CAPSTAN
SINCE 1893 AG SYSTEMS, INC.
APPLICATION SYSTEMS FOR PROFESSIONALS

Control Pressure Independent of Rate and Speed

SharpShooter®

Product Manual

4225 Kirklawn Ave. • Topeka, KS 66609 • (855) 628-7722
www.CapstanAg.com

CONTENTS

SAFETY INSTRUCTIONS

Safe Operation is the Operator's Responsibility

Safety Alert Symbol

This symbol with a warning statement means: "Warning, be alert! Your safety is involved!" Carefully read the message that follows.

- Make sure that all personnel have read this instruction manual, and thoroughly understand the procedures for safe and correct installation, operation, and maintenance.

Personal Safety

WARNING

Working with sprayer equipment can be dangerous, so the proper hand and eye protection must be used at all times.

WARNING

Sprayer lines may be pressurized. Relieve pressure before removing pressure sensor or pressure sensor lines.

WARNING

Before removal or installation of nozzle valves, make sure that the pressure has been released from the sprayer lines.

Installation Safety

- Use appropriate hand protection when hands are exposed to hazards such as: those from skin absorption of harmful substances, severe cuts or lacerations, severe abrasions, punctures, chemical burns, thermal burns, and harmful temperature extremes.
- Installation must be performed by a person who is familiar with all local, state, and federal laws.

Health & Safety

- Sealant materials must be strictly applied in accordance with the manufacturer's instructions.
- Only an approved type of sealant, gasket or tape should be used.

Chemical Safety

- Always read the label before using chemicals. Follow the instructions from the chemical manufacturer on how to select, use and handle each chemical. Note protection information each time before opening the container.
- If written warnings cannot be understood by workers, verbal warnings must be given
- Do not spill chemicals on skin or clothing. If chemicals are spilled, remove contaminated clothing immediately and wash skin (and clothing) thoroughly with soap and water. Use soap and water to wash hands and face, as well as changing clothing after spraying. Wash clothing after every use.
- The spray tank and system should be emptied of chemical mixture and flushed with clean water before servicing the spray system or spray components. Clean the machine of all chemical residue before servicing.
- Avoid inhaling chemicals. When directed to do so on the chemical label, wear protective clothing, face shield or goggles.
- Never smoke while spraying or handling chemicals.
- When spraying areas containing livestock or pets, cover food and water containers.
- If symptoms of illness occur during or shortly after spraying, immediately call a physician or go to a hospital.
- Follow the label's directions and advice to keep the residues on edible portions of plants within the limits permitted by law.
- Keep chemicals out of the reach of children, pets and unauthorized personnel. Store chemicals outside of the home, away from food and feed, and lock them in a secure area.
- Keep bystanders away from spray drift.
- Always store chemicals in their original containers and keep the containers tightly closed. Read labels for hazards about chemical reactions with certain types of metals.
- Always dispose of empty containers according to the manufacturer's directions.

INTRODUCTION

SharpShooter Spray System

The SharpShooter Spray System Technical Manual is intended to assist operators and service personnel in the proper installation, operation, maintenance and troubleshooting of the SharpShooter Spray System. Some of the following steps should only be performed by trained service personnel, these sections are clearly marked.

If a problem arises 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 Capstan Ag Systems, Inc.

Dealer: _____

Contact: _____

Phone: _____

Address: _____

City / State / Zip: _____

FACTORY SERVICE / REPAIRS
Capstan Ag Systems, Inc. **4225 S.W. Kirklawn Ave.** **Topeka, KS 66609** **Toll-free number: (855) 628-7722** **Topeka Office Fax: (785) 232-7799** **Hours: 8 a.m. to 4:30 p.m. CST**

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INTRODUCTION CONT.

SharpShooter Kit

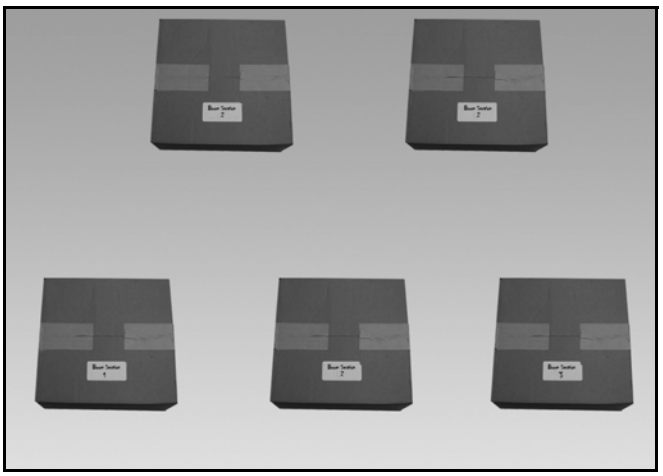
Figure 1

The SharpShooter kit ships in a box **[Figure 1]** that contains the following marked boxes:

- Pulse Generator Module
- Power Hub Module
- Boom Section Module 1
- Boom Section Module 2
- Boom Section Module 3 (etc.)

NOTE: Your SharpShooter system is assembled, tested and shipped according to your machine's boom configurations. Make sure that the boom section module boxes are installed on the appropriate boom sections (1 thru 3 etc).

Figure 2



Boom Section Module boxes **[Figure 2]** are marked for each boom section.

Boom Section Module contents may contain:

- Valve Driver
- Nozzle Valve Harnesses
- Extension Harnesses
- Nozzle Alternator Harnesses (if required)
- Y-Adapters (if required)
- Nozzle Valve Assemblies
- Plugs

NOTE: Nozzle alternator adapters and Y-adapters are also pre-assembled to the Boom Section Module components and wiring.

INTRODUCTION CONT.

SharpShooter Kit Cont.

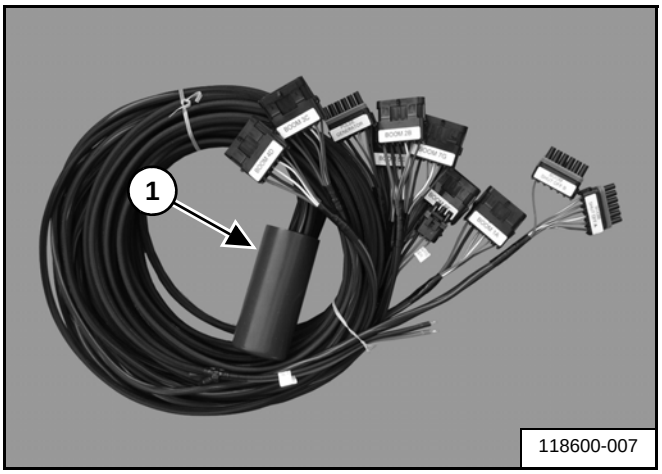
Although the installation is usually straightforward, the following are common installation oversights:

1. Never connect more than 15 nozzle valves to a single Valve Driver.
2. When routing nozzle harnesses through the boom fold and swing joints, skip two nozzle harness pigtails. This allows for boom joints to operate without damaging harnesses, and maintains even / odd nozzle pairing.
3. Where side by side nozzle valves are pulsing together, install the nozzle alternator harnesses on Valve Drivers to maintain even / odd pulses.
4. Never use Air Induction (AI) spray tips.
5. Route wires to allow for raise / lower movement of the boom mast, boom fold and boom swing functions.
6. When wiring to boom section signals, a custom harness is needed for unsupported platforms.
7. Connect the nozzle wiring harnesses to alternate pulsing on side-by-side nozzles.
8. Use the correct tip choices.
9. A laptop computer is used to check key software settings. If assistance is required, contact your SharpShooter distributor.

PARTS IDENTIFICATION

Power Hub

Figure 3

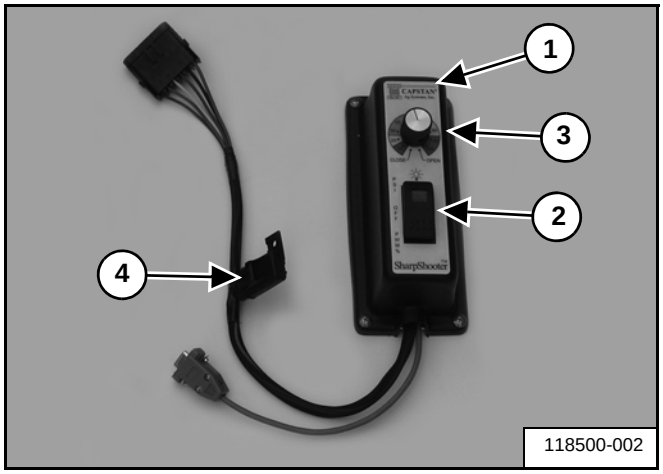


The Power Hub (Item 1) **[Figure 3]** is usually located at the center of the boom mast near the Pressure Sensor.

The Power Hub is a junction block where the battery power is routed to the Valve Drivers. The Power Hub also routes Pressure Sensor signals and Valve Driver signals to the cab box (Pulse Generator).

Pulse Generator

Figure 4



The Pulse Generator (Item 1) **[Figure 4]** is located in the sprayer's cab.

The Pulse Generator contains two switches:

- Rocker Switch (Item 2) **[Figure 4]**.
- Rotary Switch (Item 3) **[Figure 4]**.

The rocker switch has three positions and an indicator light. The three rocker switch positions are PWM, OFF, and PSI.

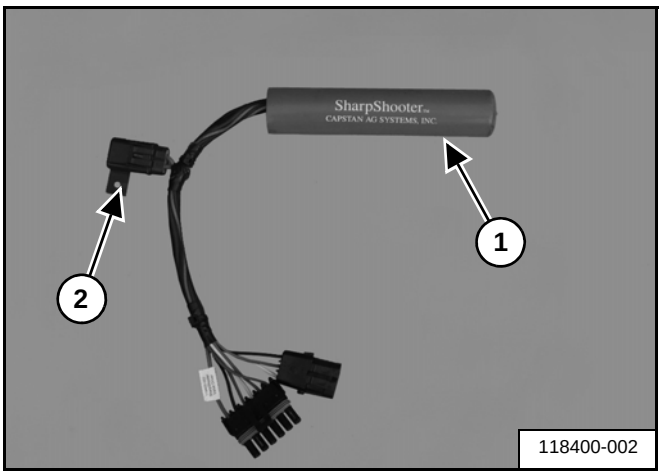
The Rotary Switch has twelve detent positions: Close, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100 and Open.

NOTE: The Pulse Generator has a 10 AMP. fuse (Item 4) [Figure 4] in the power lead.

PARTS IDENTIFICATION CONT.

Valve Driver

Figure 5



The Valve Drivers (Item 1) **[Figure 5]** are usually located next to the first nozzle on the associated boom sections.

Each Valve Driver has two connectors. The 6-Pin connector is used to connect the wiring extension to the Power Hub. The 3-Pin connector is for the boom section nozzle harness wiring.

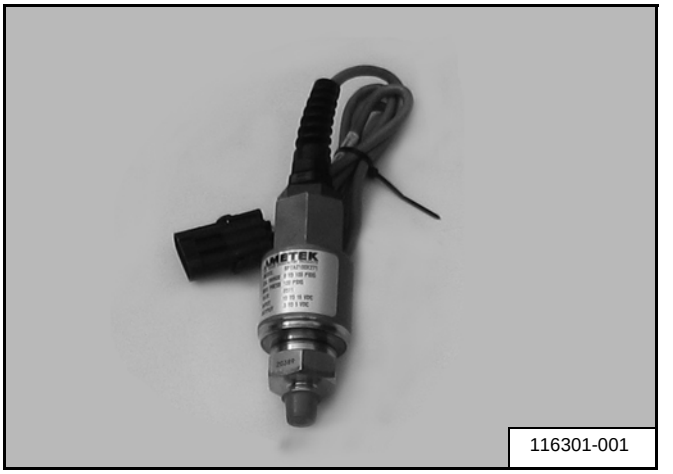
Each Valve Driver is equipped a 10 AMP. fuse (Item 2) **[Figure 5]**.

A single Valve Driver can support 15 nozzle valves.

NOTE: When a boom section contains more than 15 nozzle valves, a second Valve Driver is required. Also, a 6-pin Y-adapter harness is required to connect the two Valve Drivers together, see Y-Adapters on page 14.

Pressure Sensor

Figure 6



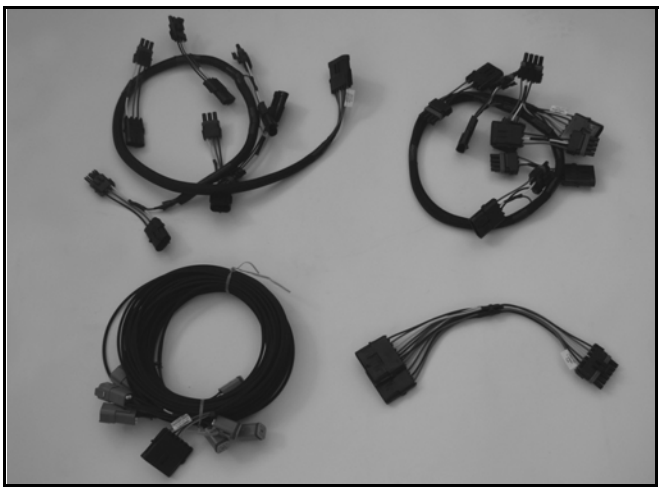
The Pressure Sensor **[Figure 6]** is usually located in the center of the boom near the boom section manifold. The Pressure Sensor must be installed at a location in the plumbing that will provide an accurate reading when all or only one boom section is turned on. A good location for the Pressure Sensor is near the sprayer's pressure gauge port.

The Pressure Sensor provides Pressure Sensor signals to the Pulse Generator.

PARTS IDENTIFICATION CONT.

Boom Shutoff Adapter

Figure 7



Several boom shutoff adapters **[Figure 7]** are available depending on the sprayer model and boom configuration.

NOTE: The boom shutoff adapter is located near the sprayer's boom shutoff valve manifold.

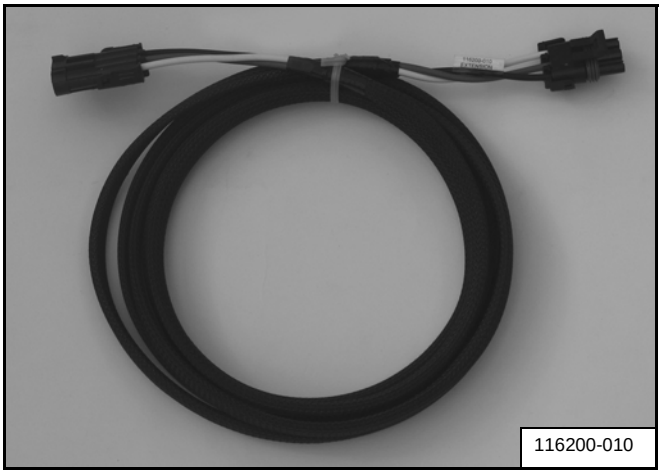
The boom shutoff adapter intercepts the signals from the machines boom section shutoff that either open and close the boom section shutoff valves.

SharpShooter uses this signal to turn on and off the nozzle valve assemblies. These assemblies are located on the boom section spray tubes. When the signal wire is powered up, 12V dc, the nozzle valves open. When the signal wire has no power, the nozzle valves close.

NOTE: For available boom section shutoff adapters see SharpShooter Parts List on page 18.

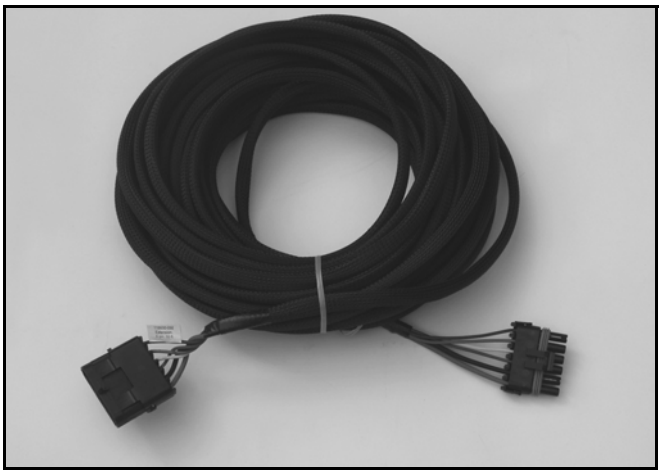
Extension Harnesses

Figure 8



The 3-Pin x 10' extension harness **[Figure 8]** is used when extra cable length is required to connect the Pressure Sensor to the Power Hub.

Figure 9



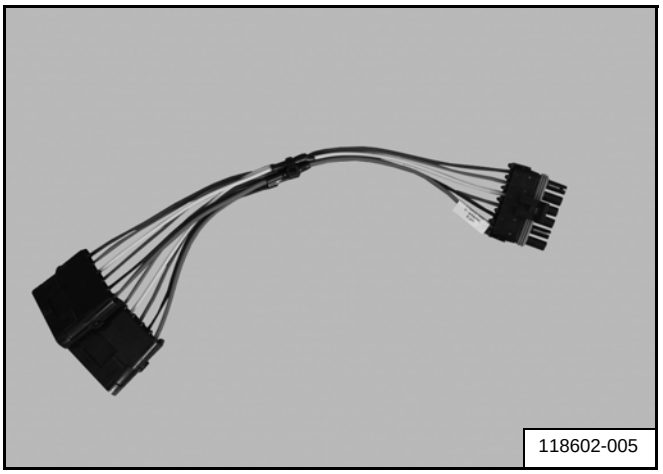
The 6-Pin extension harness **[Figure 9]** connects the Valve Drivers to the Power Hub and the Power Hub to the Pulse Generator.

- 6-Pin x 10' (118600-010)
- 6-Pin x 20' (118600-020)
- 6-Pin x 30' (118600-030)
- 6-Pin x 40' (118600-040)
- 6-Pin x 50' (118600-050)
- 6-Pin x 60' (118600-060)

PARTS IDENTIFICATION CONT.

Y-Adapters

Figure 10

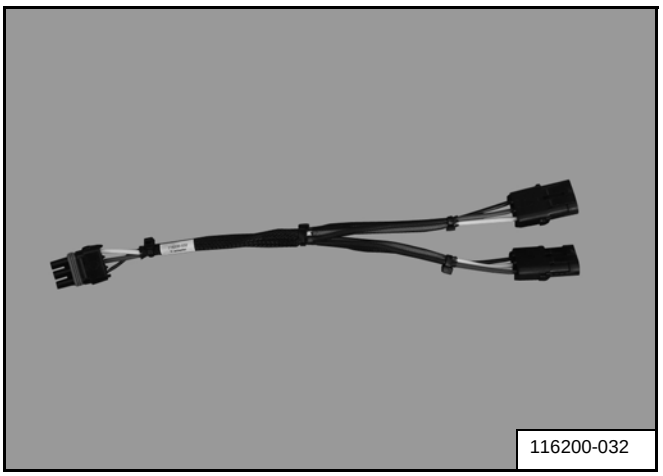


When a boom section contains more than 15 nozzles valves, the 6-Pin Y-adapter harness **[Figure 10]** is required to connect two Valve Drivers together. See General Layout Section page 30 [Example 3] boom sections 2 & 8.

The 6-Pin Y-adapter harness **[Figure 10]** is required to connect two Power Hubs together on a boom system that contains more than seven sections. See General Layout Section page 30 [Example 3] Power Hub.

NOTE: The 6-Pin Y-adapter is also used as a boom shutoff adapter on CNH machines.

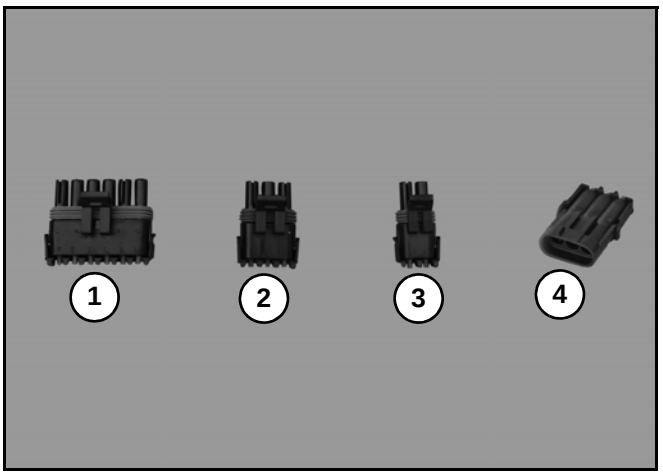
Figure 11



The 3-Pin Y-adapter harness **[Figure 11]** is required when locating a Valve Driver on the center of a boom section. The 3-Pin Y-adapter harness allows nozzle harnesses to be routed in each direction on the boom section. See General Layout Section page 28 [Example 2] boom section 4.

Packard Plug

Figure 12



Packard plugs **[Figure 12]** are used to weather proof any unused connectors.

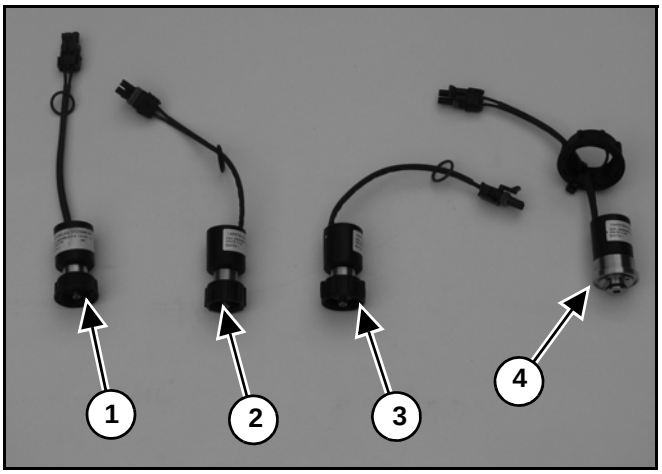
1. Plug 6-Pin Tower (116200-059)
2. Plug 3-Pin Tower (116200-046)
3. Plug 2-Pin Tower (116200-045)
4. Plug 3-Pin Shroud (116200-048)
5. Pin 6-Pin Shroud (116200-079) [not shown]

PARTS IDENTIFICATION CONT.

