when cleaning the system components.

Strainers and Screens

Important: Clean the strainers on a regular basis.

Check the mesh size of the strainers and replace the screens if they are too coarse. Use 80-mesh or finer strainer screens. The filter manufacturer is specified only on the strainer housing. Only a color code identifies the strainer mesh size, which is not consistent between filter suppliers. An 80-mesh screen is required to prevent nozzles from plugging. When selecting a strainer, do not rely on the color coding. Check with the strainer manufacturer to be sure and select the 80-mesh strainer.

Plugged strainers will cause a reduction in system operating pressure.

When replacing the mesh screen on a Tee-jet Strainers:

1. Install and set the mesh screen in the strainer head.
2. Install the strainer cap.

Important: Failure to do this will likely result in a damaged mesh screen and overall strainer failure.

Clean the Nozzle Valve(s)



Warning: Chemical residues may be present in the agricultural equipment. Always use proper personal equipment to avoid personal injury.

1. Release pressure from the system before servicing.
2. Clean the system before installation or service of the fittings, hoses, valves, or nozzles.
3. Wash the nozzle valve components to remove any debris.
4. Inspect the plunger for wear or damage.
5. If there is wear or damage to the plunger, replace the plunger.
6. Inspect the valve body.
Make sure that the orifice is not plugged with debris, worn, or damaged.
7. If there is wear or damage to the orifice, replace the valve body.
8. Wash the nozzle body components to remove any debris.

Important: Do not use brake cleaner. Brake cleaner can damage the seal.

Important: During installation, apply 40 lbf in (4.52 Nm) of torque to the coil when it threads into the valve body to properly seat the O-ring.

Plunger Seal Inspection



Figure 9:

After extended use, the plunger seal will wear a groove (1) where the seal impacts the hard orifice seat. Replace the plunger if worn or damaged.

As the groove deepens, the pressure capacity of the valve will decrease until the pressure capacity interferes with the operating pressure of the system.

The result is erratic pulsing, often described as “flickering.” The system will operate normally at lower pressures until replacement parts can be installed. High operating pressures and abrasive chemicals will accelerate the wear of the plunger seal material.

Storage of the System

Thoroughly clean the implement and the system before any long storage.

Winterize for Storage

Do not use fertilizer to winterize! The use of fertilizer to winterize will cause internal damage to the nozzle valves.

Note: Improper winterizing will result in damage to the internal components of the nozzle valves. Review the manufacturer's planter manuals for more information on proper winterizing.

Thoroughly clean the system before winter storage. Flush the system with clean water.

Winterize the system with RV antifreeze for winter storage. Proper winterizing of the machine with a CapstanAG system installed on it is essential. Make sure that the lines are completely full of antifreeze at 100% strength and that the nozzle valves are purged until 100% antifreeze is seen at all nozzle valves.

Chapter 7: Troubleshooting

Troubleshooting Charts

Note: Operate the machine to match the parameters set in the active profile:

- Speed
- Row Width
- Tip Size(s)
- Pressure

If the parameters are not met, the system will not operate correctly.

Rate Instability Problems	
Cause	Correction
Tips are too small	Find and install tips that are the correct size
Tips are too large	Find and install tips that are the correct size
Worn tips	Replace the tips
Plugged tips	Clean or replace the tips
Worn or sticky plunger(s)	Do a check of the plunger(s) and replace as needed
Inlet plugged	Do a check of the inlet and clean as necessary
Plugged filter(s)	Clean or replace the filter(s)
Filter(s) not correctly installed	Correctly install filter(s)
Plugged, kinked, or collapsed hoses	Check all hoses and replace as needed
Pump is not turned on	Refer to the sprayer manual for instructions to start the pump
Air in the spray boom	Bleed air from the system
Faulty pressure sensor	Replace the pressure sensor
Speed too slow	Increase speed
Speed too fast	Slow down
Pressure too low	Increase the pressure
Pressure too high	Decrease the pressure

Operation Problems		
Problem	Cause	Correction
Single nozzle valve drips when shut off	Plunger is lodged with debris	Clean the nozzle valve
	Plunger is worn	Replace the plunger
	O-ring is pinched or broken	Replace the O-ring
Single nozzle valve sprays erratically	Plunger is worn	Replace the plunger
Single nozzle valve will not shut off	Plunger is lodged with debris	Clean the nozzle valve
	O-ring is pinched or broken	Replace the O-ring
Single nozzle valve will not turn on	Plugged tips	Clean or replace the tips
	Plunger is lodged with debris	Clean the nozzle valve
	Coil not receiving signal	Do a check of harness(es), connect or replace as necessary
	Coil not operating	Do a check of the coil and replace as necessary
Synchro Switch Not illuminating when in the on position.	No power to cab box or system	Make sure the system is connected to a 12 V power source
		Do a check of the battery harness, power harness, and cab box harness. Replace as necessary
	Faulty cab box	Replace the cab box
Missing Wi-Fi signal	Synchro Switch not illuminating	See Troubleshooting for Synchro switch not illuminating
	Out of range for the controller Wi-Fi	Move to be in range of the controller Wi-Fi. The range is usually within 50 feet of the controller. But the range varies with obstructions between the controller and connected device.
	Faulty controller	Replace the controller
One side not turning on	Faulty or disconnected harness	Do a check of the harness and connect or replace as necessary
	Faulty cab box	Replace the cab box
	Faulty controller	Replace the controller
One side not turning off	Faulty cab box	Replace the cab box