Nozzle Valve Assembly

Capstan offers several types of nozzle valve assemblies to accommodate the variety of nozzle bodies used on sprayers. It is important to have the correct nozzle valve assembly for the nozzle body.

Figure 13



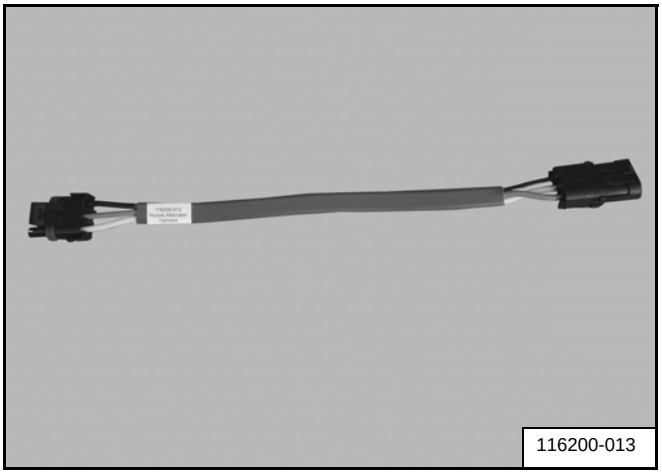
The SharpShooter pulses the Nozzle Valve Assemblies **[Figure 13]** to maintain a constant boom and tip pressure.

1. TeeJet Nozzle Valve Assembly (116190-111)
2. Arag Nozzle Valve Assembly (116290-111)
3. Wilger Nozzle Valve Assembly (116390-111)
4. Arag High Flow Nozzle Valve Assembly (116290-211)

NOTE: Only 15 nozzle valves may be installed with a single Valve Driver. If more than 15 nozzles are installed on a boom section, an additional Valve Driver and Y-adapter are required.

Nozzle Alternator Harness

Figure 14



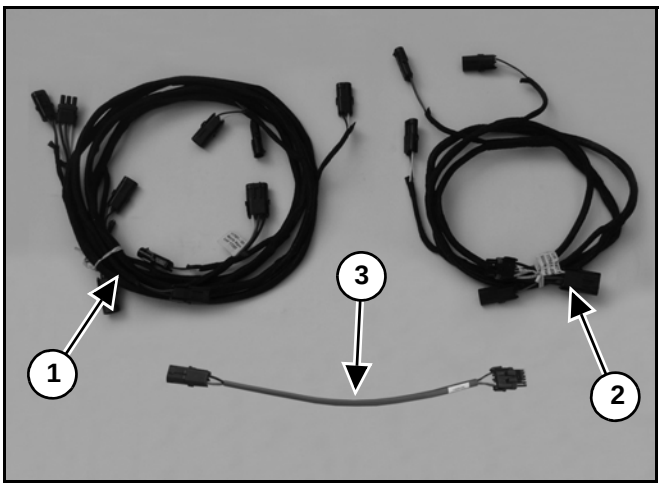
A nozzle alternator harness **[Figure 14]** is required when the nozzle harness “White” / “Green” wire alternation cannot be maintained.

If required, the nozzle alternator harness is installed between the Valve Driver and nozzle valve harness.

PARTS IDENTIFICATION CONT.

Nozzle Harnesses

Figure 15



Nozzle Harnesses **[Figure 15]**

1. Nozzle Harness, 8 x 20” (117501-005)
2. Nozzle Harness, 4 x 20” (117501-006)
3. Nozzle Harness, 1 x 20” (117501-040)
4. Nozzle Harness, 8 x 15” (117501-022) [Not Shown]
5. Nozzle Harness, 4 x 15” (117501-023) [Not Shown]

NOTE: When installing the nozzle harnesses along the booms, remember that the nozzle harness pigtails (connector’s wires) are color coded.

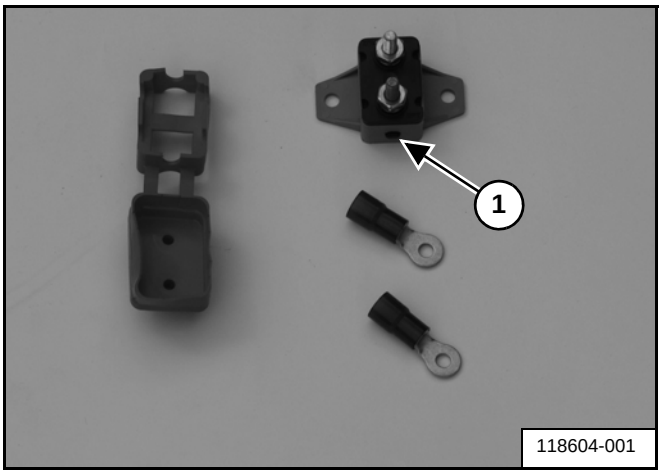
One nozzle harness pigtail will contain a White and Black wire, while the adjacent nozzle harness pigtail (connector) will contain a Green and Black wire.

NOTE: The nozzle harness pigtails (connectors) must alternate along the boom, “White” / “Green” wire alternation.

NOTE: Every other nozzle must pulse together to create pulse blending. The White wire creates an odd pulse. The Green wire creates an even pulse.

Circuit Breaker Kit (50 AMP.)

Figure 16

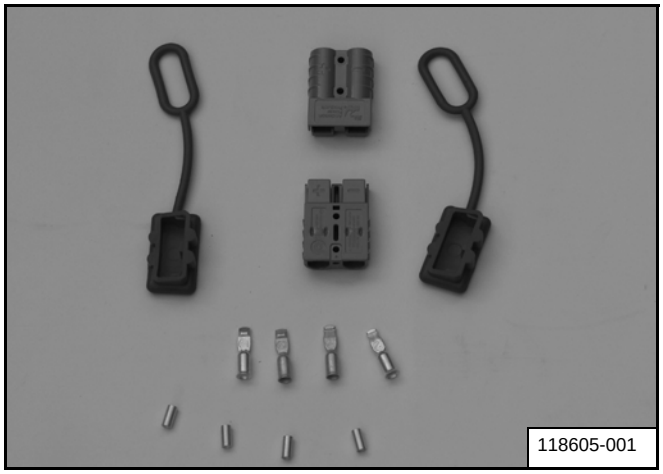


The circuit breaker kit is installed for circuit protection in the Power Hub power cable, which provides battery power to the SharpShooter system.

Circuit Breaker manual reset button (Item 1) **[Figure 16]**.

Power Disconnect Kit (Optional)

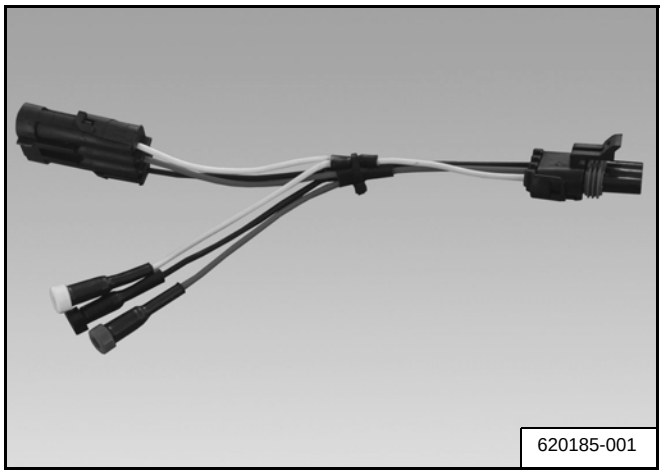
Figure 17



A power disconnect kit **[Figure 17]** is available for trailer sprayers or for sprayer applications where disconnecting of the battery power wires is desired.

Pressure Sensor Breakout Harness

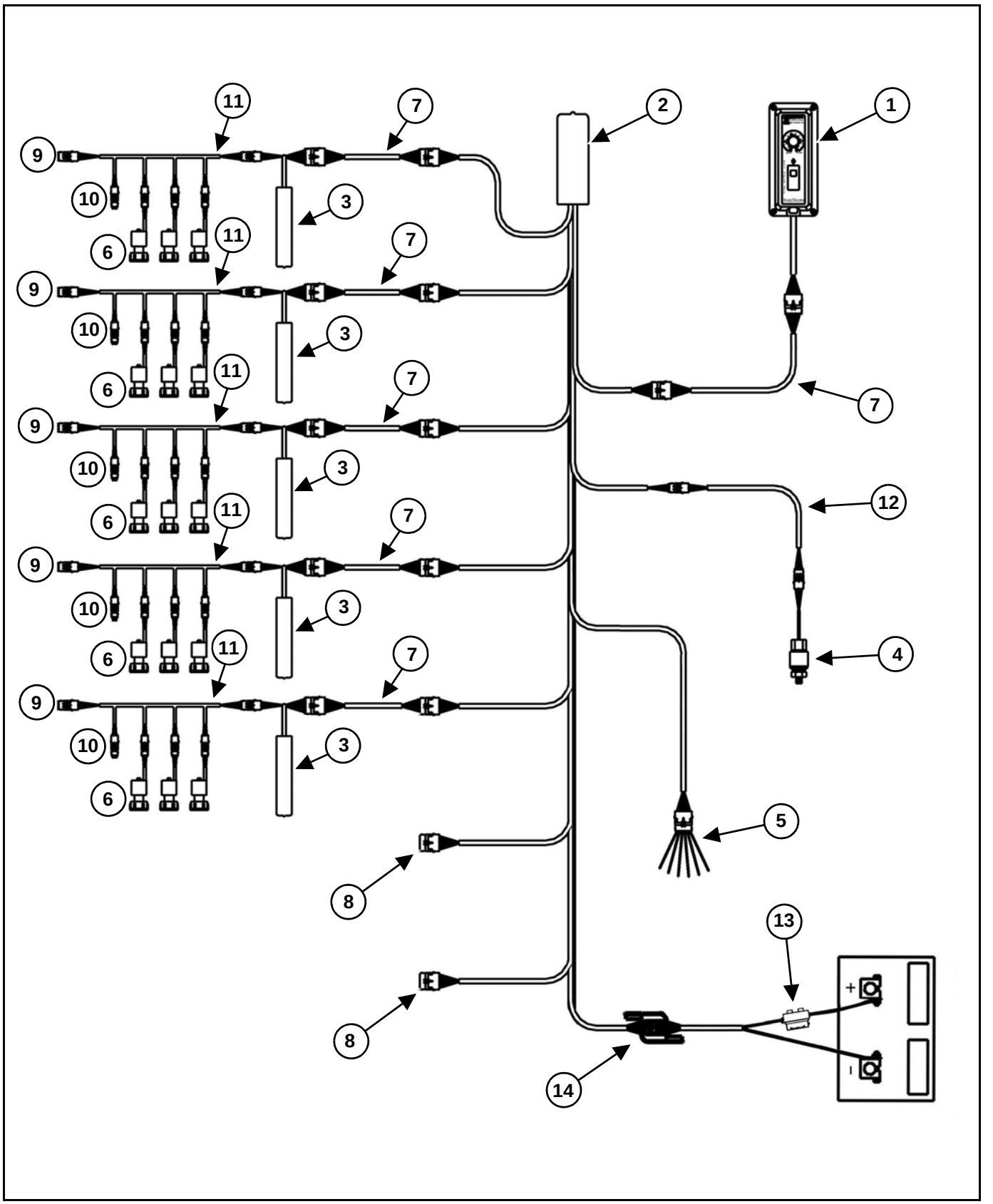
Figure 18



The Pressure Sensor Breakout Harness **[Figure 18]** is a service tool used to evaluate the Pressure Sensor.

PARTS IDENTIFICATION CONT.

SharpShooter Parts List



PARTS IDENTIFICATION CONT.

SharpShooter Parts List Cont.

ITEM NO.	PART NO.	DESCRIPTION	QTY.
1	118500-002	Pulse Generator, PWM/PSI	1
2	118600-007	Power Hub, 7 Section	0 - 2
3	118400-002	Valve Driver, 6-Pin Tower	AS Req.
4	116301-001	Pressure Sensor Assembly, 100 PSI	0 - 1
5	118602-001	Boom Shutoff Pigtail (See page 21)	0 - 1
5	118602-002	Shutoff Adapter RoGator (See page 21)	0 - 1
5	118602-003	Shutoff Adapter Apache (See page 21)	0 - 1
5	118602-004	Shutoff Adapter John Deere 4720 (See page 22)	0 - 1
5	118602-005	Shutoff Adapter CNH 6-Pin (See page 22)	0 - 1
5	118602-006	Shutoff Adapter RoGator 100' x 5 Section 5 Drivers (See page 22)	0 - 1
5	118602-007	Shutoff Adapter RoGator SS 90'/100' 5 Section 6 Drivers (See page 23)	0 - 1
5	118602-008	Shutoff Adapter SS 120' x 7 Section (See page 23)	0 - 1
5	118602-009	Shutoff Adapter 2009 John Deere 7x w Metric Pack (See page 23)	0 - 1
5	118602-010	Shutoff Adapter John Deere 7 Section, 49 Series (See page 24)	0 - 1
5	118602-011	Shutoff Adapter NH Guardian (See page 24)	0 - 1
5	118602-012	Shutoff Adapter RoGator 7 Section (See page 24)	0 - 1
5	118602-013	Shutoff Adapter RoGator 90/100' 5 Section (See page 24)	0 - 1
6	116190-111	TeeJet Nozzle Valve Assembly	0 - 84
6	116290-111	Arag Nozzle Valve Assembly	0 - 84
6	116390-111	Wilger Nozzle Valve Assembly	0 - 84
6	116290-211	Arag High Flow Nozzle Valve Assembly	0 - 84
7	118600-010	Extension 6 cond X 10'	As Req.
7	118600-020	Extension 6 cond X 20'	As Req.
7	118600-030	Extension 6 cond X 30'	As Req.
7	118600-040	Extension 6 cond X 40'	As Req.
7	118600-050	Extension 6 cond X 50'	As Req.
7	118600-060	Extension 6 cond X 60'	As Req.
8	116200-059	Plug 6-Pin Tower	0 - 6
9	116200-046	Plug 3-Pin Tower	0 - 6
10	116200-045	Plug 2-Pin Tower	As Req.
11	117501-005	8 X 20" Nozzle Harness	As Req.
11	117501-022	8 X 15" Nozzle Harness	As Req.
11	117501-006	4 X 20" Nozzle Harness	As Req.
11	117501-023	4 X15" Nozzle Harness	As Req.
11	116200-040	1 X 20" Nozzle Harness	As Req.
Not Shown	116200-013	Nozzle Alternator Harness	As Req.
12	116200-010	Extension 3 X 10'	0 - 1
13	118604-001	Circuit Breaker Kit, 50 AMP.	0 - 1
14	118605-001	Power Disconnect Kit (Optional)	0 - 1
Not Shown	116200-048	Plug 3-Pin Shroud	As Req.

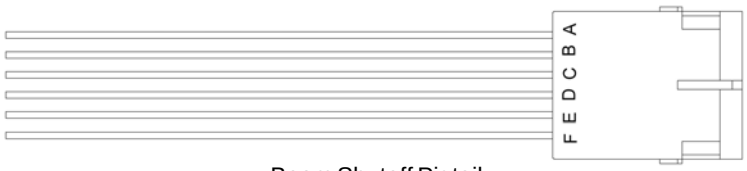
PARTS IDENTIFICATION CONT.

SharpShooter Parts List Cont.

ITEM NO.	PART NO.	DESCRIPTION	QTY.
Not Shown	116200-079	Plug 6-Pin Shroud	As Req.
Not Shown	116200-032	Y-Adapter Harness 3 cond	As Req.
Not Shown	620185-001	Pressure Break-Out Harness 3 Pin	1
Not Shown	118703-001	Installation Kit, SharpShooter	0 - 1
Not Shown	118603-001	Mounting Bracket, Pulse Generator	1
Not Shown	118603-002	Bolt, Mounting Bracket	1
Not Shown	118605-111	Ball Mount, Ram, Pulse Generator (Optional)	1
Not Shown	118156-001	SharpShooter Technical Manual (Ag)	1

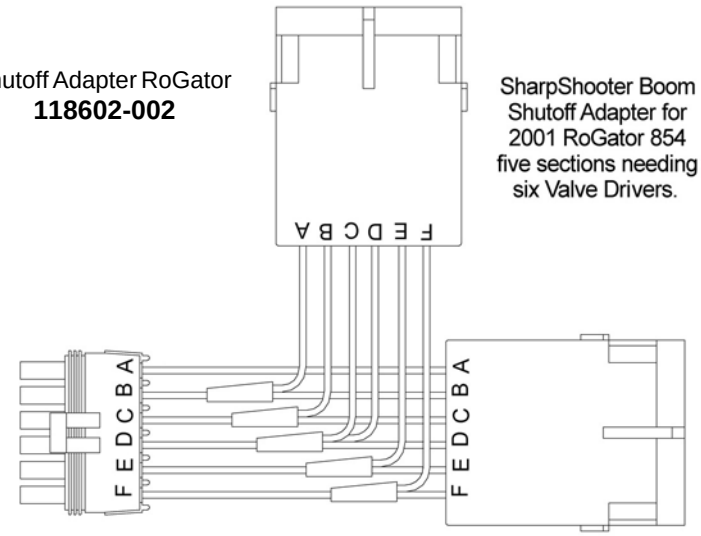
PARTS IDENTIFICATION CONT.

Boom Shutoff Adapter (Identification)



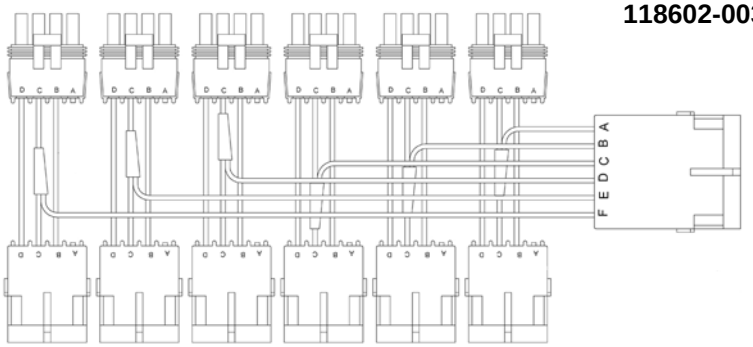
Boom Shutoff Pigtail
118602-001

Shutoff Adapter RoGator
118602-002



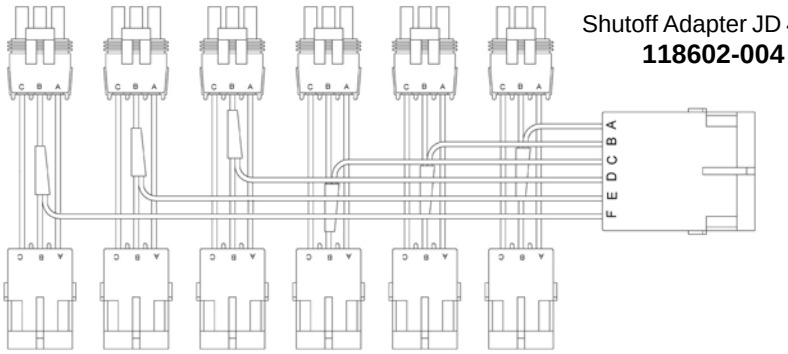
SharpShooter Boom Shutoff Adapter for 2001 RoGator 854 five sections needing six Valve Drivers.

Shutoff Adapter Apache
118602-003

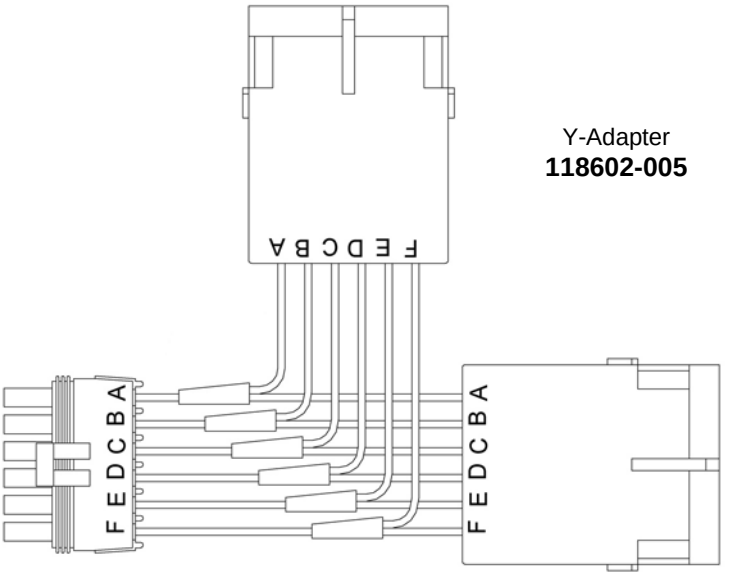


PARTS IDENTIFICATION CONT.

Boom Shutoff Adapters (Identification) Cont.

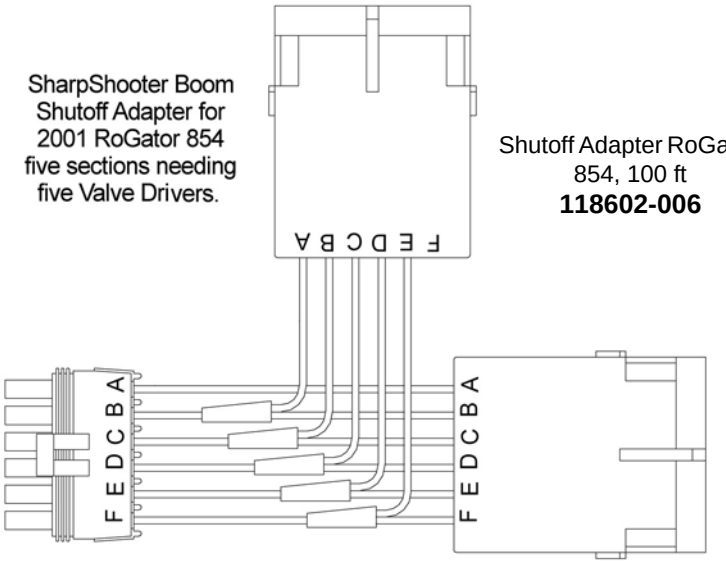


Shutoff Adapter JD 4720
118602-004



Y-Adapter
118602-005

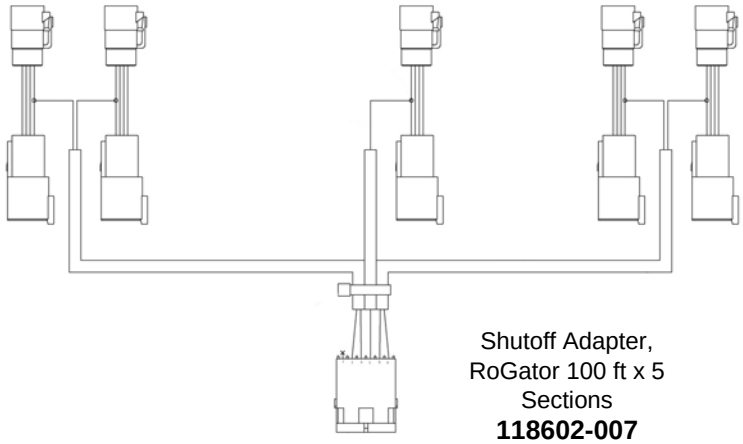
SharpShooter Boom Shutoff Adapter for 2001 RoGator 854 five sections needing five Valve Drivers.



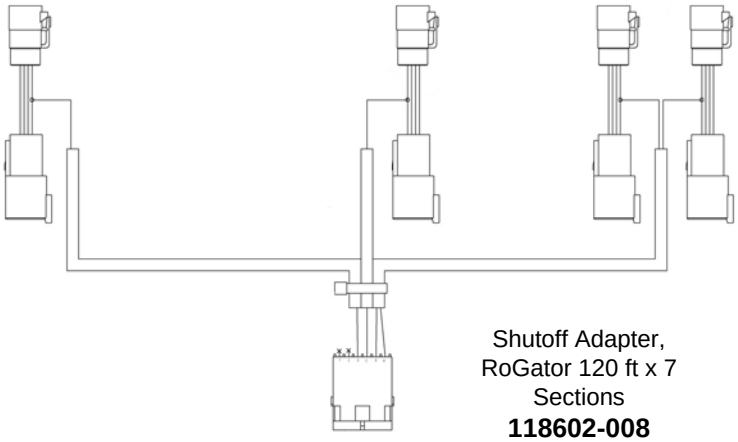
Shutoff Adapter RoGator 854, 100 ft
118602-006

PARTS IDENTIFICATION CONT.

Boom Shutoff Adapters (Identification) Cont.

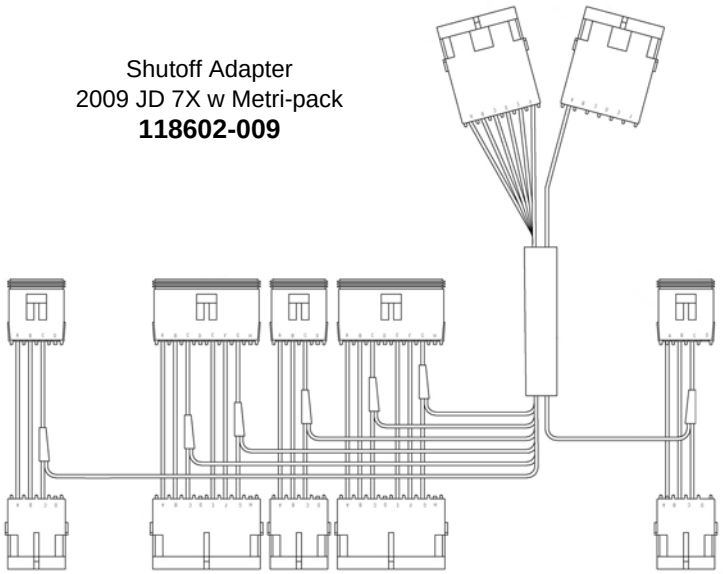


Shutoff Adapter,
RoGator 100 ft x 5
Sections
118602-007



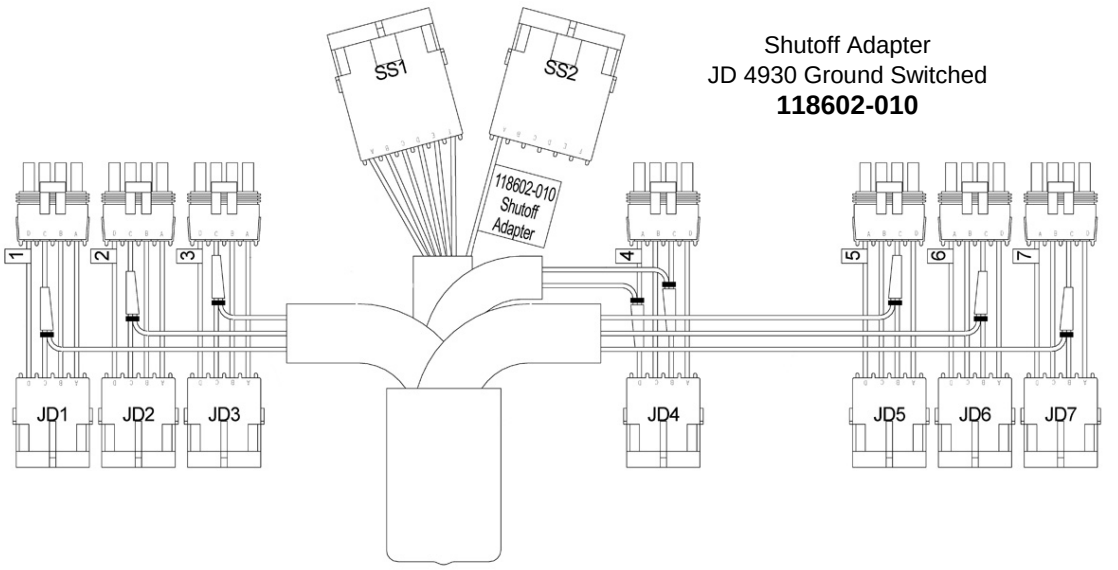
Shutoff Adapter,
RoGator 120 ft x 7
Sections
118602-008

Shutoff Adapter
2009 JD 7X w Metri-pack
118602-009

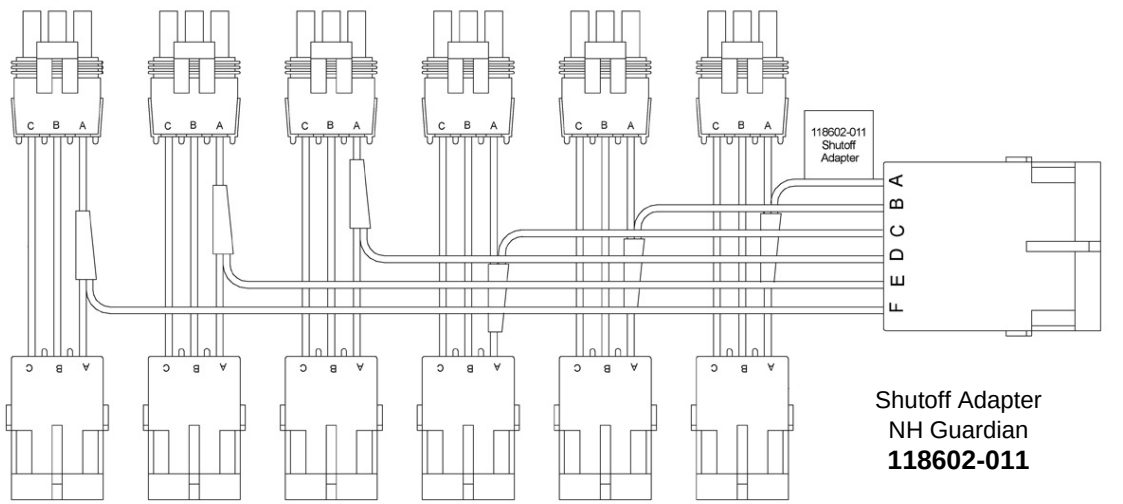


PARTS IDENTIFICATION CONT.

Boom Shutoff Adapters (Identification) Cont.



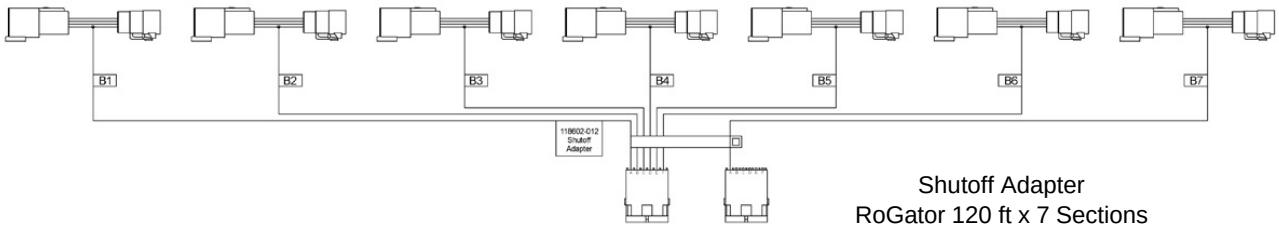
Shutoff Adapter
JD 4930 Ground Switched
118602-010



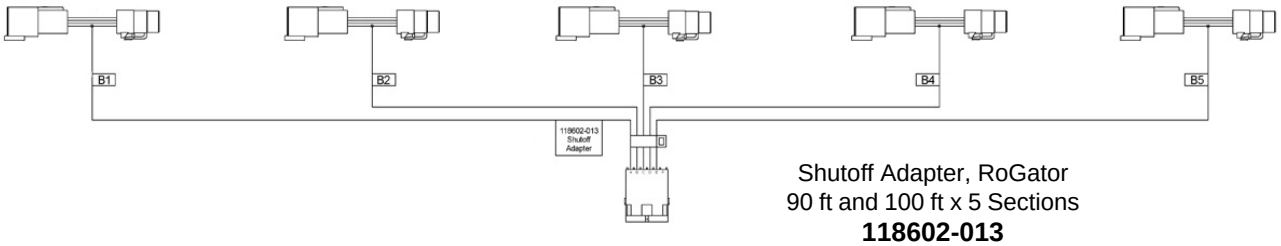
Shutoff Adapter
NH Guardian
118602-011

PARTS IDENTIFICATION CONT.

Boom Shutoff Adapters (Identification) Cont.



Shutoff Adapter
RoGator 120 ft x 7 Sections
118602-012



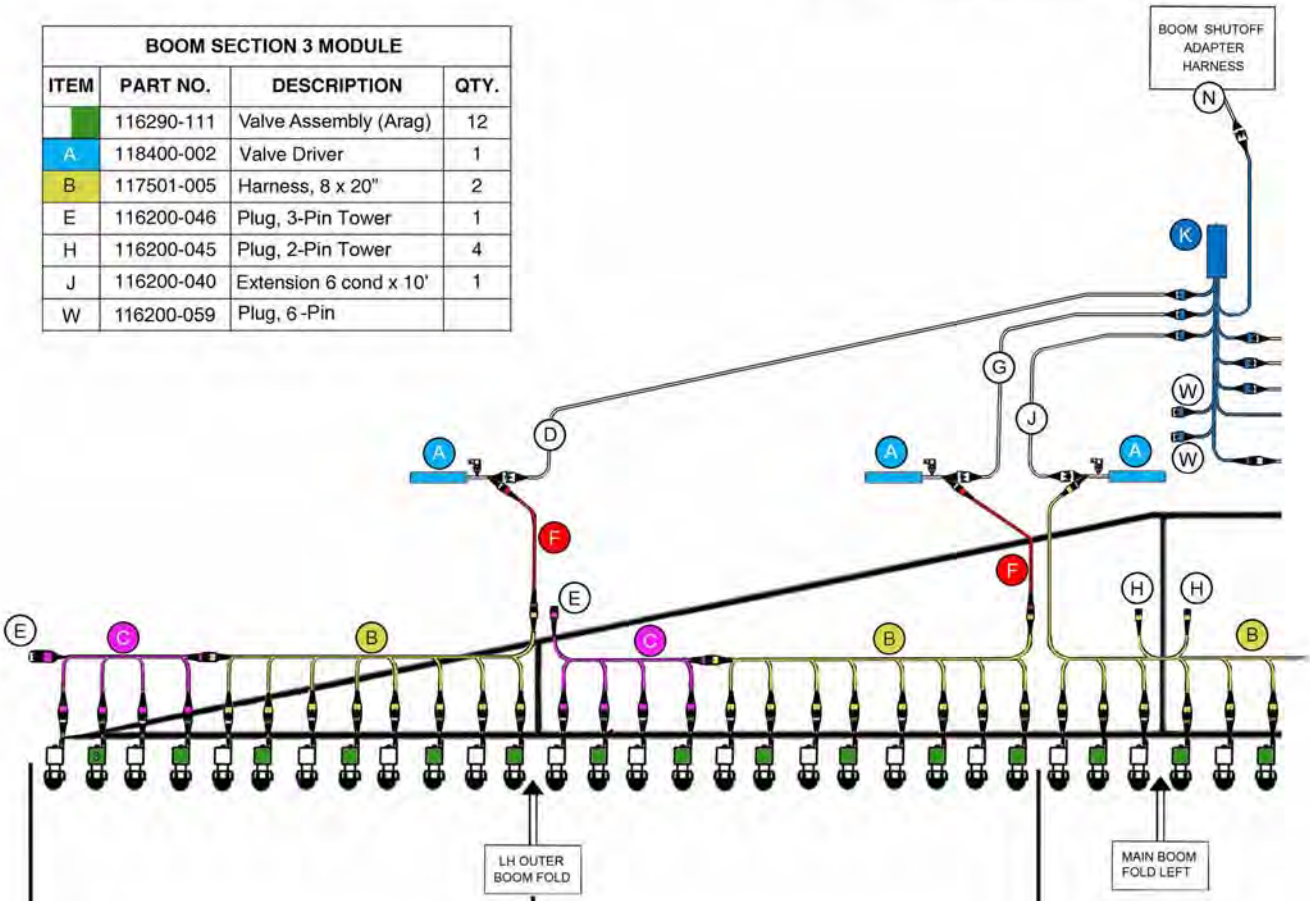
Shutoff Adapter, RoGator
90 ft and 100 ft x 5 Sections
118602-013

SHARPSHOOTER SYSTEM (GENERAL LAYOUT EXAMPLE 1)

SharpShooter System
General Layout (Example 1)

PULSE GENERATOR MODULE			
S	118500-002	Pulse Generator	1
Not Shown	118603-001	Mounting Bracket	1
Not Shown	118603-002	Bolt	1
D	118600-040	Extension 6 cond x 40'	1
Not Shown	118605-111	Ball Mount, Ram (Option)	1

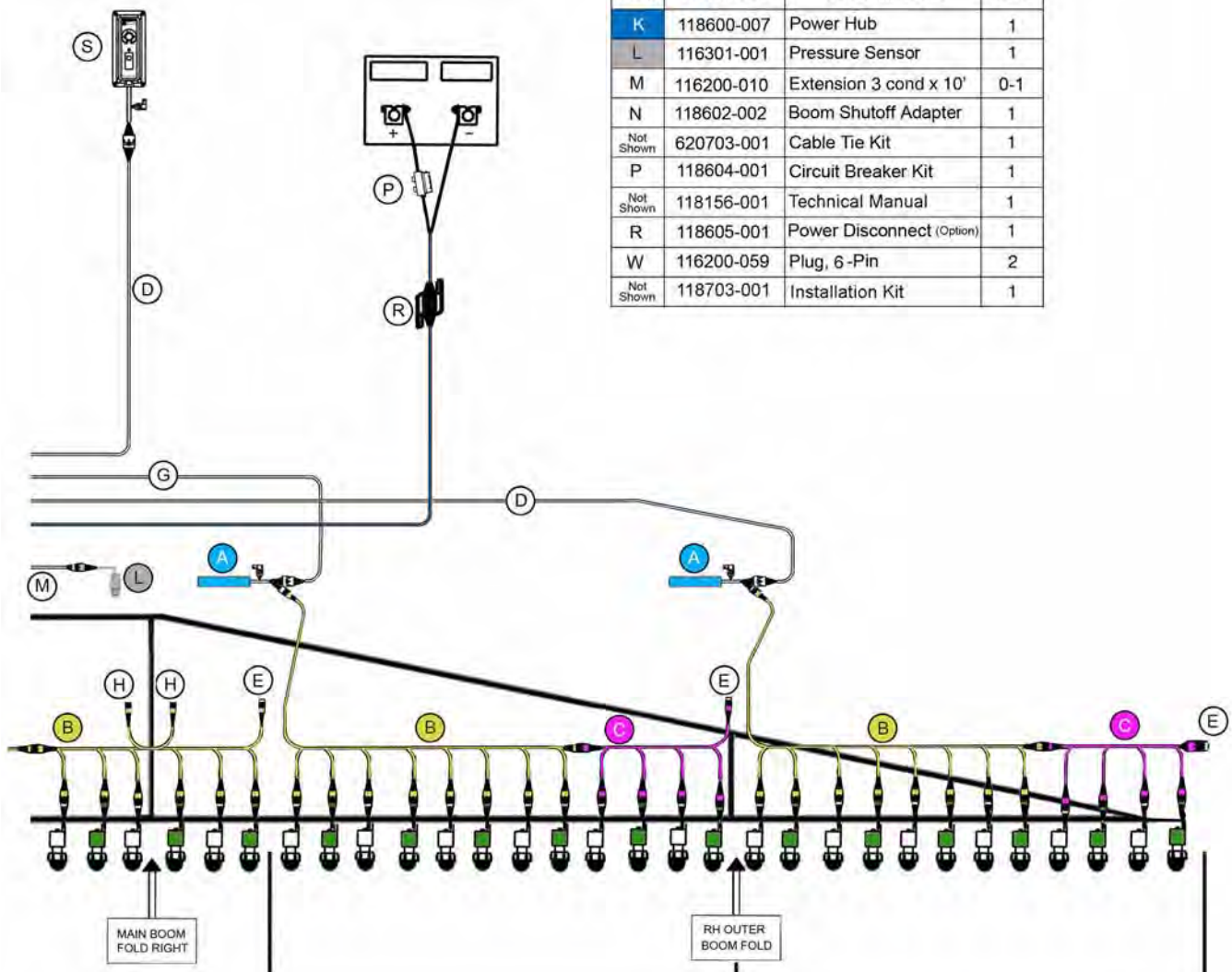
BOOM SECTION 3 MODULE			
ITEM	PART NO.	DESCRIPTION	QTY.
	116290-111	Valve Assembly (Arag)	12
A	118400-002	Valve Driver	1
B	117501-005	Harness, 8 x 20"	2
E	116200-046	Plug, 3-Pin Tower	1
H	116200-045	Plug, 2-Pin Tower	4
J	116200-040	Extension 6 cond x 10'	1
W	116200-059	Plug, 6 -Pin	



BOOM SECTION 1 MODULE			
ITEM	PART NO.	DESCRIPTION	QTY.
	116290-111	Valve Assembly (Arag)	12
A	118400-002	Valve Driver	1
B	117501-005	Harness, 8 x 20"	1
C	117501-006	Harness, 4 x 20"	1
D	118600-040	Extension 6 cond x 40'	1
E	116200-046	Plug, 3-Pin Tower	1
F	116200-013	Nozzle Alternator	1

BOOM SECTION 2 MODULE			
ITEM	PART NO.	DESCRIPTION	QTY.
	116290-111	Valve Assembly (Arag)	12
A	118400-002	Valve Driver	1
B	117501-005	Harness, 8 x 20"	1
C	117501-006	Harness, 4 x 20"	1
E	116200-046	Plug, 3-Pin Tower	1
F	116200-013	Nozzle Alternator	1
G	118600-020	Extension 6 cond x 20'	1

BOOM SECTION 3 MODULE (Table Above)



POWER HUB MODULE			
ITEM	PART NO.	DESCRIPTION	QTY.
K	118600-007	Power Hub	1
L	116301-001	Pressure Sensor	1
M	116200-010	Extension 3 cond x 10'	0-1
N	118602-002	Boom Shutoff Adapter	1
Not Shown	620703-001	Cable Tie Kit	1
P	118604-001	Circuit Breaker Kit	1
Not Shown	118156-001	Technical Manual	1
R	118605-001	Power Disconnect (Option)	1
W	116200-059	Plug, 6-Pin	2
Not Shown	118703-001	Installation Kit	1

BOOM SECTION 4 MODULE			
ITEM	PART NO.	DESCRIPTION	QTY.
	116290-111	Valve Assembly (Arag)	12
A	118400-002	Valve Driver	1
B	117501-005	Harness, 8 x 20"	1
C	117501-006	Harness, 4 x 20"	1
G	118600-020	Extension 6 cond x 20'	1
E	116200-046	Plug, 3-Pin Tower	1