Website Problems	
Problem	Correction
I can not find the profile I saved.	Check for a similar profile name. Only letters, numbers and the special characters ~ () _ { } [] . are allowed in profile names.
I get the error message The web server is out of storage space.	Contact your CapstanAG representative for instructions to delete profiles. You should be able to store over 8,000.
A profile was transmitted successfully but the spray pattern did not change.	Verify both the left and right boom switches are in the off position when transmitting a profile.
I get one or many Error: Did not receive expected response when trying to transmit a profile.	Move closer to the machine and try again. If that does not work turn the Synchro switch to off, wait five seconds, turn the switch on then try to transmit again.
When creating a profile I get a Nozzle error.	If the flow is too much, decrease the flow percentage or increase the tip size to adjust the flow to an acceptable value. If the flow is too little, decrease the tip size or increase the flow percentage to adjust the flow to an acceptable value.
The profile will not transmit when I press Transmit.	Verify none of the tip sizes are 0 for the profile trying to be transmitted.
I see a web page I'm not used to	Verify you visited either transmit.html or generate.html
The web page fails to load	Verify you are connected to the Synchro
The Synchro Wi-Fi is not listed on my device	Verify the red Synchro switch is turned on
	Make sure that you are within range of the controller Wi-Fi

Interchange the Components

The system includes a number of multiple parts:

- Nozzle Valves
- Nozzle Harnesses
- Extension Harnesses

When troubleshooting failed components, it can be helpful to replace the failed part with a working part at another location. If the problem follows the failed part to the new location, repair or replace the failed part.

If the problem does not follow the failed part, then the problem is likely elsewhere in the system, and other troubleshooting means may be followed.

Note: Use caution when failed parts are interchanged with a part that is operating correctly; in rare cases, the failed component may cause other components to fail at the new location.

Nozzle Valves

Important: Do not operate the system at 125 psi or more. Operating the system at this pressure will damage the plungers.

Plugged nozzle valves can be classified into two categories:

- Plunger blockage
- Plunger stuck

Plunger blockage results when larger debris catches between the orifice and plunger seal. This is the smallest flow passage within the nozzle valve.

Stuck plungers result when smaller debris collects around the barrel of the plunger and binds the plunger in place. Symptoms of a blocked or stuck plunger are:

- Constant application
- Leaking when the nozzle is shut off
- No application

Note: Pinched or split O-rings will also cause nozzles to drip when shutoff.

Note: Operating a plugged nozzle valve for extended periods of time may result in a nozzle valve coil failure. Immediately clean any plugged nozzle valves.

Note: Before removing the nozzle valves, make sure that the pressure has been released from the system.

Recommendation: Use an 80-mesh screen to prevent the nozzles from plugging.

Do a check of the mesh size of the strainers and replace strainers if they are too coarse.

Clean the Nozzle Valve(s)



Warning: Chemical residues may be present in the agricultural equipment. Always use proper personal equipment to avoid personal injury.

1. Release pressure from the system before servicing.
2. Clean the system before installation or service of the fittings, hoses, valves, or nozzles.
3. Wash the nozzle valve components to remove any debris.
4. Inspect the plunger for wear or damage.
5. If there is wear or damage to the plunger, replace the plunger.
6. Inspect the valve body.
Make sure that the orifice is not plugged with debris, worn, or damaged.
7. If there is wear or damage to the orifice, replace the valve body.
8. Wash the nozzle body components to remove any debris.

Important: Do not use brake cleaner. Brake cleaner can damage the seal.

Important: During installation, apply 40 lbf in (4.52 Nm) of torque to the coil when it threads into the valve body to properly seat the O-ring.

Plunger Seal Inspection



Figure 10:

After extended use, the plunger seal will wear a groove (1) where the seal impacts the hard orifice seat. Replace the plunger if worn or damaged.

As the groove deepens, the pressure capacity of the valve will decrease until the pressure capacity interferes with the operating pressure of the system.

The result is erratic pulsing, often described as “flickering.” The system will operate normally at lower pressures until replacement parts can be installed. High operating pressures and abrasive chemicals will accelerate the wear of the plunger seal material.

System Dry Test



Figure 11:

1. Make sure that the sprayer is off.
2. On the cab box (1), toggle the red **Synchro** switch (2) to **ON**.
The LED (3) in the switch will illuminate.
The system should come with an active profile from the factory.
3. Toggle the **L** switch (4) to **ON**.
The LED (5) in the switch will illuminate.
4. Make sure that you can hear the nozzles click on the left side of the machine.
5. Toggle the **L** switch to **OFF**.
The LED in the switch will not illuminate.
6. Toggle the **R** switch (6) to **ON**.
The LED (7) in the switch will illuminate.
7. Make sure that you can hear the nozzles click on the right side of the machine.
8. Toggle the **R** switch to **OFF**.
The LED in the switch will not illuminate.
9. Start the system wet test.

System Wet Test



Figure 12:

1. Use water to pressurize the system.
2. On the cab box (1), toggle the red **Synchro** switch (2) to **ON**.
The LED (3) in the switch will illuminate.
The system should come with an active profile from the factory.
3. Toggle the **L** switch (4) to **ON**.
The LED (5) in the switch will illuminate.
4. Make sure that all of the nozzles spray on the left side of the machine.
5. Do a check for leaks and repair as necessary.
6. Toggle the **L** switch to **OFF**.
The LED in the switch will not illuminate.
7. Toggle the **R** switch (6) to **ON**.
The LED (7) in the switch will illuminate.
8. Make sure that all of the nozzles spray on the right side of the machine.
9. Do a check for leaks and repair as necessary.
10. Toggle the **R** switch to **OFF**.
The LED in the switch will not illuminate.
11. If the system test fails, see the troubleshooting chapter in the operator manual.
12. If the system test passes, attach the harnesses with cable ties.
Note: Make sure that you route the harnesses where damage is minimized. Make sure that the harnesses are not exposed to impact or debris.
Note: Make sure that you avoid pinch points, or other sharp edges that can cause damage.
13. Installation is now complete and the system is ready for operation.
See the quick start guide and/or the operator manual for system operation.

Coil Assembly Test

Use a voltmeter to measure the ohms of resistance across pins A and B on the coil connector.

Notice: Correct resistance is:

- **12-watt coils resistance—10 ohms to 11.5 ohms**

If correct resistance is not found:

- Clean the connector terminals and retest
- Replace the coil assembly

Coil assembly failures are often the result of two factors:

- Extended valve use with a plugged nozzle
- Extended use in corrosive environments

Recommendation: Clean any plugged valve assemblies immediately.

Recommendation: Rinse the inside of the booms, and wash the outside of the coil assemblies with clean water as often as practical.

Do a Check of the System Load Capacity

1. Start the engine of the machine.
2. Turn on the cab box and all of the boom sections.
3. Turn on all of the electrical loads, including the air conditioning, etc.
4. See what the voltage readout is at the power source.

The nozzle valves operate best at 12 VDC or higher. Using less than 12 VDC will result in reduced pressure capacity. This will often result in erratic nozzle pulsing, sometimes described as flickering. Also, do a check of the nozzle valves for worn plunger seals.

If low voltage is observed, do a check of:

- The battery terminals and clean as necessary
- The condition of the battery
- The condition of the alternator
- The condition of the connections

Battery Voltage Test

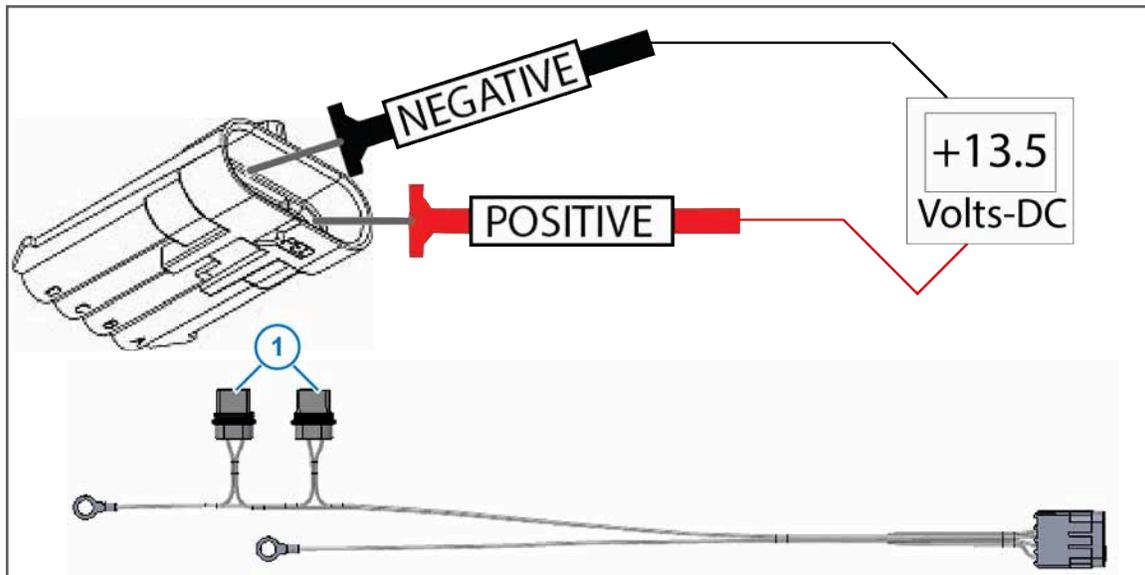


Figure 13:

Disconnect the power harness (4-pin weather-pack connector) from the controller.