BOOM SECTION 5 MODULE			
ITEM	PART NO.	DESCRIPTION	QTY.
	116290-111	Valve Assembly (Arag)	12
A	118400-002	Valve Driver	1
B	117501-005	Harness, 8 x 20"	1
C	117501-006	Harness, 4 x 20"	1
D	118600-040	Extension 6 cond x 40'	1
E	116200-046	Plug, 3-Pin Tower	1

SHARPSHOOTER SYSTEM (GENERAL LAYOUT EXAMPLE 2)

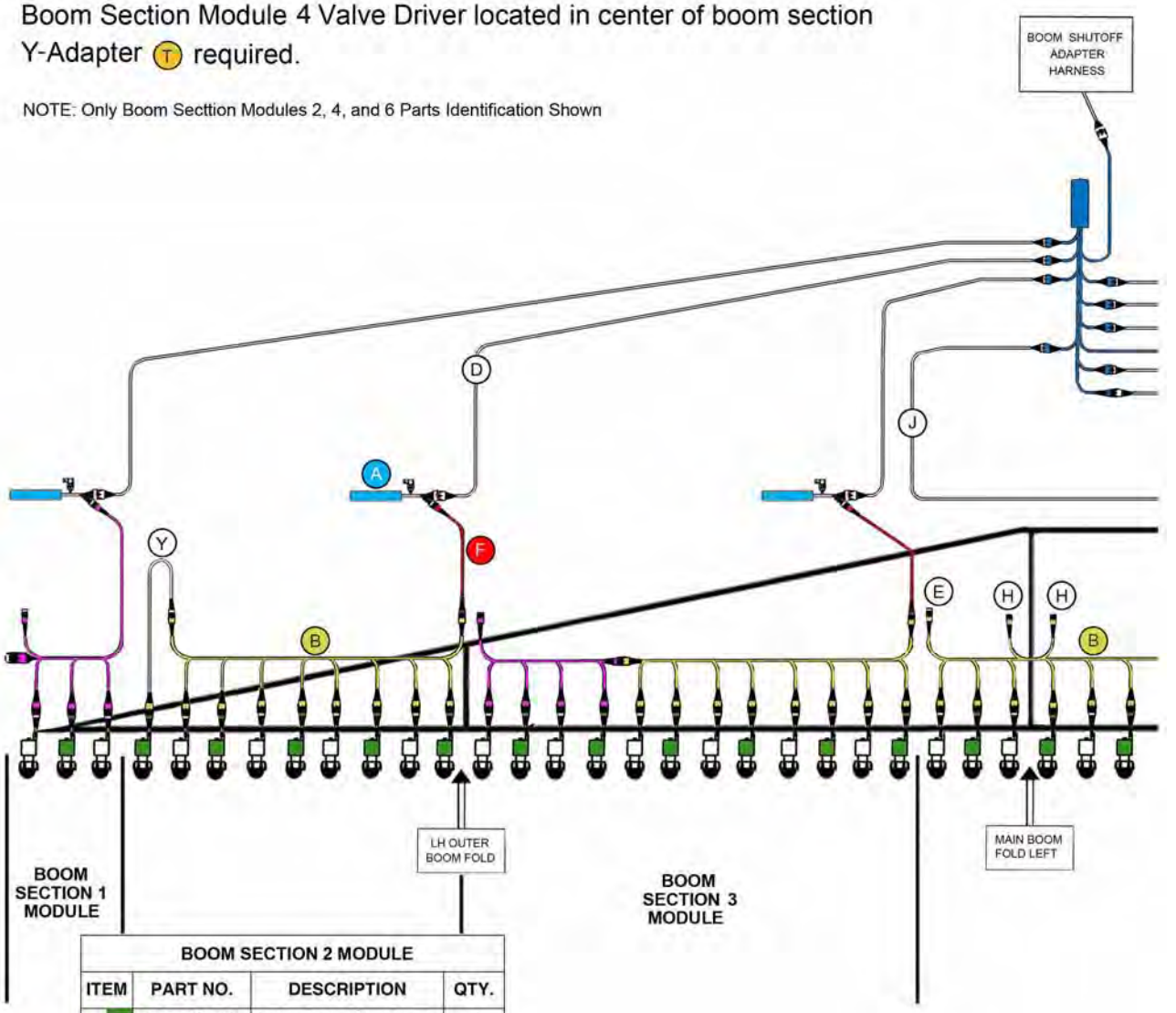
SharpShooter System
General Layout (Example 2)

Boom Section Modules 2 & 6 require 1 x 20" Nozzle Harness (Y)

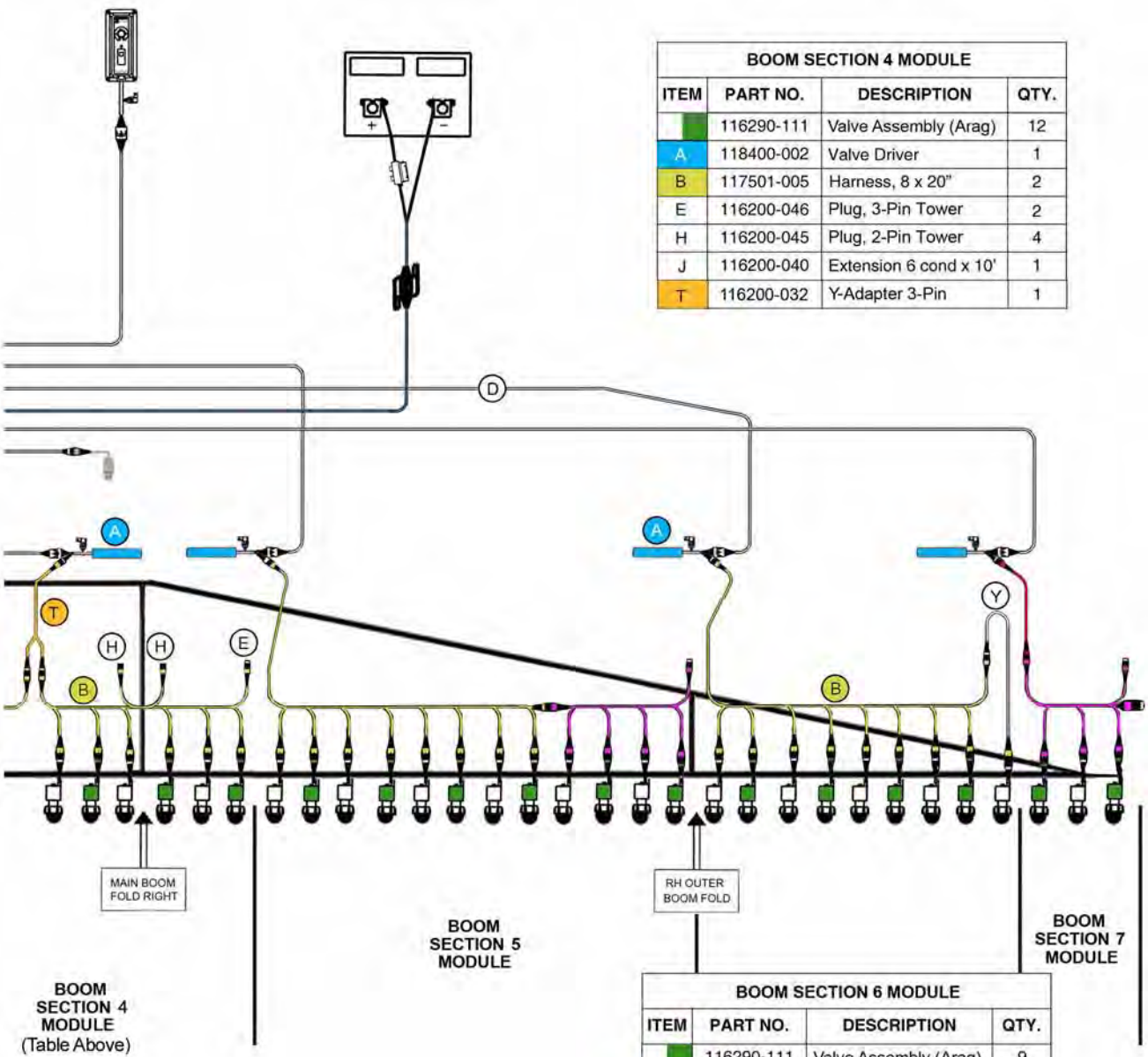
Boom Section Module 4 Valve Driver located in center of boom section

Y-Adapter (T) required.

NOTE: Only Boom Secttion Modules 2, 4, and 6 Parts Identification Shown



BOOM SECTION 2 MODULE			
ITEM	PART NO.	DESCRIPTION	QTY.
	116290-111	Valve Assembly (Arag)	9
A	118400-002	Valve Driver	1
B	117501-005	Harness, 8 x 20"	1
D	118600-040	Extension 6 cond x 40'	1
F	116200-013	Nozzle Alternator	1
Y	116200-040	Harness, 1 x 20"	1



BOOM SECTION 4 MODULE			
ITEM	PART NO.	DESCRIPTION	QTY.
	116290-111	Valve Assembly (Arag)	12
A	118400-002	Valve Driver	1
B	117501-005	Harness, 8 x 20"	2
E	116200-046	Plug, 3-Pin Tower	2
H	116200-045	Plug, 2-Pin Tower	4
J	116200-040	Extension 6 cond x 10'	1
T	116200-032	Y-Adapter 3-Pin	1

BOOM SECTION 6 MODULE			
ITEM	PART NO.	DESCRIPTION	QTY.
	116290-111	Valve Assembly (Arag)	9
A	118400-002	Valve Driver	1
B	117501-005	Harness, 8 x 20"	1
D	118600-040	Extension 6 cond x 40'	1
Y	116200-040	Harness, 1 x 20"	1

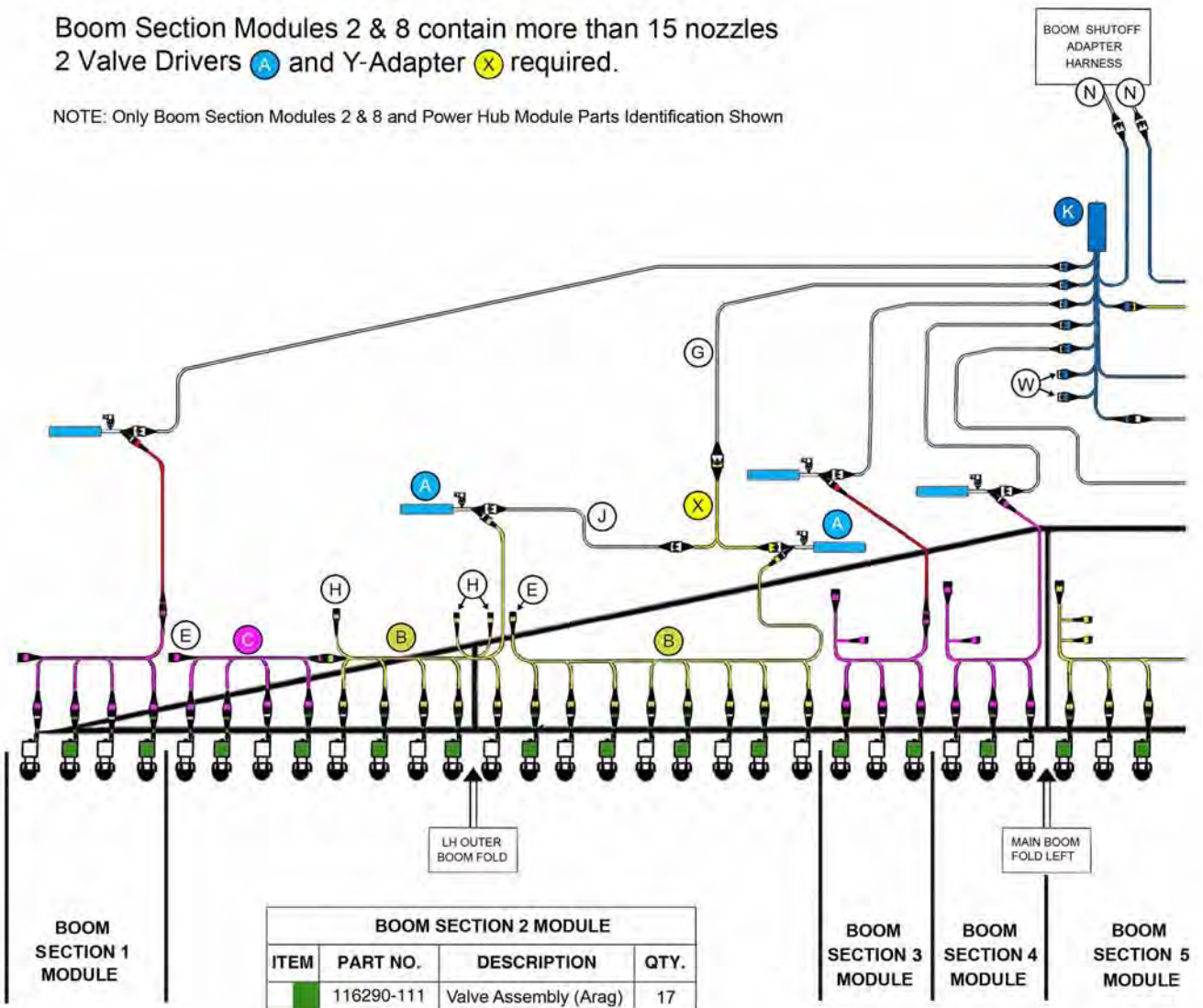
SHARPSHOOTER SYSTEM (GENERAL LAYOUT EXAMPLE 3)

SharpShooter System
General Layout (Example 3)

Boom contains more than 7 sections
2 Power Hub Modules (K) and Y-Adapter (X) required.

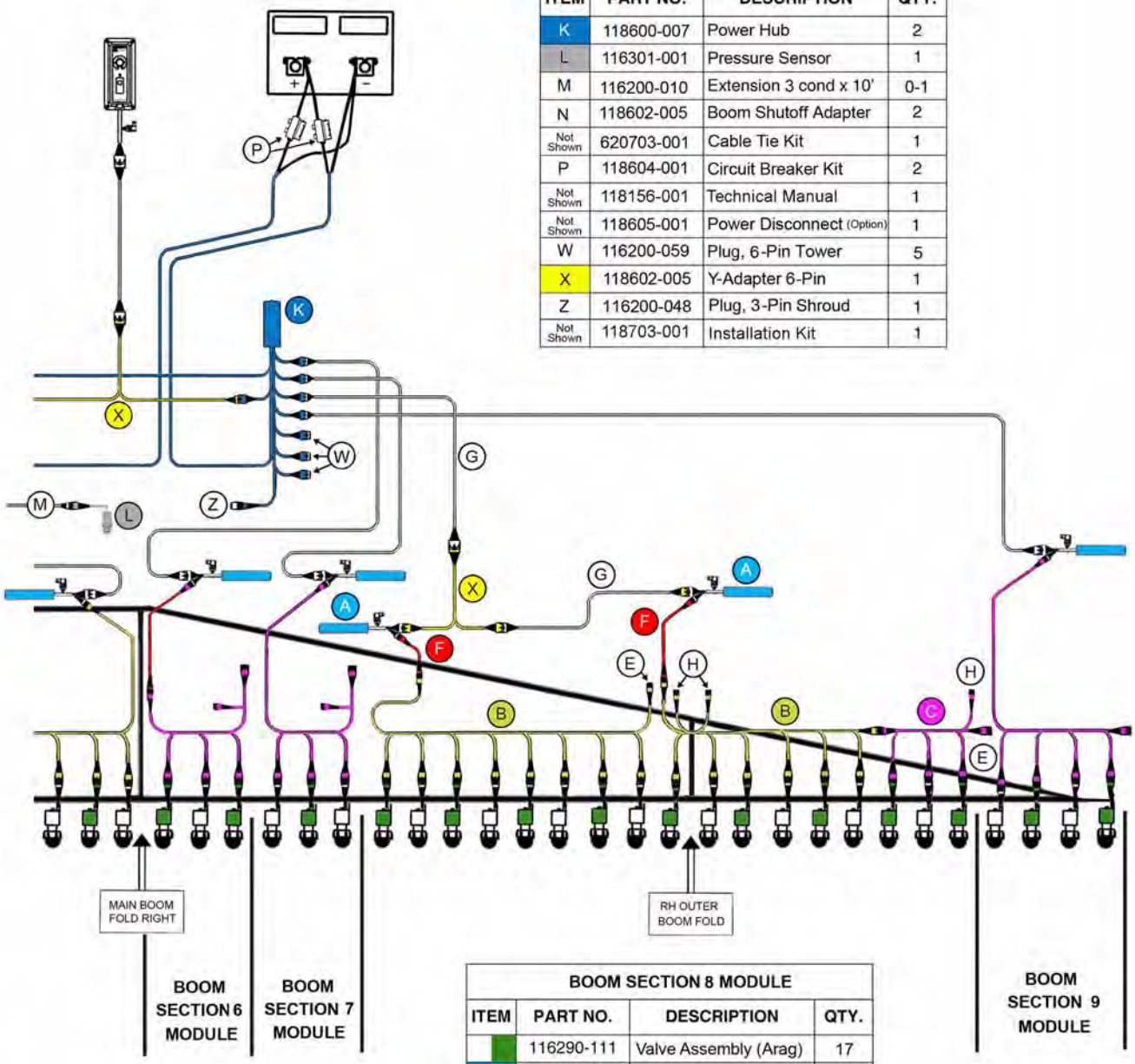
Boom Section Modules 2 & 8 contain more than 15 nozzles
2 Valve Drivers (A) and Y-Adapter (X) required.

NOTE: Only Boom Section Modules 2 & 8 and Power Hub Module Parts Identification Shown



BOOM SECTION 2 MODULE			
ITEM	PART NO.	DESCRIPTION	QTY.
	116290-111	Valve Assembly (Arag)	17
A	118400-002	Valve Driver	2
B	117501-005	Harness, 8 x 20"	2
C	117501-006	Harness, 4 x 20"	1
E	116200-046	Plug, 3-Pin Tower	2
G	118600-020	Extension 6 cond x 20'	1
H	116200-045	Plug, 2-Pin Tower	3
J	116200-040	Extension 6 cond x 10'	1
X	118602-005	Y-Adapter 6-Pin	1

POWER HUB MODULE			
ITEM	PART NO.	DESCRIPTION	QTY.
K	118600-007	Power Hub	2
L	116301-001	Pressure Sensor	1
M	116200-010	Extension 3 cond x 10'	0-1
N	118602-005	Boom Shutoff Adapter	2
Not Shown	620703-001	Cable Tie Kit	1
P	118604-001	Circuit Breaker Kit	2
Not Shown	118156-001	Technical Manual	1
Not Shown	118605-001	Power Disconnect (Option)	1
W	116200-059	Plug, 6-Pin Tower	5
X	118602-005	Y-Adapter 6-Pin	1
Z	116200-048	Plug, 3-Pin Shroud	1
Not Shown	118703-001	Installation Kit	1

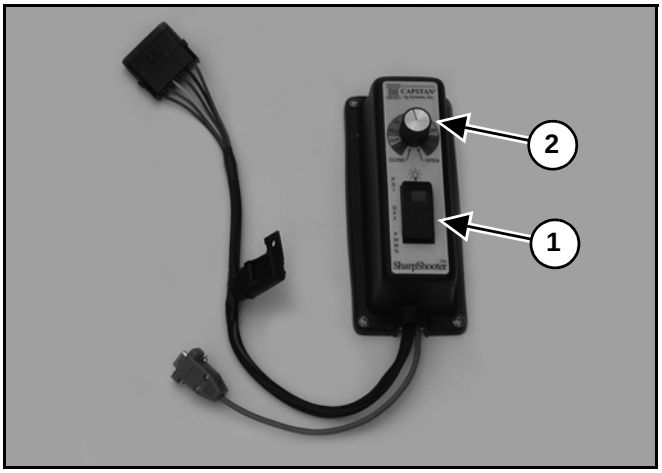


BOOM SECTION 8 MODULE			
ITEM	PART NO.	DESCRIPTION	QTY.
	116290-111	Valve Assembly (Arag)	17
A	118400-002	Valve Driver	2
B	117501-005	Harness, 8 x 20"	2
C	117501-006	Harness, 4 x 20"	1
E	116200-046	Plug, 3-Pin Tower	2
F	116200-013	Nozzle Alternator	2
G	118600-020	Extension 6 cond x 20'	1
H	116200-045	Plug, 2-Pin Tower	3
J	116200-040	Extension 6 cond x 10'	1
X	118602-005	Y-Adapter 6-Pin	1

OPERATION

Operator Controls

Figure 19

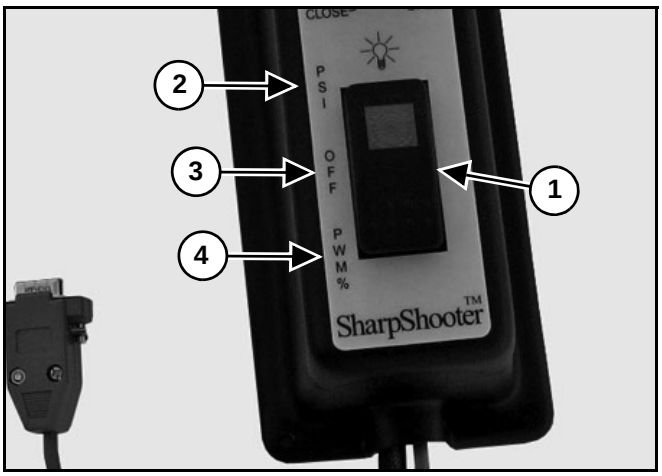


The SharpShooter Pulse Generator has one rocker (Item 1) and one rotary switch (Item 2) **[Figure 19]**.