- With the engine of the machine running, use a voltmeter to observe that there is a 13.5 VDC between pin A and pin C or pin B and pin D.
- With the engine of the machine off, there is a 12.0 VDC between pin A and pin C or pin B and pin D.

Make sure that the polarity is accurate by looking at the positive voltage when the red (positive) probe is connected to pin 1, and the black (negative) probe is connected to pin 6.

If there is no voltage present between pin A (PWR +) and pin C (GND -) or pin B (PWR +) and pin D (GND -), do a check of:

- The 20A fuses (1) on the power harness
- The condition of the battery, battery harness, ring terminals, and alternator

Chapter 8: Schematics

System Layout

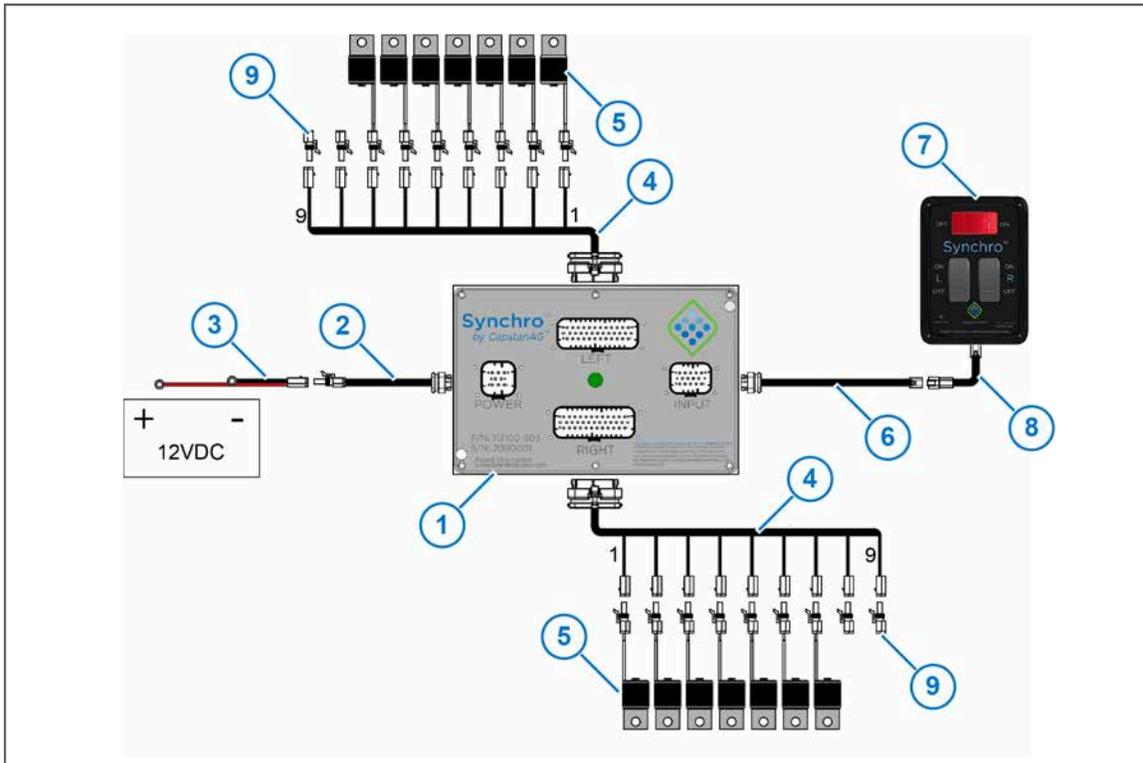


Figure 14:

Callout	Description	Callout	Description
(1)	Control Module	(6)	Cab Box Harness
(2)	Power Harness	(7)	Cab Box
(3)	Battery Harness	(8)	Cab Box Extension Harness
(4)	Valve Harness	(9)	2-pin WP Tower Dust Plug
(5)	Valve Assembly		

Parts List

Table 1: System Base Components

Part Number	Description	Drawing Description	Qty
113100-503	Control Module	Control Module Assembly, Synchro Orchard	1
113100-542	Cab Box	Cabbox Assembly, Synchro Orchard	1
113100-514	Power Harness	Power Harness, 20ft Synchro Orchard	1
113100-530	Cab Box Harness	Cabbox Harness, 35ft Synchro Orchard	1
113100-543	Cab Box Extension Harness	Cabbox Extension Harness, 10ft Synchro Orchard	1

Table 2: Valve Assembly

Amount should equal the number of nozzle locations on the sprayer

Part Number	Description	Drawing Description	Qty
113100-570	Valve Assembly	Valve Assy 12W Std spring, 15 series, 1/4 x 1/4 NPT SS	Varies

Table 3: Battery Extension Harness

Part Number	Description	Drawing Description	Qty
113100-510	Battery Harness—5 ft	Battery Harness, 5ft Synchro Orchard	1
113100-512	Battery Harness—20 ft	Battery Harness, 20ft Synchro Orchard	