The Rocker Switch (Item 1) **[Figure 19]** has three positions and an indicator light. The three rocker switch positions are: PWM, OFF and PSI.

The twelve Rotary Switch (Item 2) **[Figure 19]** detent positions are: Close, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100 and Open.

Figure 20



PSI Mode (Top) - The standard operating mode for the SharpShooter is the PSI mode (Item 2). When the rocker switch (Item 1) **[Figure 20]** is in the PSI mode the SharpShooter will pulse the nozzle valves at a duty cycle percentage. The result will be indicated in the boom pressure by the rotary switch.

OFF Mode (Center) - With the rocker switch (Item 1) in OFF mode (Item 3) **[Figure 20]**, the sprayer will only operate as a conventional rate controller. The Nozzle Solenoids work as an electronic On / Off drip check and work with the boom section On / Off switches.

NOTE: Spraying with the SharpShooter in the OFF Mode in the conventional rate controller may require smaller tips to spray effectively.

PWM Mode (Bottom) - With the rocker switch (Item 1) in PWM mode (Item 4) **[Figure 20]**, the SharpShooter will pulse the nozzle valves at the duty cycle percentage selected by the rotary switch. This mode known as the Rate Controller Only Mode, is used in the event that he SharpShooter fails to automatically control pressure. It is not necessary to change tips.

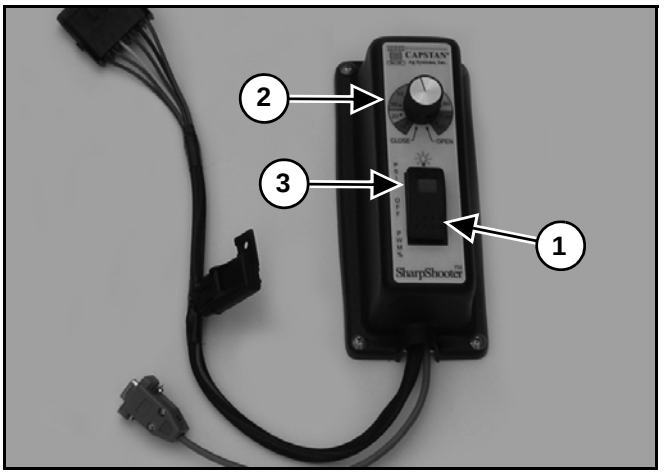
OPERATION CONT.

Operator Controls Cont.

Manual flow control is made possible by using speed and pressure calibration techniques. When calculating actual nozzle flow, it is recommended to account for the pressure drop across the nozzle valve orifice. This is especially for the large size tips (08's, 10's, 15's) where nozzle valve pressure drop is significant. Reference SharpShooter tip selection guide to determine nozzle valve pressure drop for various tip sizes, see PWM Tip Selection Guide on pages 41 & 42.

Before applying any product to the crop or field, we recommend a physical flow calibration.

Figure 21



Open / Close Valves - When the rocker switch (Item 1) is in either PSI mode or PWM mode, the rotary switch (Item 2) **[Figure 21]** in "OPEN" position or in "CLOSE" position, will fully open or fully close the nozzle valves. This allows the operator to disable the pulsing of the valves. Pulsing may not be desired for row banding, drop nozzles, special applications, maintenance, troubleshooting, or in the event of a system failure.

Indicator Light - The indicator light (Item 3), which is located in the rocker switch (Item 1) **[Figure 21]**, will be on when power is supplied to the SharpShooter system.

When the rocker switch (Item 1) is in PWM mode, the indicator light (Item 3) **[Figure 21]** will flash two times per second (2hz), this indicates that the nozzle valves are pulsing at the fixed duty cycle percentage, as selected on the rotary switch.

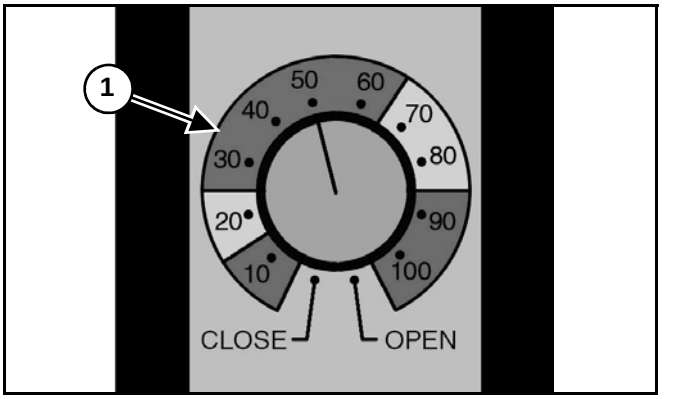
When the rocker switch (Item 1) is in PSI mode, the indicator light (Item 3) **[Figure 21]** will be constant. This indicates that the nozzle valves are pulsing at a variable duty cycle percentage in order to achieve the pressure selected on the rotary switch.

The indicator light (Item 3) **[Figure 21]** will flash slowly, one time per second (1hz), when the automatic pressure control is suspended.

The SharpShooter control is suspended and the indicator light will flash slowly in the following positions:

1. Minimum Duty Cycle Limit
2. Maximum Duty Cycle Limit
3. Low Pressure Shutoff
4. Start-Up Delay
5. Run / Hold Delay

Figure 22



The color graphic (Item 1) **[Figure 22]** surrounds the rotary switch and indicates the Preferred (Green), Caution (Yellow) or Warning (Red) ranges of operation.

Twelve detent Rotary Switch positions:

1. CLOSE Valves
2. 10 (Red)
3. 20 (Yellow)
4. 30 (Green)
5. 40 (Green)
6. 50 (Green)
7. 60 (Green)
8. 70 (Yellow)
9. 80 (Yellow)
10. 90 (Red)
11. 100 (Red)
12. OPEN Valves

NOTE: Reference SharpShooter tip selection guide to determine suitable spray pressure ranges for various speeds and tip sizes. See PWM Tip Selection Guide on pages 41 & 42.

OPERATION CONT.

Operator Controls Cont.

The SharpShooter is especially useful in solving the following three basic spraying problems:

1. Excessive spray drift at high rates and / or speeds.
2. Inconsistent application over wide speed ranges and frequent speed changes.
3. Limited variable rate application ranges.

Solving Problem 1: Excessive Spray Drift at High Rates and / or Speeds

Select the appropriate spray tip size, style and pressure for the application rate and maximum field speed and level to reach the desired spray drift control. For typical infield spraying, move the SharpShooter's Pulse Generator rocker switch to PSI mode, and adjust the rotary switch to the desired spray pressure and droplet pattern. For on-the-go drift control, switch the rotary switch to the minimum pressure that the tip is capable of, (typically 20 PSI). The SharpShooter will adjust the nozzle pulsing to the lower pressure to reduce drift while still maintaining the proper rate. Although the top end speed range might decrease slightly, the SharpShooter still maintains an impressive speed range at the lower set pressure. When the drift control is no longer necessary, simply switch the rotary switch back to the higher pressure.

Solving Problem 2: Inconsistent Application over Wide Speed Ranges

Select the appropriate spray tip size, style and pressure to achieve a consistent application up to an 8:1 speed range or with frequent speed changes. Move the SharpShooter's Pulse Generator rocker switch to PSI mode and adjust the rotary switch to the desired spray pressure. When slowing down, SharpShooter will adjust the nozzle pulsing to keep the operator pressure set-point constant. The same happens when speeding up. The SharpShooter will maintain the desired spray pressure up to an (8:1 speed range) by adjusting the nozzle pulsing to maintain the constant pressure set by the operator.

Solving Problem 3: Limited Variable Rate Application Ranges

Typically, chemical rates vary within a 2:1 rate range. To achieve that range of application rate with a single tip, select the appropriate spray tip size, style and pressure for the coverage desired at the highest application rate and fastest speed. Move the SharpShooter's Pulse Generator rocker switch to PSI mode and then adjust the rotary switch to the desired spray pressure. When changing rates, the SharpShooter will adjust the nozzle pulsing to permit the rate range of flow to change while still maintaining a constant spray pressure.

Component Failure During Operation

SharpShooter has been designed with several features that allow the operator to continue spraying in the event of a SharpShooter component failure.

When the SharpShooter does not automatically control pressure and does not pulse:

- Turn the SharpShooter's Pulse Generator to the OFF MODE to operate in a Rate Controller mode. Different tips will be required to spray properly. With the SharpShooter Pulse Generator turned to "Off" or removed, the Valve Drivers will continue to open or close the nozzle valves with the boom section on / off switches. The spray rate controller will continue to function normally. This feature will allow the operator to repair / replace the SharpShooter Pulse Generator in the event of a failure.

When the SharpShooter will not automatically control pressure but still pulses:

- To operate in a Rate Controller mode, turn the SharpShooter's Pulse Generator on in PWM mode. Different tips are NOT required. You can continue to use the tips selected for the SharpShooter PSI mode.
- In PWM mode, the nozzle valves will pulse at the selected duty cycle. The duty cycle percentage very closely approximates the actual flow through the nozzle. For instance, using a #8 sized tip and a 50% duty cycle will result in flow similar to a #4 size tip. The SharpShooter acts as an MANUAL TIP CHANGER to control pressure at the proper rate.
- In the event of a pressure sensor failure, SharpShooter's PWM mode will allow the operator to adjust the pressure range in which the Rate Controller operates. This pressure range can be changed on-the-go for varying spray conditions.

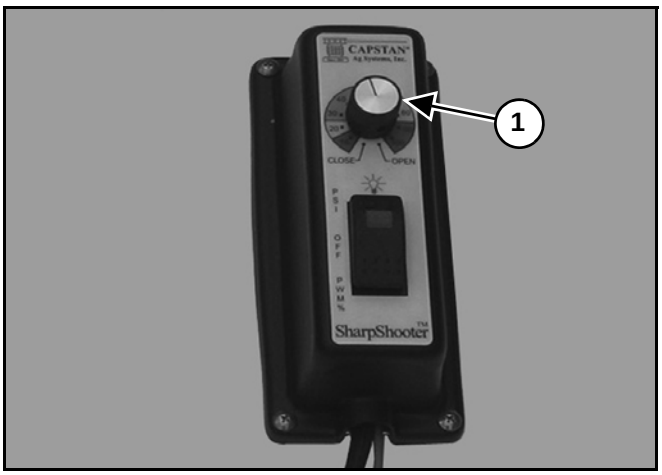
OPERATION CONT.

Component Failure During Operation Cont.

When the Rate Controller or flow meter fails, and the SharpShooter continues to pulse:

- The operator can spray according to traditional Speed and Pressure techniques by using a nozzle chart. Put the rate controller in manual mode and the SharpShooter in PWM mode. Change the duty cycle percentage to meet the flow requirement from the speed and pressure calculation.

Figure 23



Open / Close Valves

- "Open valve" and "close valve" positions are available on the SharpShooter's Pulse Generator selection knob (Item 1) **[Figure 23]**.

- In either PSI or PWM mode, the open / close valve position will open / close the nozzle valves regardless of the pressure or flow settings. This feature allows the operator to control the valves.

NOTE: This control method is useful in emergency situations where an untrained person might need to stop the spray or empty the tank.

Interchangeable Components

- The SharpShooter uses multiple Valve Drivers, Nozzle Valves, and Extension Harnesses. To assist in troubleshooting, identical components can be swapped. It is recommended that the operator carry a spare Valve Driver and spare nozzle valves in critical situations.

OPERATION CONT.

Control Features

Start-Up - In PSI mode, the SharpShooter will begin pulsing at 50% duty cycle and will remain constant until the start-up delay time has lapsed. This allows the flow control system to establish itself before the SharpShooter begins to control the pressure. The rocker switch indicator light will flash slowly, to alert the operator that the initialization delay has been activated. The start-Up delay time is equal to the Run / Hold delay time.

Low Pressure Shutoff - In PSI mode, the SharpShooter will turn off the nozzle valves when the pressure falls below 8 PSI. This feature is intended to duplicate the effect of the nozzle drip checks found on sprayers. To alert the operator that the low pressure shutoff feature has been activated, the rocker switch indicator light will flash slowly. When the pressure rises above 10 PSI again, the SharpShooter will pulse at 50% duty cycle for the start-up delay period and then will resume pressure control.

The low pressure shutoff feature can be disabled through the DB9 serial port with the use of a computer and terminal emulator program.

When disabled, the SharpShooter will maintain a minimum duty cycle percentage, equal to the pulse frequency, regardless of either low or zero pressure.

Run / Hold - In PSI mode, the SharpShooter will stop controlling pressure when the boom is turned off and the run / hold signal is removed. When the boom is turned on and the run / hold signal is returned, the SharpShooter will resume pulsing at the previous duty cycle before the boom was shutoff. This duty cycle will remain for a delay period of three seconds. This allows the flow control system to resume control. Once the delay period has elapsed, the SharpShooter will resume pressure control. The rocker switch indicator light will flash slowly, to alert the operator that the run / hold delay has been activated.

The run / hold feature can be disabled on the cab control circuit board by turning S1#2 to ON, see Circuit Board Switch Positions on page 39. When disabled, the SharpShooter will attempt to control pressure, and will either modulate to the minimum or the maximum duty cycle. This modulation causes the SharpShooter, (when the boom is turned back on), to spike / dip the pressure or cause control instability until the system catches up and pressure control resumes.

The run / hold delay value can be adjusted from 0 to 20 seconds through the DB9 serial port with the use of a computer and terminal emulator program.

OPERATION CONT.

Control Features Cont.

Control Parameters - SharpShooter uses three control parameters to stabilize the pressure control algorithm in the control software:

1. Proportional Gain - Determines the speed that the SharpShooter drives the duty cycle toward the target value.

   Proportional gain can be adjusted from -20 to +20 through the DB9 serial port with the use of a computer and terminal emulator program.

   Factory setting for proportional gain is “8.”

2. Integral Gain - Determines the acceleration.

   Integral gain can be adjusted from -20 to +20 through the DB9 serial port with the use of a computer and terminal emulator program.

   Factory setting for integral gain is “2.”

3. Derivative Gain - Determines the accuracy.

   Proportional, integral and derivative gains can be set through the DB9 serial port with the use of a computer and terminal emulator program.

   Factory setting for derivative gain is “1.”

Flow Meter Simulator - The SharpShooter has an internal flow meter that mathematically calculates what the actual flow through the pulsing nozzles should be. This calculated flow can estimate nozzle wear and troubleshoot system problems. When a healthy SharpShooter system is operating, the calculated flow should match the actual flow recorded by the rate controller. As the pulsing nozzles wear, they become more restrictive, and the actual flow will be lower than the calculated flow.

The SharpShooter flow meter output and setup parameters are available through the DB9 serial port with the use of a computer and terminal emulator program. Flow meter settings include pulsing valve size, tip size, valve count, boost tip size and specific gravity.

Hour Meter - The SharpShooter has an internal hour meter that records the total time that the SharpShooter pulsing nozzles have been operating. The SharpShooter hour meter is available through the DB9 serial port with the use of a computer and terminal emulator program.

OPERATION CONT.

Circuit Board Switch Positions

To access the Pulse Generator circuit board setups, remove the four screws from the Pulse Generator and lift the lid away from the back panel. Reference the SharpShooter Pulse Generator internal circuit board switches and their proper settings below:

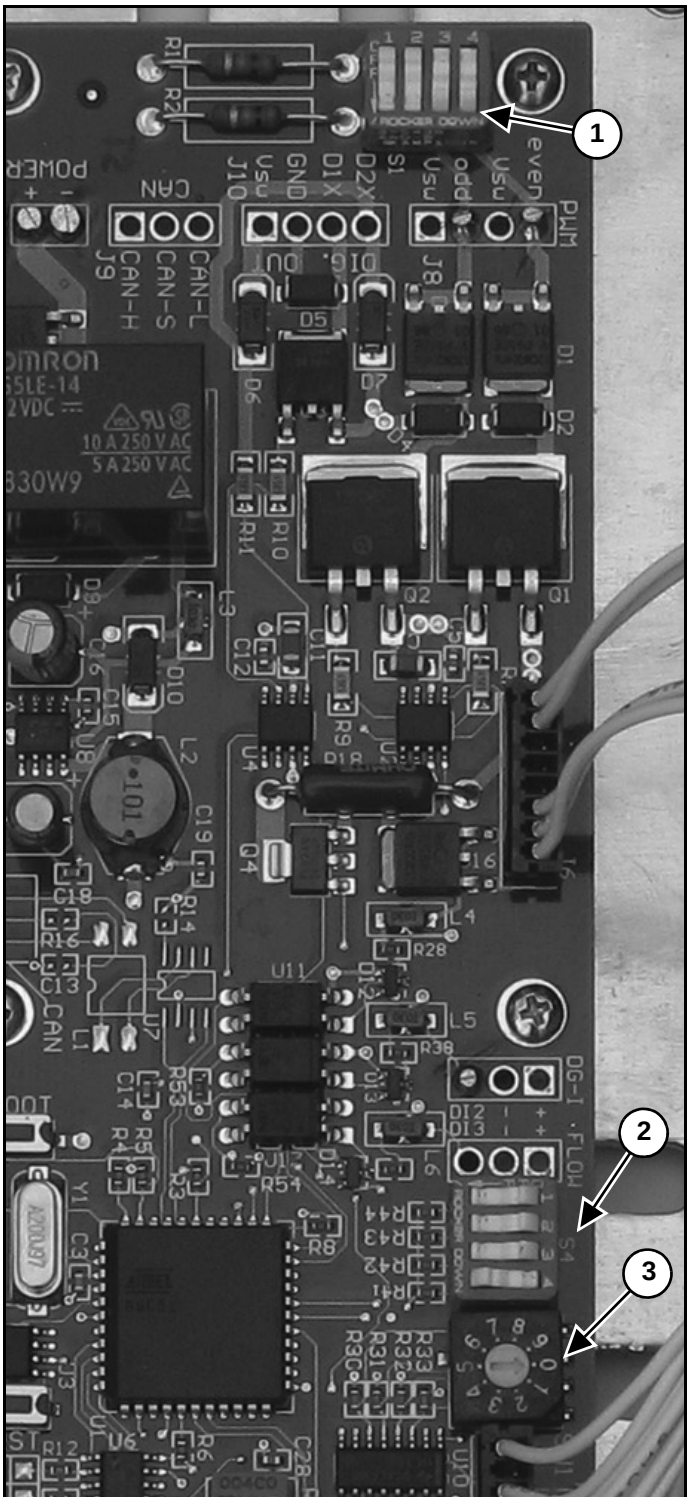
The four “dip” Switches for Switch S1 (Item 1) should be set to the following positions:

- S1 - 1 OFF
- S1 - 2 OFF
- S1 - 3 ON
- S1 - 4 ON

The four “dip” Switches for Switch S4 (Item 2) should be set to the following positions:

- S4 - 1 OFF
- S4 - 2 OFF
- S4 - 3 OFF
- S4 - 4 ON

The Rotary Switch (Item 3) is set to “0” for Ag.



OPERATION CONT.

Tip Selection and Capacities

It is important to adhere to the following rules:

1. Always use 110 degree spray angle tips, and maintain the boom height at 24” or greater. If 80 degree spray angle tips are used, maintain the boom height at 36” or greater.

2. Never use Air Induction (AI) spray tips.

The following tip selection chart describes the speed ranges expected when operating with a rate controller at various rates and pressures. To use the chart, select the application rate and move down the column to the desired speed range. Select a tip that provides the boom pressure you wish to spray.

10 GPA		
2	to	14
2	to	17
2	to	19
3	to	20

Strainers - Most sprayers are built with strainers to filter debris from the spray. An 80-mesh screen is recommended to prevent nozzles from plugging.

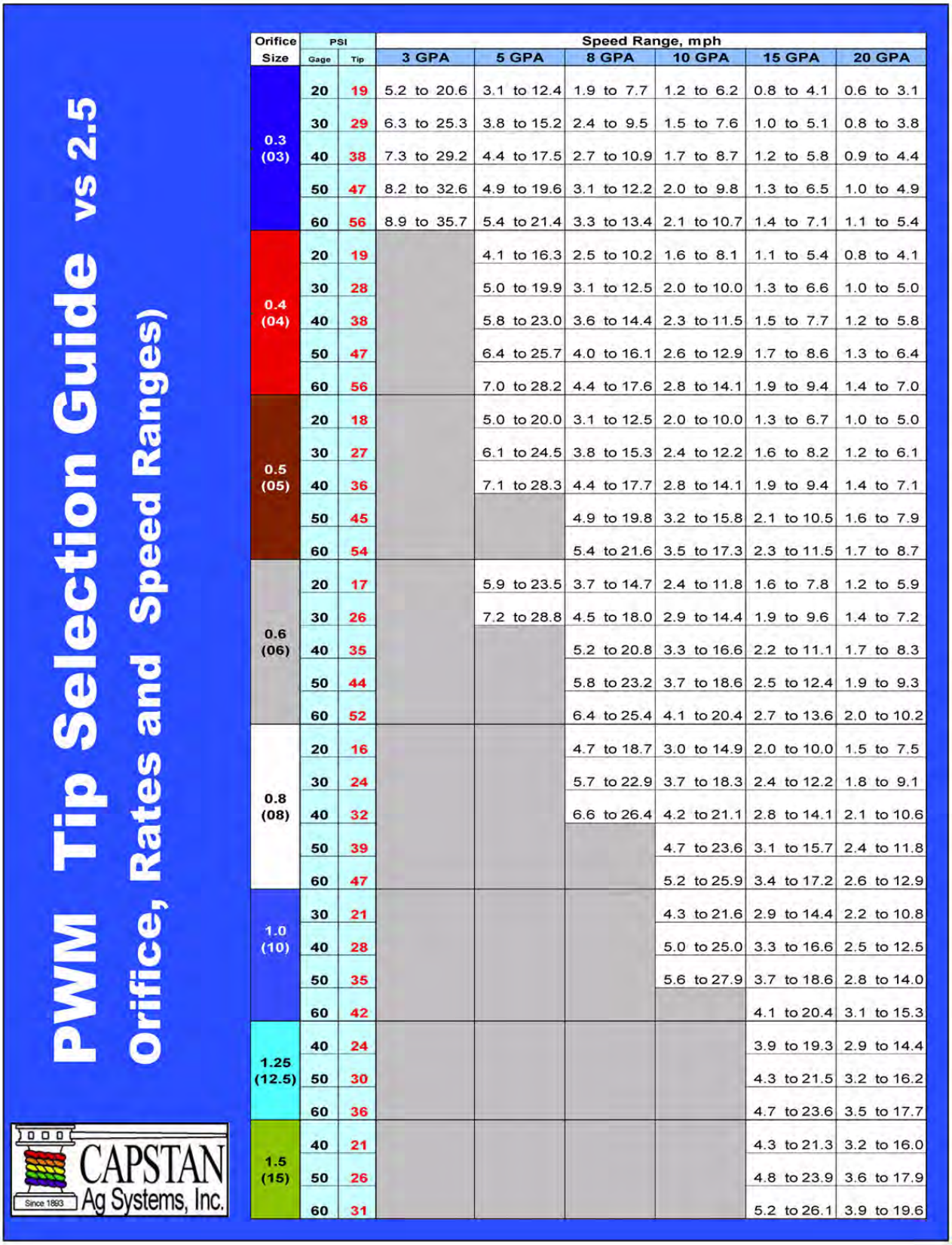
Figure 24

Check the mesh size of the strainers **[Figure 24]** and replace the screens if they are too coarse.

NOTE: Use 80-mesh or finer strainer screens.

OPERATION CONT.

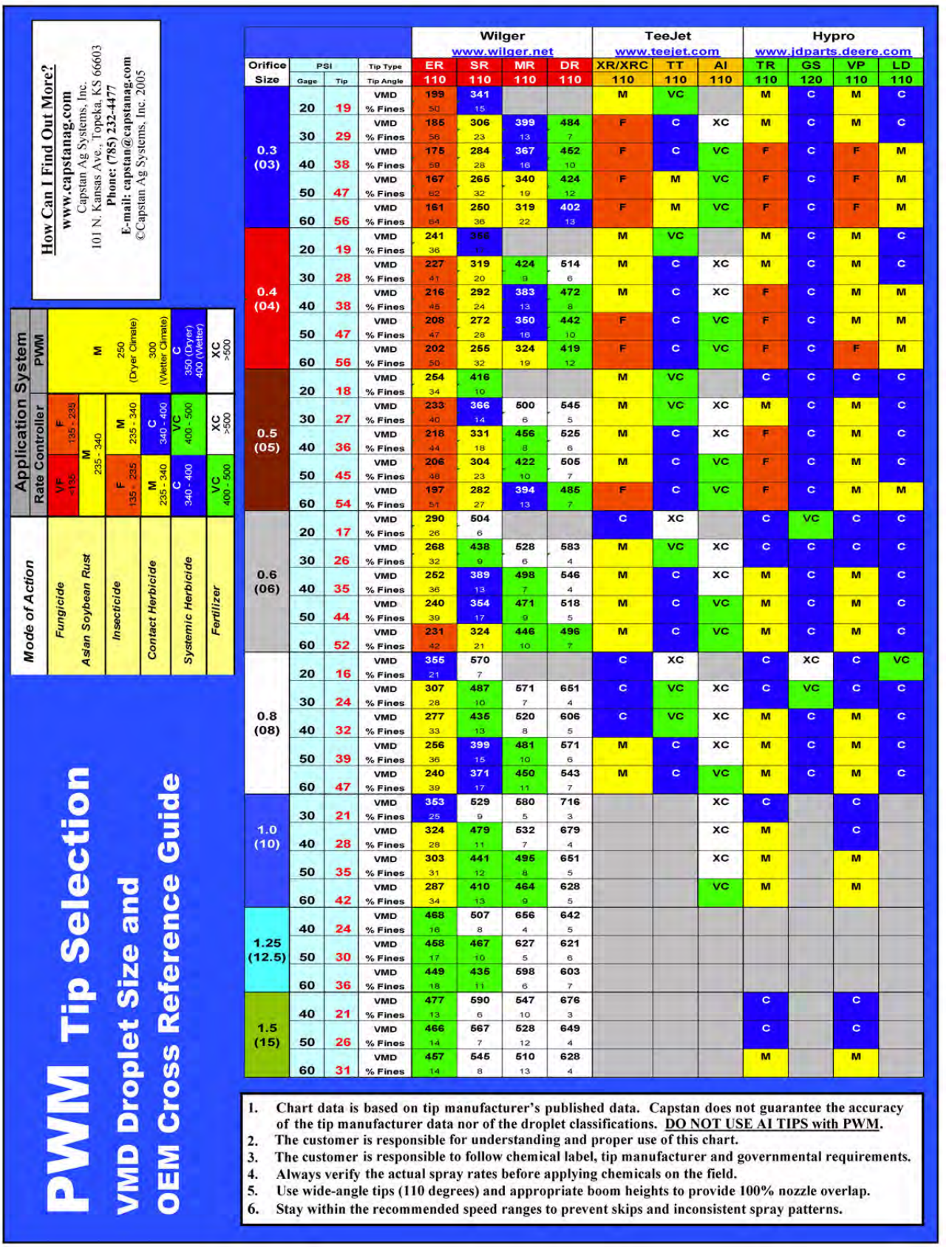
PWM Tip Selection Guide



Orifice Size	PSI Gage	PSI Tip	Speed Range, mph 3 GPA	5 GPA	8 GPA	10 GPA	15 GPA	20 GPA
0.3 (03)	20	19	5.2 to 20.6	3.1 to 12.4	1.9 to 7.7	1.2 to 6.2	0.8 to 4.1	0.6 to 3.1
	30	29	6.3 to 25.3	3.8 to 15.2	2.4 to 9.5	1.5 to 7.6	1.0 to 5.1	0.8 to 3.8
	40	38	7.3 to 29.2	4.4 to 17.5	2.7 to 10.9	1.7 to 8.7	1.2 to 5.8	0.9 to 4.4
	50	47	8.2 to 32.6	4.9 to 19.6	3.1 to 12.2	2.0 to 9.8	1.3 to 6.5	1.0 to 4.9
	60	56	8.9 to 35.7	5.4 to 21.4	3.3 to 13.4	2.1 to 10.7	1.4 to 7.1	1.1 to 5.4
0.4 (04)	20	19		4.1 to 16.3	2.5 to 10.2	1.6 to 8.1	1.1 to 5.4	0.8 to 4.1
	30	28		5.0 to 19.9	3.1 to 12.5	2.0 to 10.0	1.3 to 6.6	1.0 to 5.0
	40	38		5.8 to 23.0	3.6 to 14.4	2.3 to 11.5	1.5 to 7.7	1.2 to 5.8
	50	47		6.4 to 25.7	4.0 to 16.1	2.6 to 12.9	1.7 to 8.6	1.3 to 6.4
	60	56		7.0 to 28.2	4.4 to 17.6	2.8 to 14.1	1.9 to 9.4	1.4 to 7.0
0.5 (05)	20	18		5.0 to 20.0	3.1 to 12.5	2.0 to 10.0	1.3 to 6.7	1.0 to 5.0
	30	27		6.1 to 24.5	3.8 to 15.3	2.4 to 12.2	1.6 to 8.2	1.2 to 6.1
	40	36		7.1 to 28.3	4.4 to 17.7	2.8 to 14.1	1.9 to 9.4	1.4 to 7.1
	50	45			4.9 to 19.8	3.2 to 15.8	2.1 to 10.5	1.6 to 7.9
	60	54			5.4 to 21.6	3.5 to 17.3	2.3 to 11.5	1.7 to 8.7
0.6 (06)	20	17		5.9 to 23.5	3.7 to 14.7	2.4 to 11.8	1.6 to 7.8	1.2 to 5.9
	30	26		7.2 to 28.8	4.5 to 18.0	2.9 to 14.4	1.9 to 9.6	1.4 to 7.2
	40	35			5.2 to 20.8	3.3 to 16.6	2.2 to 11.1	1.7 to 8.3
	50	44			5.8 to 23.2	3.7 to 18.6	2.5 to 12.4	1.9 to 9.3
	60	52			6.4 to 25.4	4.1 to 20.4	2.7 to 13.6	2.0 to 10.2
0.8 (08)	20	16			4.7 to 18.7	3.0 to 14.9	2.0 to 10.0	1.5 to 7.5
	30	24			5.7 to 22.9	3.7 to 18.3	2.4 to 12.2	1.8 to 9.1
	40	32			6.6 to 26.4	4.2 to 21.1	2.8 to 14.1	2.1 to 10.6
	50	39				4.7 to 23.6	3.1 to 15.7	2.4 to 11.8
	60	47				5.2 to 25.9	3.4 to 17.2	2.6 to 12.9
1.0 (10)	30	21				4.3 to 21.6	2.9 to 14.4	2.2 to 10.8
	40	28				5.0 to 25.0	3.3 to 16.6	2.5 to 12.5
	50	35				5.6 to 27.9	3.7 to 18.6	2.8 to 14.0
	60	42					4.1 to 20.4	3.1 to 15.3
1.25 (12.5)	40	24					3.9 to 19.3	2.9 to 14.4
	50	30					4.3 to 21.5	3.2 to 16.2
	60	36					4.7 to 23.6	3.5 to 17.7
1.5 (15)	40	21					4.3 to 21.3	3.2 to 16.0
	50	26					4.8 to 23.9	3.6 to 17.9
	60	31					5.2 to 26.1	3.9 to 19.6

OPERATION CONT.

PWM Tip Selection Guide Cont.



OPERATION CONT.

Technical Bulletin - July 11, 2001 (Revised April 12, 2006)

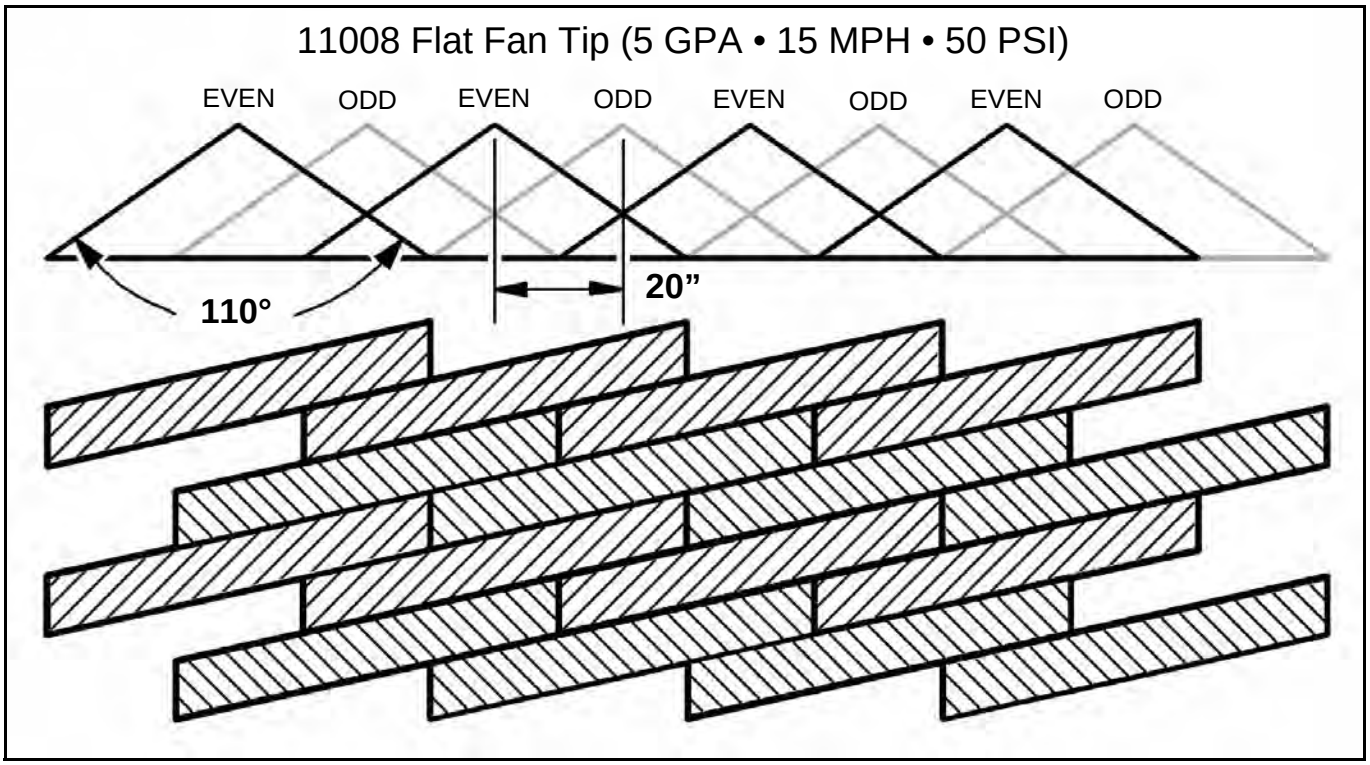
Spray Skips from Poor Pulse Blending

NOTE: For: Synchro®, SharpShooter® and Case AIM Command® Blended Pulse Spray Systems. (For additional information contact your Synchro, SharpShooter, or Case AIM Command dealer.

Over the years, Capstan's field engineers have received many questions about blended pulse spraying, and its potential for causing skips in the field. In rare instances, skipping has been documented in the field. This technical bulletin is intended to explain pulse blending, and the techniques used to provide optimum spray coverage and to prevent skipping.

What is blended pulse spraying? Each nozzle in a blended pulse spray system emits 10 spray pulses per second. Adjacent nozzles have alternate timing. The alternating pulses, the overlapping spray patterns and the natural dispersing of droplets, blend together to provide consistent coverage of the target.

What makes the pulses blend? Below is an illustration of what a blended pulse spray pattern might look like if it were sprayed upon a flat surface. This spray pattern is similar to a #8 size flat fan spray tip (with a 110 degree fan angle) that is spraying 5 gpa at 15 mph with a 50 PSI boom pressure. The nozzles are 20" apart. Each tip is rotated 12.5 degrees to prevent pattern interference between nozzles. The minimum boom height is 21" above the spray target.



In this example, each nozzle sprays 1/3 of the time, but adjacent nozzles alternate and overlap to fill in areas between the nozzles. As the sprayer increases speed, rate, or boom height, the pulses become wider, this provides additional overlap, better pulse blending, and increased spray coverage.

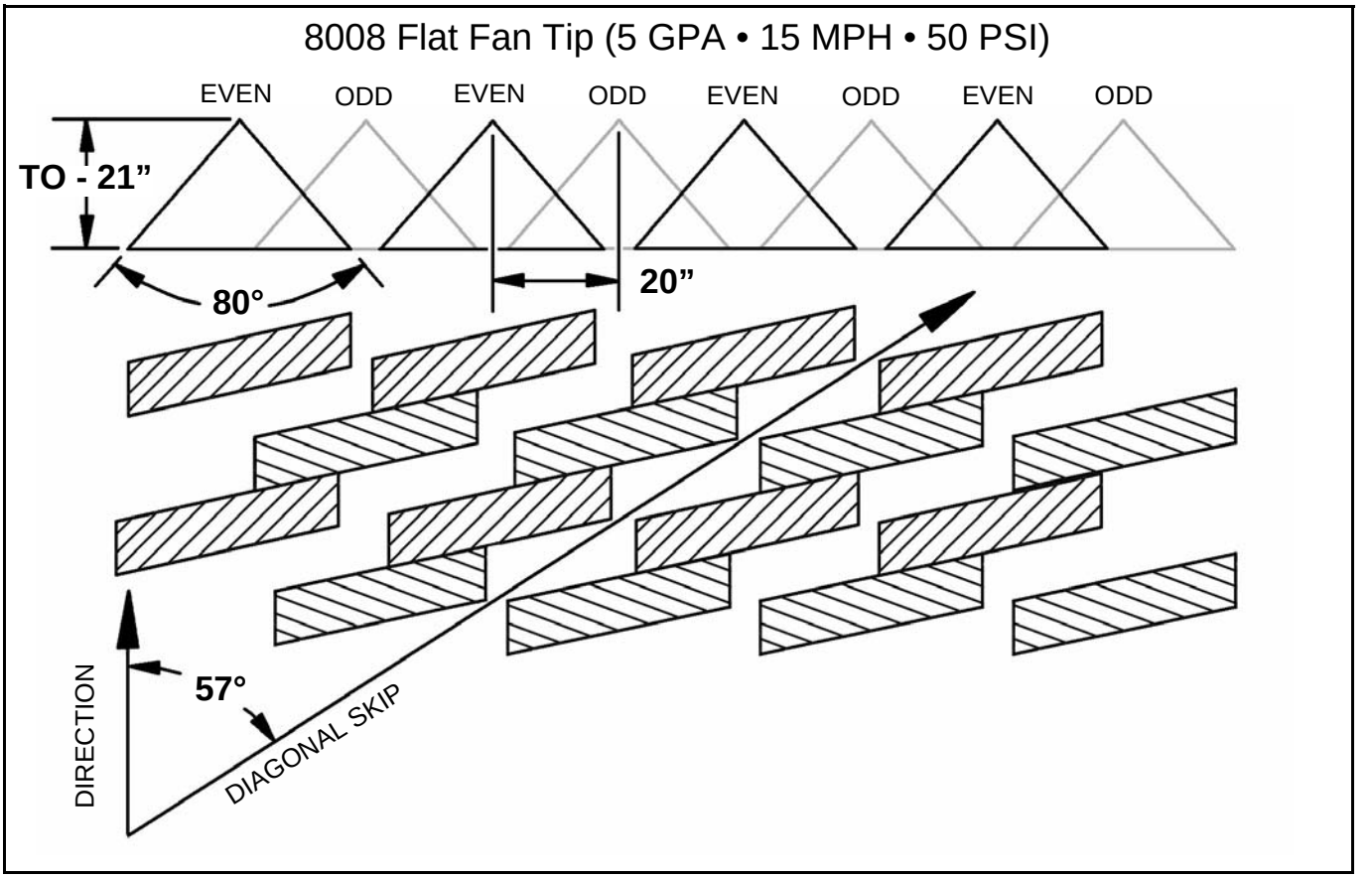
As the sprayer decreases speed or rate, skips may begin to appear. For this example, a smaller tip size would be recommended if slower speeds are desired.

Pattern width and natural droplet dispersion are not shown in the diagram. These factors help to smooth out the pulses and fill in skips. The amount of droplet dispersion depends on the style of tip being used. For example, low-drift tips typically emit large droplets and provide minimal droplet dispersion.

OPERATION CONT.

Technical Bulletin - July 11, 2001 (Revised April 12, 2006) Cont.

What causes skipping? Below is the same illustration from the previous page except that 80 degree fan angle tips are used rather than 110 degree tips. In this case, the 21" boom height doesn't provide adequate nozzle overlap and skips can be seen. Tips emitting small droplets, with plenty of droplet dispersion, will fill in large skips. Large droplet tips may not fill in the skips, and this may result in poor coverage. The skips appear as diagonal lines in the direction of travel. The angle of the diagonal depends upon the speed of the sprayer.



To Prevent Skipping:

1. Use wide-angle spray tips and appropriate boom heights to provide 150% nozzle overlap.
- For 80 degree tips, use 36" or greater boom height.
- For 110 degree tips, use 21" or greater boom height.
- Use pressures which fully develop the intended fan angle.

2. Avoid pulse duty cycles below 33%.
- Use appropriately sized spray tips for the desired speed, rate, and pressure ranges.
- Avoid speeds in the lower 1/3 of the speed range.
- Avoid rates in the lower 1/3 of the rate range.

3. Use additional caution when using drift control tips or drift control additives which increase droplet size and reduce droplet dispersion. Carefully observe the boom height, duty cycle, and tip selection recommendations to ensure adequate spray coverage.

4. **Always read and follow chemical label instructions!** Agronomic and environmental factors significantly affect efficiency of the chemicals, and will magnify the adverse effects of poor coverage. Carefully observe boom height, duty cycle and tip selection recommendations for hot and dry field conditions, large / mature weed pressures, etc.

5. Always apply blended pulse broadcast sprays using a 10hz or greater pulse frequency! Capstan's "Commander" module and SharpShooter Pulse Generator allow the pulse frequency to be reduced for non-sprayer applications, when uniform coverage is not required.

SHARPSHOOTER INSTALLATION OVERVIEW

WARNING

Working with sprayer equipment can be dangerous, so the proper hand and eye protection must be used at all times.

Before installation of the **SharpShooter** system components, make sure the machine / sprayer is clean. Flush the spray system with water and make sure that the pressure is released from the sprayer system. Unfold and lower the sprayer booms.

NOTE: The following are the basic eight steps for installing the SharpShooter system. If additional installation information is required, refer to pages 46 thru 56.

NOTE: For general reference of SharpShooter System components and wiring, see General Layout section pages 26 - 30 (Examples 1-3).

SharpShooter Installation Overview Steps 1 - 8

1. **PULSE GENERATOR MODULE** - Install the Pulse Generator inside the cab with the mounting bracket and bolt provided with the Pulse Generator Module.

NOTE: Install the Pulse Generator within reach of the operator.

2. **POWER HUB MODULE** - Install the Power Hub on the boom mast, and secure it with cable ties.