Table 4: Valve Harnesses

Need two harnesses-one for the right side and one for the left side of the sprayer

Distance from the control box to nozzles is less than 15 ft			
Part Number	Description	Drawing Description	Qty
113100-550	16-drop Valve Harness—15 ft	16 Drop Valve Harness, 15ft Synchro Orchard	2
113100-551	9-drop Valve Harness—15 ft	9 Drop Valve Harness, 15ft Synchro Orchard	
Distance from the control box to nozzles is less than 30 ft			
Part Number	Description	Drawing Description	Qty
113100-555	16-drop Valve Harness—30 ft	16 Drop Valve Harness, 30ft Synchro Orchard	2
113100-556	9-drop Valve Harness—30 ft	9 Drop Valve Harness, 30ft Synchro Orchard	

Table 5: Miscellaneous

Part Number	Description	Drawing Description	Qty
113100-595	Installation Guide	Installation Guide, Synchro Orchard	1
113100-596	Operator Manual	Operators Manual, Synchro Orchard	1
113100-597	Quick Start Guide	Quick Start Guide, Synchro Orchard	1
113100-590	Mounting Kit	Mounting Kit—RAM cabbox mount, and custom controller mounting bracket	1
116200-045	2-pin WP Tower Dust Plug	Dust Plug, 2 Pin WP Tower	Varies
120100-010	Installation Kit	Install Kit, Cable Ties	1
113100-594	ID Decal	Decal, Synchro Orchard ID	2

Table 6: Optional OEM Specific Installation Kits

Part Number	Description
113100-580	Air-O-Fan Install Kit
113100-581	Rears 24 Valve Install Kit
113100-582	Lectro Blast Install Kit
113100-583	Durand Wayland Install Kit

Control Module Pinout

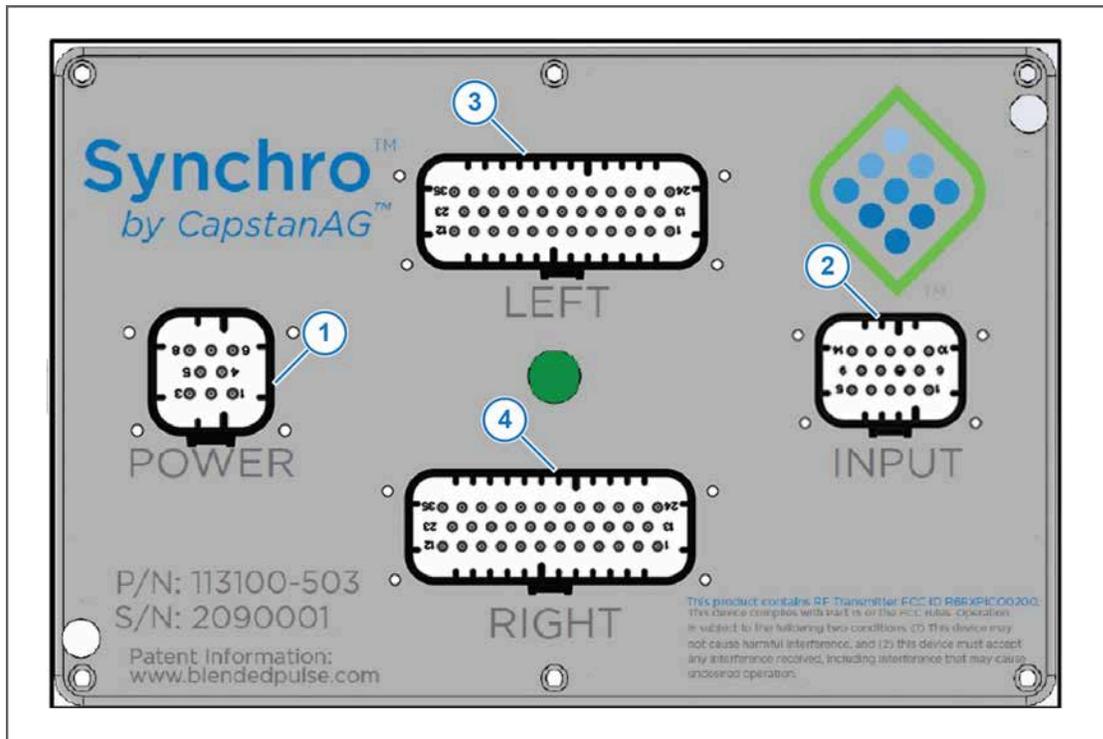


Figure 15:

Table 7: POWER Connector (1) Pinout—8-pin DT Receptacle

Pin	Color	Pin	Color
1	Red	5	Plug
2	Red	6	Black
3	Plug	7	Black
4	Plug	8	Plug

Table 8: INPUT Connector (2) Pinout—14-pin DT Receptacle

Pin	Color	Pin	Color
1	Red	8	Plug
2	Violet	9	Plug
3	Yellow	10	Plug
4	Pink	11	Plug
5	Brown	12	Plug
6	Black	13	Plug
7	Plug	14	Plug