NOTE: Due to the extension harness lengths, locate the Power Hub as close to the center of the mast as possible, see Extension Harnesses on page 13.

3. Install the Pressure Sensor into the machine's boom manifold with the fittings and sealant tape supplied in the Power Hub Module kit. Connect the Pressure Sensor to the Power Hub.

NOTE: If additional harness length is required to connect the Pressure Sensor to the Power Hub, a 3-Pin extension harness may be used.

4. Install the Boom Shutoff Adapter between the machine's boom section manifold and the machine's boom section harness. Connect the Boom Shutoff Adapter to the Power Hub.

NOTE: Your SharpShooter system has been shipped according to your machine's boom configurations. Make sure that the individually marked Boom Section Module box's components / harnesses are installed on the appropriate boom sections (1 thru 3 etc).

5. **BOOM SECTION MODULE** - Install the individually marked Boom Section Module box components to the appropriate boom sections.

   A. Install and secure the Valve Drivers on the boom near the first nozzle of each boom section.

   B. Route and secure nozzle harnesses along the boom sections.

   C. Remove and discard the "check valve" and diaphragm cap from each nozzle body. Install one nozzle valve assembly per body.

6. Install extension harnesses from each boom section Valve Driver and connect them to the appropriate connector on the Power Hub.

7. Install extension harness from the Pulse Generator to the Power Hub.

8. Install the Circuit Breaker near the machine's batteries. Route and attach Power Hub power leads to the circuit breaker and battery.

NOTE: To prevent damage to the wiring harnesses, allow enough slack to raise and lower the booms and to operate the boom folds.

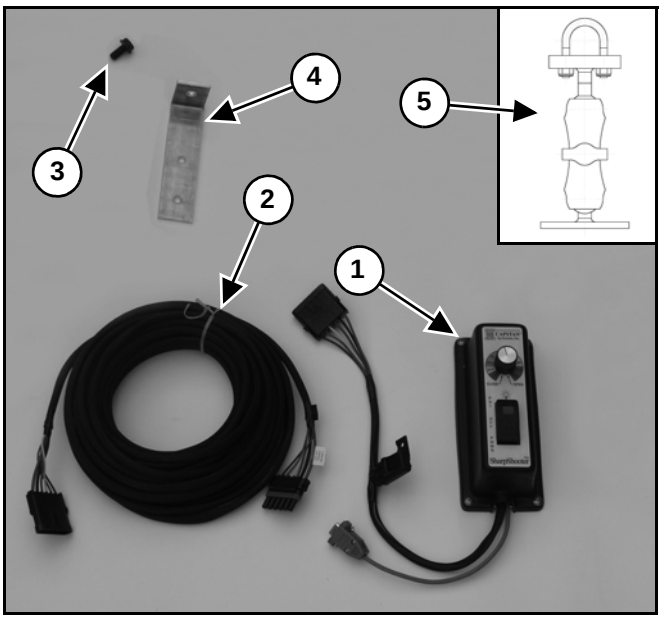
NOTE: Once the SharpShooter system installation is complete, the SharpShooter system is ready for testing. See INSTALLATION SYSTEM TEST on page 57.

SHARPSHOOTER INSTALLATION DETAIL

STEP 1

Pulse Generator Module

Figure 25



The Pulse Generator Module **[Figure 25]** contains the following:

1. Pulse Generator
2. Extension harness, 6-Pin
3. Bolt
4. Mounting bracket
5. Ball mount, ram (Optional)

Choose a mounting location in the cab within reach and view of the operator. The Pulse Generator is not weatherproof, so choose a location that is protected from the elements.

Secure the mounting bracket at the desired location.

The Pulse Generator has several slots in the aluminum back plate. These slots are designed to allow nylon cable ties to be passed through the slots and around the mounting bracket to secure the Pulse Generator to the bracket.

Use caution when mounting the Pulse Generator so that the circuit board does not get broken, grounded or pinched.

NOTE: The Pulse Generator has a 10 AMP. fuse in the power lead. Locate this fuse, so that the fuse is accessible for service.

The Pulse Generator 6-Pin extension harness will be routed from the Pulse Generator and will be connected to the Power Hub.

Connect the extension harness to the Pulse Generator. Route and secure the 6-Pin extension harness along the existing wiring / plumbing until the extension harness reaches to the Power Hub extension connector labeled Pulse Generator.

Secure excess wire with cable ties.

STEP 2

Power Hub Module

Figure 26

The Power Hub Module **[Figure 26]** contains the following:

- SharpShooter Installation Guide
- SharpShooter Technical Manual
- Power Hub
- Pressure Sensor
- Boom Shutoff Adapter
- Circuit Breaker
- Cable Tie Kit
- Plugs
- Extension 3 cond x 10’

Using cable ties, install the Power Hub on, or near, the center of the boom mast.

NOTE: Mount the Power Hub in either a horizontal or vertical position, so that water will not collect near the wires.

The Power Hub is also where the Pressure Sensor, boom section Valve Drivers, and Boom Shutoff Adapter connect.

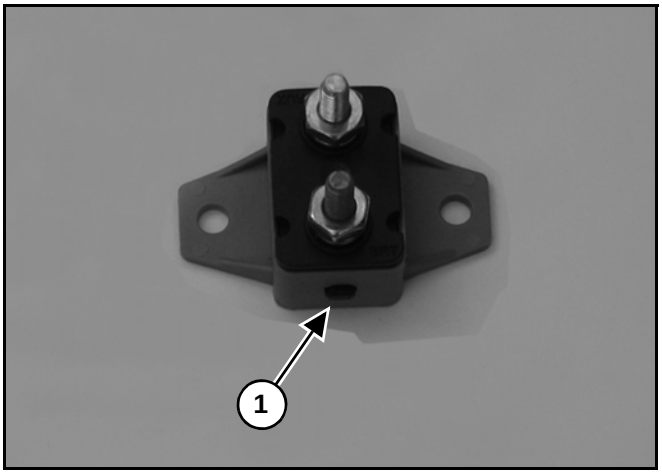
Locating the Power Hub near the Pressure Sensor will eliminate the use of an extension wire to the Pressure Sensor.

The Power Hub has a 40’ power wire. Route and secure the power wire along existing wiring / plumbing until the power wire reaches into the battery box.

NOTE: It is recommended that all SharpShooter component wiring and connections are completed before the Power Hub power wire battery connection is completed.

Circuit Breaker

Figure 27



To install the Circuit Breaker, select a location in the Power Hub positive power (Red) wire where the circuit breaker is accessible for service.

Circuit Breaker reset button (Item 1) **[Figure 27]**.

IMPORTANT

When disconnecting the battery terminals, remove the NEG (-) cable first, then remove the POS (+) cable. When connecting cables, connect the POS (+) cable first, then connect the NEG (-) cable.

With the Power Hub power wire (Red wire) disconnected from the battery, cut the Red wire and strip the insulation from each cut. Crimp the ring terminals provided to each wire end. Secure the ring terminals to the Circuit Breaker terminals. Install the rubber boot onto the Circuit Breaker.

NOTE: The rubber boot may have to be trimmed for wire clearance.

Connect the Power Hub power wire to the battery.

SHARPSHOOTER INSTALLATION DETAIL CONT.

STEP 2 CONT.

Power Hub Module Cont.

Pressure Sensor

NOTE: The Pressure Sensor must be installed in the plumbing in a location that will have an accurate reading when all or only one boom section is turned on.

NOTE: The Pressure Sensor must be installed vertically with the Pressure Sensor facing up.

WARNING

Sprayer lines may be pressurized. Relieve pressure before removing the pressure sensor or the pressure sensor lines.

Figure 28

It is recommended that the Pressure Sensor **[Figure 28]** be installed near the existing Pressure Sensor or pressure gauge (in the main boom plumbing).

SharpShooter's Pressure Sensor has a male ¼" pipe thread boss. Sometimes an unused boss is available on the sprayer. It is usually necessary to remove the pressure gauge / line and install a tee (supplied with kit).

The Pressure Sensor will then screw into one leg of the tee, and the pressure gauge / line will screw into the other leg. A short nipple may be required to install the tee, and a reducer bushing may be required to facilitate ¼" pipe threads.

Use Teflon® tape to prevent leakage and be cautious not to over tighten the metal sensor when installing the Pressure Sensor into plastic bosses.

NOTE: See Page 56 for installation of a Pressure Sensor onto a sprayer.

Boom Shutoff Adapters

Locate the machine's boom shut off valves. They are usually located on top or near the boom section shutoff manifold at the boom mast.

Disconnect each boom shutoff connector.

Install the boom shutoff adapter between the machine's boom shutoff valve manifold and the machine's boom shutoff harness.

See Boom Shutoff Adapters (Identification) on page 19 - 24 for reference to your boom shutoff adapter.

NOTE: Install dust caps on all unused connectors.

NOTE: Connect the Boom Shutoff Adapter to the Power Hub.

NOTE: To prevent damage to wiring harnesses, allow enough slack to raise and lower the booms.

STEP 3

Boom Section Modules

Figure 29

Boom Section Module boxes (Item 1) **[Figure 29]** are marked for each boom section.

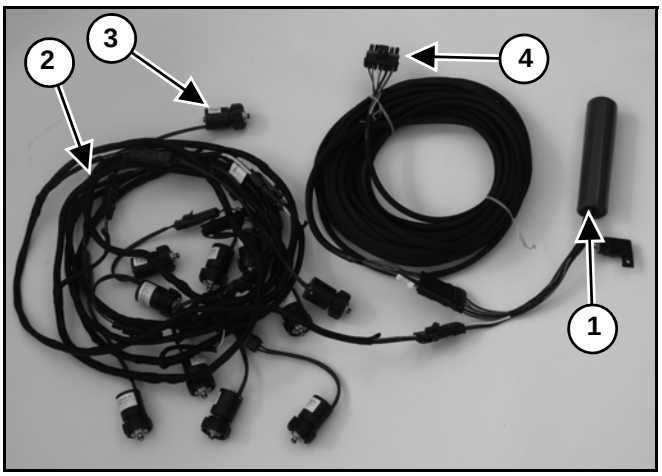
NOTE: Your SharpShooter system has been shipped according to your machine's boom configurations. Make sure the individually marked Boom Section Module box's components / harnesses are installed on the appropriate boom sections (1 thru 3 etc).

Boom Section Module contents may be as follows:

- Valve Driver
- Nozzle Valve Harnesses
- Extension Harnesses
- Alternator Harnesses (if required)
- Y-Adapters (if required)
- Nozzle Valve Assemblies
- Plugs

NOTE: Boom Section Module harness lengths and component quantities will vary according to each of your machine's boom section configurations.

Figure 30



All Boom Section Module components and wiring have been previously connected and tested at the factory. The Valve Driver (Item 1), nozzle harnesses (Item 2), nozzle valve assemblies (Item 3) and 6-Pin extension harness (Item 4) **[Figure 30]** are included in your kit.

NOTE: If your boom section requires it, nozzle alternator harnesses and Y-adapters will also be installed and connected to the Boom Section Module components / wiring.

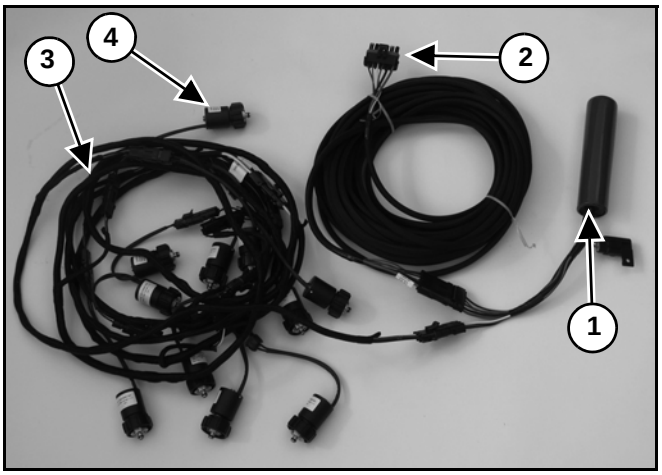
SHARPSHOOTER INSTALLATION DETAIL CONT.

STEP 3 CONT.

Boom Section Modules Cont.

Valve Driver

Figure 31



With cable ties, mount and secure the Valve Driver (Item 1) **[Figure 31]** to the boom, near the first nozzle valve on the appropriate boom section. See General Layout Section pages 26 - 30 (Examples 1-3).

NOTE: Mount the Valve Driver in a horizontal or vertical position, so that water will not collect near wires.

The 6-conductor extension wire (Item 2) **[Figure 31]** must be routed and secured along the boom and connected to the appropriate connector on the Power Hub (located at the boom mast).

Nozzle Harnesses

Route and secure nozzle harnesses (Item 3) along the boom section. Install the nozzle valves assemblies (Item 4) **[Figure 31]** to the machine's nozzle bodies.

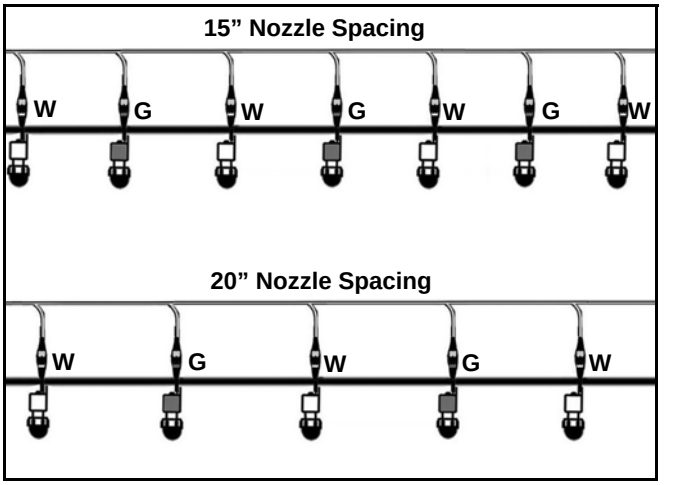
NOTE: For correct procedure on installing nozzle valves, see Nozzle Valves on page 51.

NOTE: Repeat procedures for all boom sections.

When installing the nozzle harnesses along the booms, remember that the nozzle harness pigtails (connector wires) are color coated.

The nozzle harness pigtail (connectors) contains a White and Black wire, while the adjacent pigtail (connector) contains a Green and Black wire.

Figure 32



NOTE: The nozzle harness pigtails (connectors) must alternate along the boom, "White" / "Green" wire alternation [Figure 32].

NOTE: Every other nozzle must pulse together to create pulse blending - White wire odd pulse - Green wire even pulse.

NOTE: The leading edge of the nozzle harness has a 3-Pin connector that connects to the Valve Driver.

Additional wire length is required when routing nozzle harnesses around boom fold hinges.

When routing nozzle harnesses around a boom fold, skip and cap two nozzle harness pigtails (connectors) around the boom fold. When connecting the nozzle harness pigtail to the next nozzle valve, allow enough slack in the harness for the operation of the boom fold and preserve the correct nozzle alternation.

NOTE: Install dust caps on all the unused connectors and secure the nozzle harness wiring with cable ties, allow enough slack to operate the boom fold.

STEP 3 CONT.

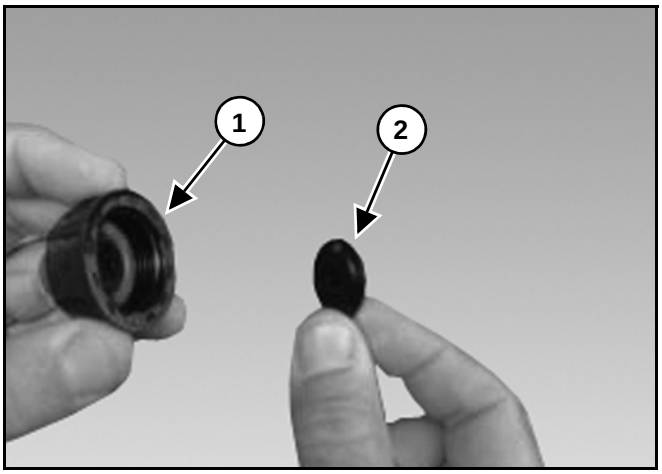
Boom Section Modules Cont.

Nozzle Valves

> **WARNING**
>
> **Before removal or installation of the nozzle valves, make sure that the pressure has been released from the sprayer lines.**

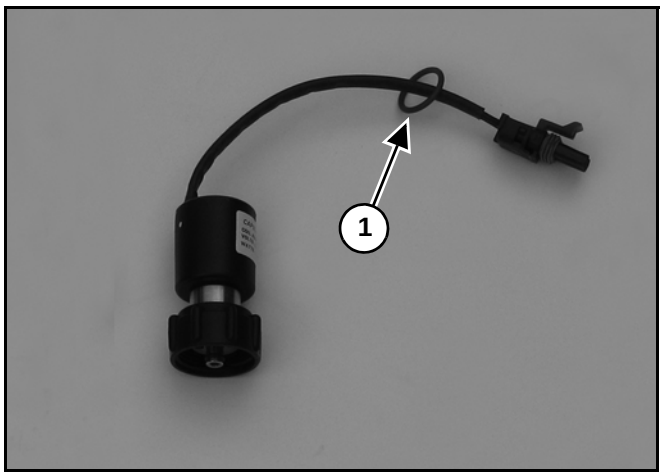
NOTE: While incorrect nozzle valves may screw onto the nozzle body, they will leak or pop off under pressure. It is important to have the correct nozzle valve for the nozzle body.

Figure 33



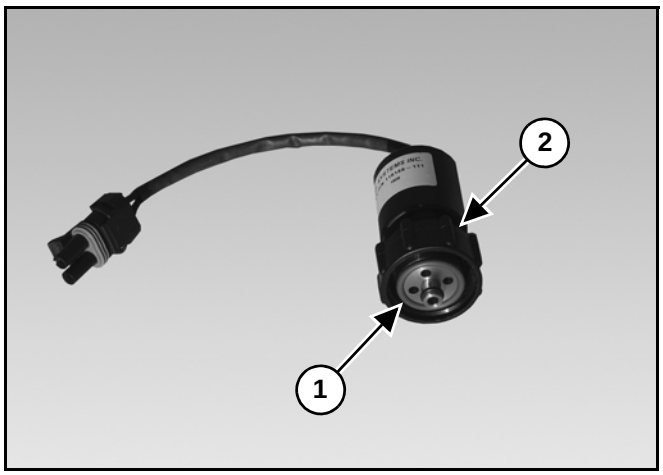
Remove and discard the drip check (Item 1) and diaphragm (Item 2) **[Figure 33]** from the nozzle bodies on the sprayer.

Figure 34



Remove the O-ring (Item 1) **[Figure 34]** from the nozzle valve, the O-ring is either shipped on the cord of each nozzle valve or in a separate bag.

Figure 35



Install the O-ring (Item 1) into the cap of the nozzle valve (Item 2) **[Figure 35]**.

NOTE: When ordering the SharpShooter kit, the nozzle valve assembly threaded cap is unique to different brands of nozzle bodies. Be sure to have identified the nozzle body types being used on the sprayer.

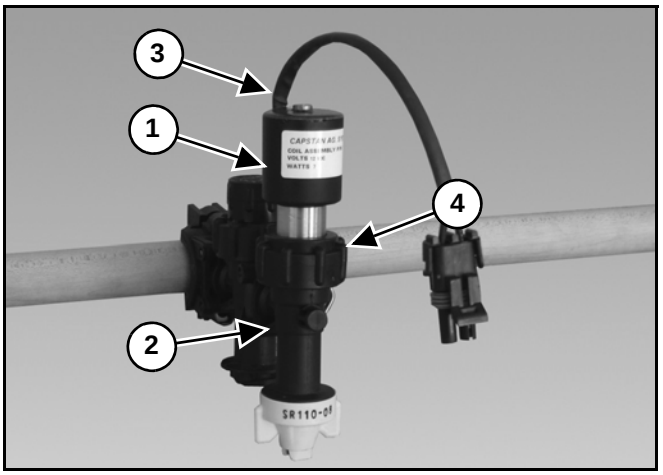
SHARPSHOOTER INSTALLATION DETAIL CONT.

STEP 3 CONT.

Boom Section Modules Cont.

Nozzle Valves Cont.

Figure 36



Install the nozzle valve assembly (Item 1) onto the nozzle body (Item 2). Rotate the nozzle valve assembly so that the wire (Item 3) is close to the boom tube, then finger tighten the cap (Item 4) **[Figure 36]**.

NOTE: If the coil housing spins, then the nozzle valve needs to be tightened until the coil housing will not rotate.

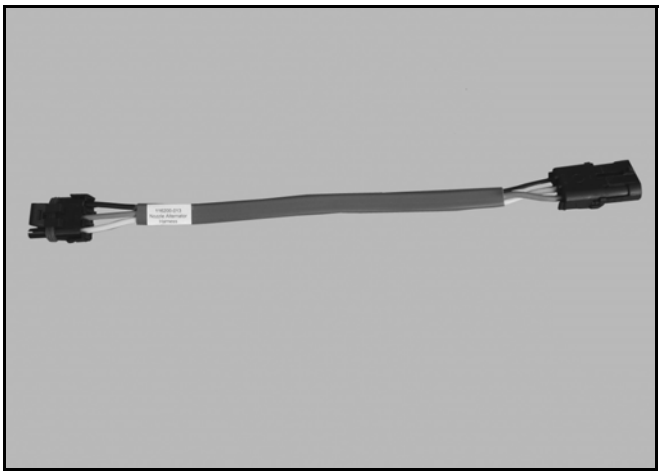
NOTE: Repeat procedures [Figure 33] thru [Figure 36] for all nozzle valve assemblies.