Table 9: LEFT Connector (3) Pinout—35-pin AMP Connector

Pin	Color		Pin	Color
1	Red/White		19	Yellow/Orange
2	Red/White		20	Yellow/Orange
3	Black/White		21	Green/Orange
4	Black/White		22	Green/Orange
5	Blue/White		23	Brown/Orange
6	Blue/White		24	Brown/Orange
7	Yellow/White		25	White/Red
8	Yellow/White		26	White/Red
9	Green/White		27	White/Black
10	Green/White		28	White/Black
11	Brown/White		29	White/Blue
12	Brown/White		30	White/Blue
13	Red/Orange		31	White/Orange
14	Red/Orange		32	White/Orange
15	Black/Orange		33	Plug
16	Black/Orange		34	Plug
17	Blue/Orange		35	Plug
18	Blue/Orange			

Table 10: RIGHT Connector (4) Pinout—35-pin AMP Connector

Pin	Color		Pin	Color
1	Red/White		19	Yellow/Orange
2	Red/White		20	Yellow/Orange
3	Black/White		21	Green/Orange
4	Black/White		22	Green/Orange
5	Blue/White		23	Brown/Orange
6	Blue/White		24	Brown/Orange
7	Yellow/White		25	White/Red
8	Yellow/White		26	White/Red
9	Green/White		27	White/Black
10	Green/White		28	White/Black
11	Brown/White		29	White/Blue

Pin	Color		Pin	Color
12	Brown/White		30	White/Blue
13	Red/Orange		31	White/Orange
14	Red/Orange		32	White/Orange
15	Black/Orange		33	Plug
16	Black/Orange		34	Plug
17	Blue/Orange		35	Plug
18	Blue/Orange			

Cab Box Harness Pinout



Figure 16:

Table 11: 14-pin AMP Plug Connector Pinout (1)

Pin	Color		Pin	Color
1	Red		8	Plug
2	Violet		9	Plug
3	Yellow		10	Plug
4	Pink		11	Plug
5	Brown		12	Plug
6	Black		13	Plug
7	Plug		14	Plug

Table 12: 6-Pin DT Plug Connector Pinout(2)

Pin	Color		Pin	Color
1	Red		4	Pink
2	Violet		5	Brown
3	Yellow		6	Black

Power Harness Pinout

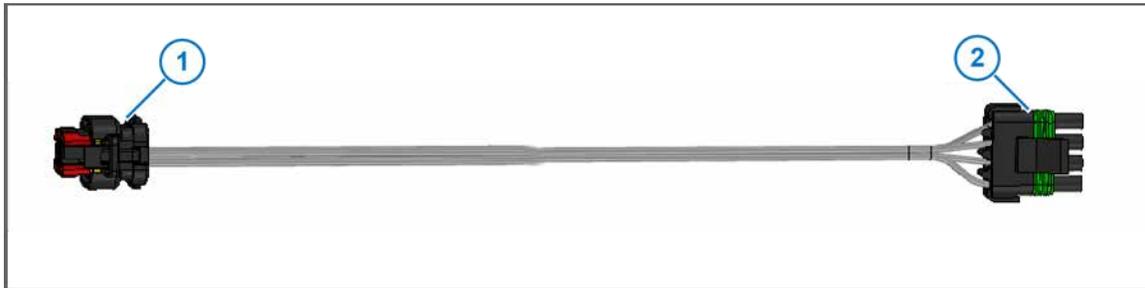


Figure 17:

Table 13: 8-Pin AMP Plug Connector Pinout (1)

Pin	Color		Pin	Color
1	Red		5	Plug
2	Red		6	Black
3	Plug		7	Black
4	Plug		8	Plug

Table 14: 4-Pin Tower WP Connector Pinout (2)

Pin	Color		Pin	Color
A	Red		C	Black
B	Red		D	Black

Battery Harness Pinout

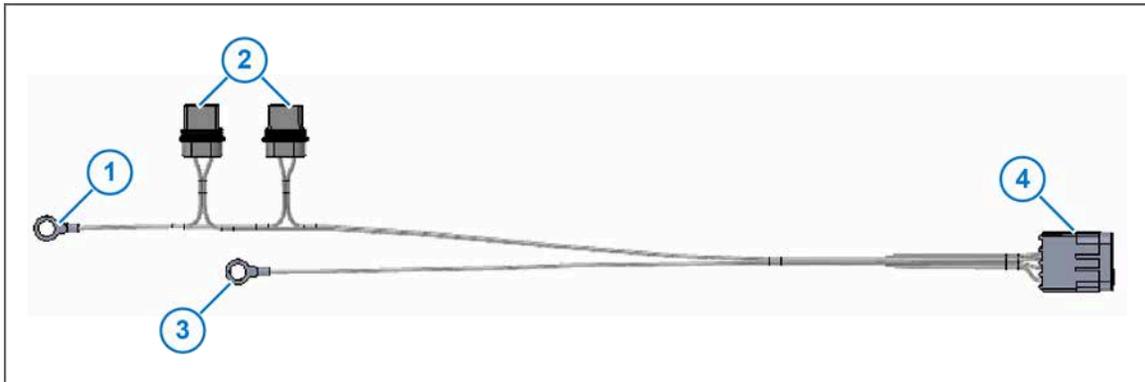


Figure 18:

The power (Red) wire (1) has two 20 A fuses (2) and connects to the positive power terminal. The ground (black) wire (3) connects to a ground.

Table 15: The 4-pin WP Shroud connector (4)

Pin	Color		Pin	Color
A	Red (Fuse 1)		C	Black
B	Red (Fuse 2)		D	Black

Valve Harness

Valve Harness—16 Valves Pinout

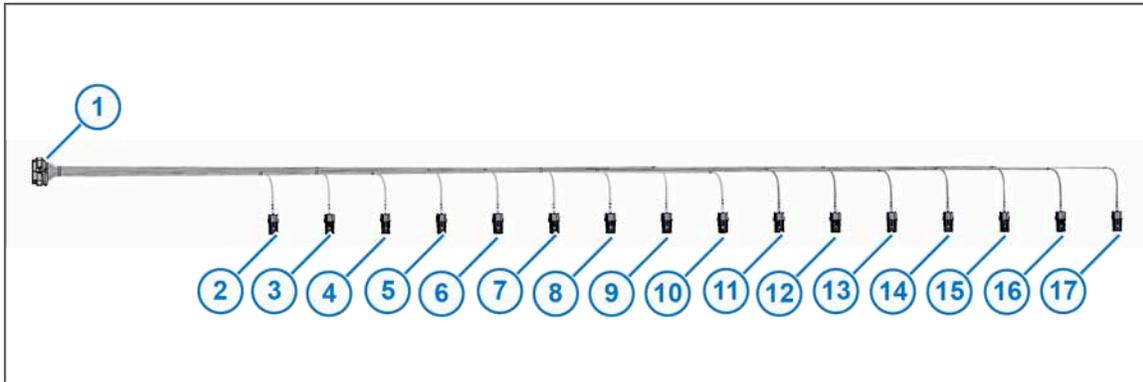


Figure 19:

Table 16: 35-in AMP Connector Pinout (1)

Pin	Color	Pin	Color
1	Red/White	19	Yellow/Orange
2	Red/White	20	Yellow/Orange
3	Black/White	21	Green/Orange
4	Black/White	22	Green/Orange
5	Blue/White	23	Brown/Orange
6	Blue/White	24	Brown/Orange
7	Yellow/White	25	White/Red
8	Yellow/White	26	White/Red
9	Green/White	27	White/Black
10	Green/White	28	White/Black
11	Brown/White	29	White/Blue
12	Brown/White	30	White/Blue
13	Red/Orange	31	White/Orange
14	Red/Orange	32	White/Orange
15	Black/Orange	33	Plug
16	Black/Orange	34	Plug
17	Blue/Orange	35	Plug
18	Blue/Orange		

Table 17: 2-Pin WP Shroud Connector Pinout (2)

Pin	Color		Pin	Color
1	Red/White		2	Red/White

Table 18: 2-Pin WP Shroud Connector Pinout (3)

Pin	Color		Pin	Color
1	Black/White		2	Black/White

Table 19: 2-Pin WP Shroud Connector Pinout (4)

Pin	Color		Pin	Color
1	Blue/White		2	Blue/White

Table 20: 2-Pin WP Shroud Connector Pinout (5)

Pin	Color		Pin	Color
1	Yellow/White		2	Yellow/White

Table 21: 2-Pin WP Shroud Connector Pinout (6)

Pin	Color		Pin	Color
1	Green/White		2	Green/White

Table 22: 2-Pin WP Shroud Connector Pinout (7)

Pin	Color		Pin	Color
1	Brown/White		2	Brown/White

Table 23: 2-Pin WP Shroud Connector Pinout (8)

Pin	Color		Pin	Color
1	Red/Orange		2	Red/Orange

Table 24: 2-Pin WP Shroud Connector Pinout (9)

Pin	Color		Pin	Color
1	Black/Orange		2	Black/Orange

Table 25: 2-Pin WP Shroud Connector Pinout (10)

Pin	Color		Pin	Color
1	Blue/Orange		2	Blue/Orange

Table 26: 2-Pin WP Shroud Connector Pinout (11)

Pin	Color		Pin	Color
1	Yellow/Orange		2	Yellow/Orange

Table 27: 2-Pin WP Shroud Connector Pinout (12)

Pin	Color		Pin	Color
1	Green/Orange		2	Green/Orange

Table 28: 2-Pin WP Shroud Connector Pinout (13)

Pin	Color		Pin	Color
1	Brown/Orange		2	Brown/Orange

Table 29: 2-Pin WP Shroud Connector Pinout (14)

Pin	Color		Pin	Color
1	White/Red		2	White/Red

Table 30: 2-Pin WP Shroud Connector Pinout (15)

Pin	Color		Pin	Color
1	White/Black		2	White/Black

Table 31: 2-Pin WP Shroud Connector Pinout (16)

Pin	Color		Pin	Color
1	White/Blue		2	White/Blue

Table 32: 2-Pin WP Shroud Connector Pinout (17)

Pin	Color		Pin	Color
1	White/Orange		2	White/Orange

Valve Harness—9 Valves Pinout

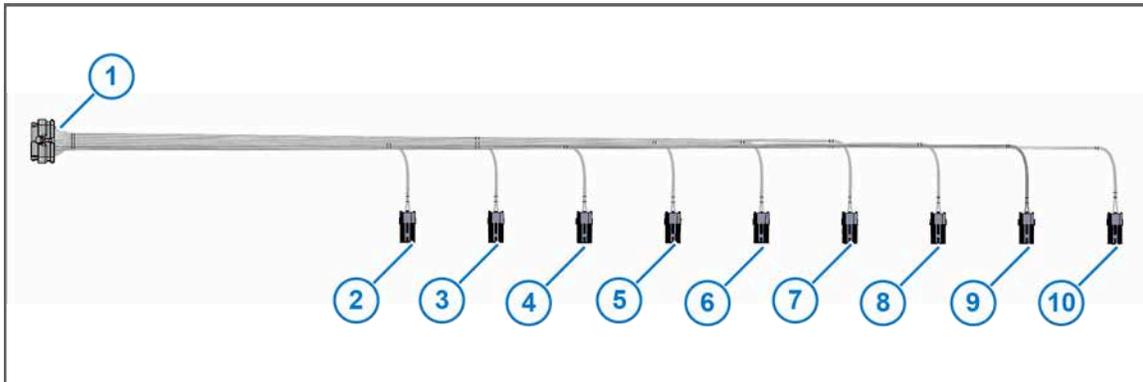


Figure 20:

Table 33: 35-in AMP Connector Pinout (1)

Pin	Color		Pin	Color
1	Red/White		19	Plug
2	Red/White		20	Plug
3	Black/White		21	Plug
4	Black/White		22	Plug
5	Blue/White		23	Plug
6	Blue/White		24	Plug
7	Yellow/White		25	Plug
8	Yellow/White		26	Plug
9	Green/White		27	Plug
10	Green/White		28	Plug
11	Brown/White		29	Plug
12	Brown/White		30	Plug
13	Red/Orange		31	Plug
14	Red/Orange		32	Plug
15	Black/Orange		33	Plug
16	Black/Orange		34	Plug
17	Blue/Orange		35	Plug
18	Blue/Orange			

Table 34: 2-Pin WP Shroud Connector Pinout (2)

Pin	Color		Pin	Color
1	Red/White		2	Red/White

Table 35: 2-Pin WP Shroud Connector Pinout (3)

Pin	Color		Pin	Color
1	Black/White		2	Black/White

Table 36: 2-Pin WP Shroud Connector Pinout (4)

Pin	Color		Pin	Color
1	Blue/White		2	Blue/White

Table 37: 2-Pin WP Shroud Connector Pinout (5)

Pin	Color		Pin	Color
1	Yellow/White		2	Yellow/White

Table 38: 2-Pin WP Shroud Connector Pinout (6)

Pin	Color		Pin	Color
1	Green/White		2	Green/White

Table 39: 2-Pin WP Shroud Connector Pinout (7)

Pin	Color		Pin	Color
1	Brown/White		2	Brown/White

Table 40: 2-Pin WP Shroud Connector Pinout (8)

Pin	Color		Pin	Color
1	Red/Orange		2	Red/Orange

Table 41: 2-Pin WP Shroud Connector Pinout (9)

Pin	Color		Pin	Color
1	Black/Orange		2	Black/Orange

Table 42: 2-Pin WP Shroud Connector Pinout (10)

Pin	Color		Pin	Color
1	Blue/Orange		2	Blue/Orange

Nozzle Valve Assembly

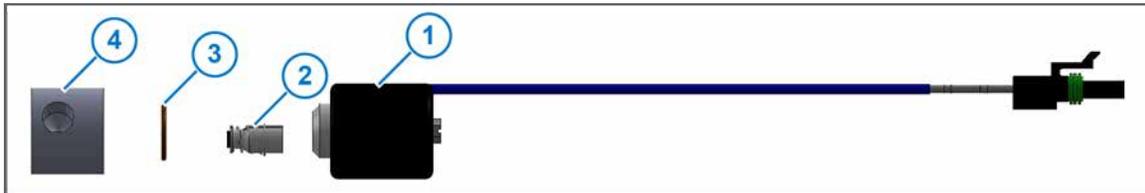


Figure 21:

Item	Description	Part Number	Item	Description	Part Number
1	Coil	625147-011	3	O-ring	715022-204
2	Plunger	716009-111	4	Valve Body	621083-001

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