NOTE: If interference issues arise when installing nozzle valves onto the sprayer nozzle bodies, see Special Installation Instructions on page 54.

NOTE: Once the SharpShooter system installation is complete, the SharpShooter system is ready for testing. See INSTALLATION SYSTEM TEST on page 57.

Nozzle Alternator Harness (If Required)

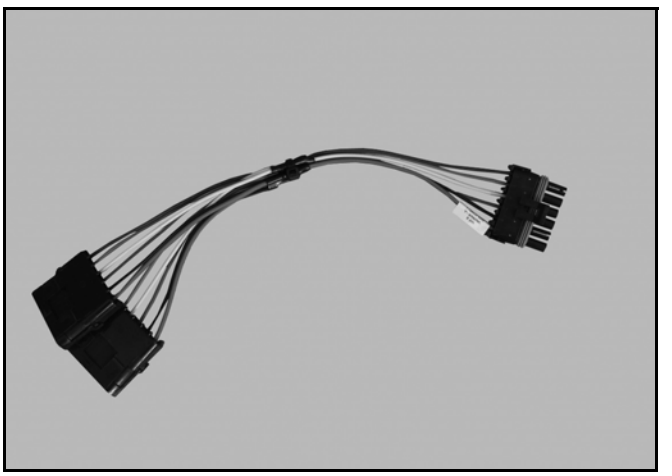
Figure 37



NOTE: A nozzle alternator harness [Figure 37] is required only when the nozzle harness "White" / "Green" wire alternation cannot be maintained between nozzle valves.

6-Pin Y-Adapter Harness (If Required)

Figure 38



The 6-pin Y-adapter harness **[Figure 38]** has two functions:

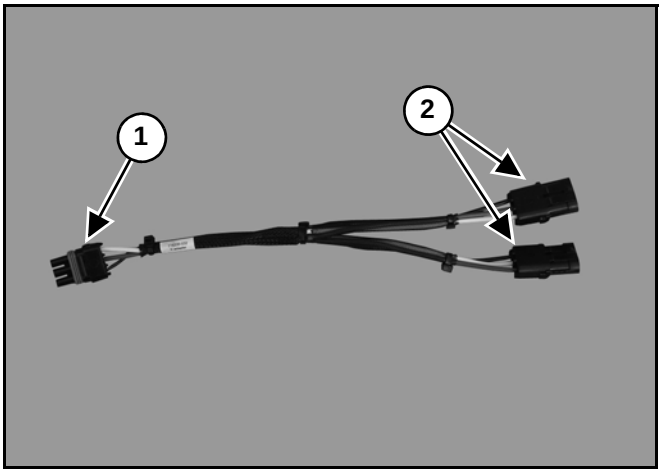
- When a boom section has more than 15 nozzle valves, the 6-pin Y-adapter harness is used to connect two Valve Drivers together.
- When the sprayer has more than 7 boom sections, the 6-pin Y-adapter harness is used to connect two Power Hubs together.

STEP 3 CONT.

Boom Section Modules Cont.

3-Pin Y-Adapter Harness (If Required)

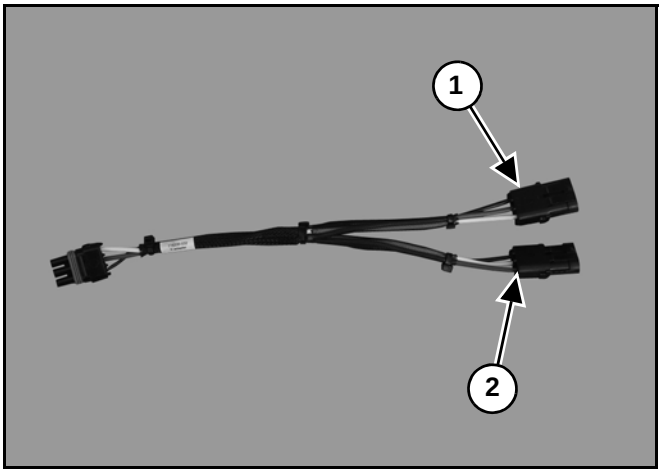
Figure 39



The 3-Pin Y-adapter harness **[Figure 39]** is required when locating a Valve Driver on the center of a boom section. The 3-Pin tower end (Item 1) will connect to the Valve Driver.

Each 3-Pin shroud end (Item 2) **[Figure 39]** connects to a nozzle harness and allows the nozzle harnesses to be routed in each direction on the boom section.

Figure 40



When connecting the 3-pin Y-adapter harness shroud ends to the nozzle harnesses, take note of the White wire (position C) (Item 1) and White wire (position B) (Item 2) **[Figure 40]**.

The connector (Item 1) **[Figure 40]** White wire (position C) must connect to the nozzle harness on the first nozzle valve of the White alteration.

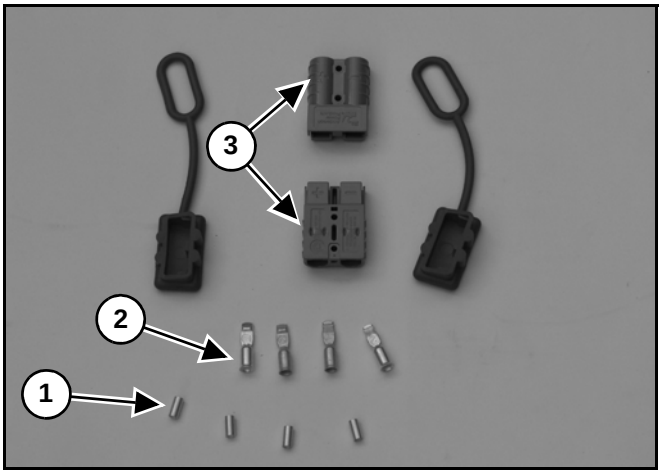
Power Disconnect Kit (Optional)

A power disconnect kit is available for trailer sprayers or for sprayer applications where disconnecting of the battery power wires is desired.

IMPORTANT

When disconnecting the battery terminals, remove the NEG (-) cable first, then remove the POS (+) cable. When connecting cables, connect the POS (+) cable first, then connect the NEG (-) cable.

Figure 41



After the battery Power Hub power wires are disconnected, cut and strip the wires at the desired disconnect location. Crimp the spacer bushing (Item 1) and terminal (Item 2) onto each wire. Insert the terminals into the housing, making sure that the positive (+) and negative (-) wires are in the correct housing (Item 3) **[Figure 41]** location.

The power disconnect housing locations are marked with a (+) positive and (-) negative.

SHARPSHOOTER INSTALLATION DETAIL CONT.

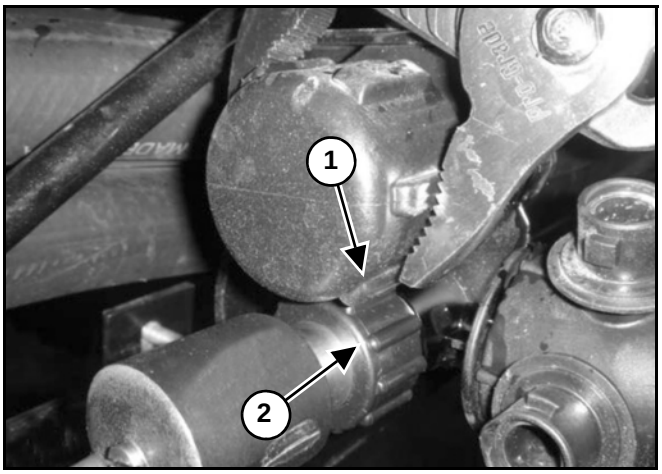
Special Installation Instructions

Nozzle Valves

> **WARNING**
>
> **Before removing or installing the nozzle valves, make sure that the pressure has been released from the sprayer lines.**

NOTE: The special installation instructions show the interference issues that occur on some model sprayers.

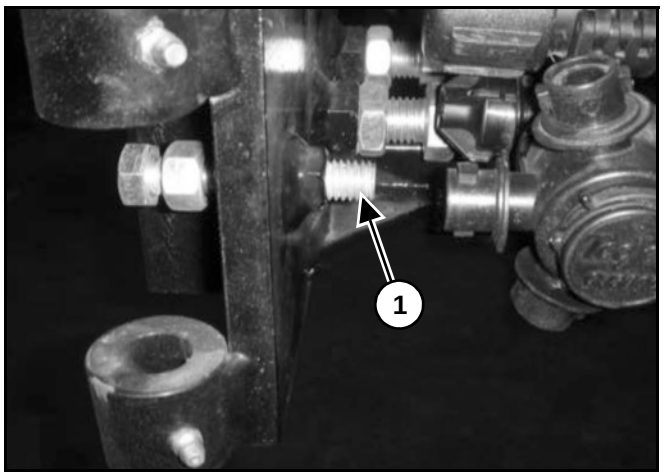
Figure 42



If the knurls of the boom tube threaded caps (Item 1) interfere with the nozzle valve threaded cap (Item 2) **[Figure 42]**, use channel lock pliers to slightly rotate the threaded cap until the nozzle valve assembly cap is free to rotate and tighten.

NOTE: Some boom tube supports may need to be adjusted for nozzle valve assembly clearance.

Figure 43



At the end of the inner boom structure, an additional section of boom can be added. A boom stop bolt (Item 1) **[Figure 43]** may interfere with the valve assembly installation.

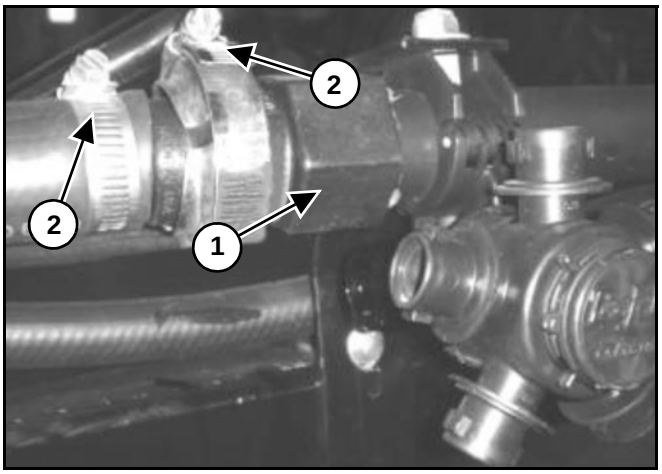
In this case, the bolt was not required and removed. In addition, the boom liquid tube retainers were also loosened. The boom tube was moved slightly toward the inside of the machine in order to install the valve assembly.

SHARPSHOOTER INSTALLATION DETAIL CONT.

Special Installation Instructions Cont.

Nozzle Valves Cont.

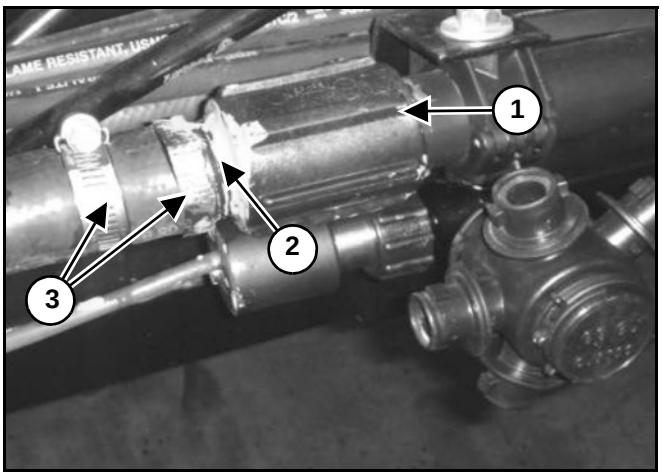
Figure 44



At two locations, the quick coupler boom tube fitting (Item 1) **[Figure 44]** interferes with the valve assembly installation.

Remove the clamp (Item 2) and quick coupler boom tube fitting (Item 1) **[Figure 44]**.

Figure 45



Install the female coupler (Item 1) and a male threaded barb (Item 2) **[Figure 45]**.

Tighten the hose clamps (Item 3) **[Figure 45]**.

Once the quick coupler boom tube fitting is removed **[Figure 44]** install glue and install the plastic female coupler **[Figure 45]**. The barb connector glues into the female coupler and the hose reinstalls with a band clamp.

SHARPSHOOTER INSTALLATION DETAIL CONT.

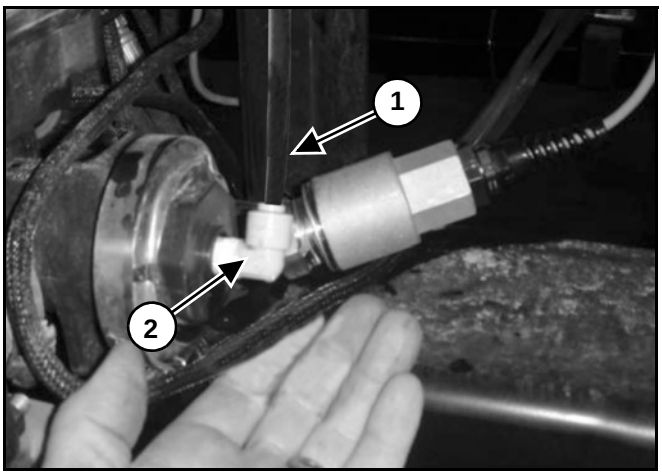
Special Installation Instructions Cont.

Pressure Sensor

NOTE: Instructions are shown for the Pressure Sensor installed onto a sprayer. Installation procedures for your sprayer may be slightly different.

NOTE: The Pressure Sensor must be installed vertically, with the Pressure Sensor up.

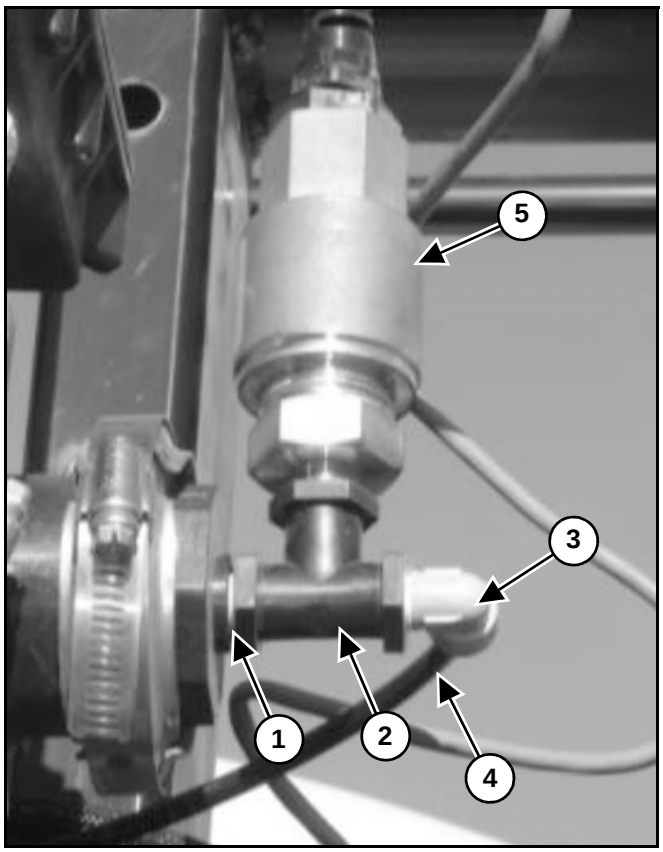
Figure 46



Remove the sprayer's Pressure Sensor line (Item 1) from the ¼" x 90° plastic elbow fitting (Item 2) **[Figure 46]**.

Remove the ¼" x 90° plastic elbow fitting (Item 2) **[Figure 46]**.

Figure 47



Install the ¼" nipple (Item 1) wrapped with Teflon® tape and the ¼" tee (Item 2) **[Figure 47]** that are supplied with kit.

Wrap and reinstall the ¼" x 90° plastic elbow fitting (Item 3), then install the sprayer's pressure line (Item 4) **[Figure 47]** into the ¼" x 90° plastic elbow fitting.

Wrap and install the Pressure Sensor (Item 5) **[Figure 47]** into the tee.

NOTE: The Pressure Sensor will connect to the Power Hub.

INSTALLATION SYSTEM TEST

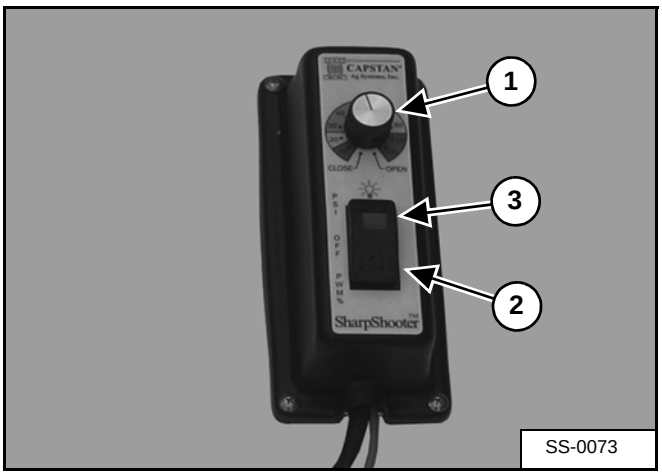
Fill the product tank with 100 gallons of clean water.

Pulse Generator Check

It is recommended that the computer be connected to the diagnostic pigtail on the Pulse Generator and to have the Capstan Diagnostic tool running. See PROGRAMMING PARAMETERS on page 59 for Capstan Diagnostic Tool information.

Power to the Pulse Generator:

Figure 48



1. Connect the Pulse Generator to the extension harness.
2. Turn the rotary switch (Item 1) **[Figure 48]** to 50.
3. Turn the rocker switch (Item 2) **[Figure 48]** to the PWM mode.
4. Observe that the rocker switch light (Item 3) **[Figure 48]** is flashing two times per second.

NOTE: This confirms that the Pulse Generator fuse is functioning, the rocker switch is functioning, and that power is being received by the circuit board.

Boom Section Control Check:

1. With the rate controller master switch Off, turn the rate controller ON.
2. Turn ON all rate controller boom sections switches.
3. Turn the rocker switch to the PWM mode.
4. Turn the rotary switch to 50.
5. Turn the rate controller master switch ON.

NOTE: All solenoids valves on the boom should start clicking.

6. Turn OFF all rate controller boom sections switches.
7. Turn the rate controller boom section 1 switch ON.

NOTE: The solenoids valves on boom section 1 should start clicking.

8. Repeat step 7 for each boom section.

NOTE: If the solenoids valves on a different boom section click on instead, the shutoff adapter is not properly connected to the appropriate boom sections.

PWM Mode Check:

To confirm that the Pulse Generator is functioning in PWM mode, perform the following steps.

1. Set a test speed and a rate value in the rate controller.
2. Turn ON the machines product pump.
3. Turn ON the boom, and allow the machine to spray water until rate and pressure values are achieved.
4. Place the rocker switch in the PWM mode.
5. Turn the rotary switch to 50.

NOTE: The boom should be spraying and the solenoid valves on the boom should be pulsing.

6. Turn the rotary switch to 20 to observe an increase in pressure.
7. Turn the rotary switch to 80 to observe a decrease in pressure.

INSTALLATION SYSTEM TEST CONT.

PSI Mode Check:

To confirm that the Pulse Generator is operating in PSI mode, perform the following steps.

NOTE: The rate controller may need to be adjusted to put SharpShooter in a practical control range. See the rate controller Operation Manual.

1. Turn the rotary switch to 40.
2. Place the rocker switch in the PSI mode.
3. Observe that the SharpShooter adjusts the pulse duty cycle to achieve 40 PSI.
4. Set the rate controller in manual mode.
5. Using the rate controller, decrease the rate until SharpShooter reaches minimum pulse duty cycle and begins to flash the rocker switch light one time per second.
6. Using the rate controller, increase the rate until SharpShooter reaches maximum duty cycle (100% or open flow) and begins to flash the rocker switch light one time per second.

Static Systems Check:

1. Set the rate controller to 10 GPA.
2. Enter a test speed of 10 mph.
3. Turn ON the product pump.
4. Place the rocker switch in the PSI mode.
5. Turn the rotary switch to 40.

NOTE: Let the rate and pressure stabilize at 10 GPA and 40 PSI. Check that the speed is at 10 mph.

Pressure Control Test:

1. Turn the rotary switch to 60.

NOTE: Check to see if the pressure does climb to 60 PSI. With the test speed still at 10 mph, the rate should settle back to the 10 GPA mark.

2. Turn the rotary switch to 20.

NOTE: Check to see if the pressure does drop to 20 PSI. With the test speed still at 10 mph, the rate should settle back to the 10 GPA mark.

3. Return the rotary switch to 40.

Flow Control Test:

1. Start with a test speed set at 10 mph, a pressure of 40 PSI, and a rate at 10 GPA.
2. On the rate controller, increase the rate to 15 GPA.

NOTE: The rate controller should work to achieve the 15 GPA and the pressure should settle back to 40 PSI.

3. On the rate controller, decrease the rate to 5 GPA.

NOTE: The rate controller should work to achieve the 5 GPA and the pressure should settle back to 40 PSI.

Speed Control Test:

1. Start with a test speed set at 10 mph, a pressure of 40 PSI and the rate at 10 GPA.
2. Increase the test speed to 15 mph.

NOTE: The rate controller should work to return to 10 GPA and the pressure should settle back to the 40 PSI.

3. Decrease the test speed to 5 mph.

NOTE: The rate controller should work to return to 10 GPA and the pressure should settle back to the 40 PSI.

NOTE: If any of these installation tests fail, See PROGRAMMING PARAMETERS on page 59.

If all tests are successful, your machine is ready to use.

If all tests are successful, the SharpShooter system is now ready for field operation.

PROGRAMMING PARAMETERS

Verifying SharpShooter Programming Parameters

Once all of the components are installed, the next step is to validate the SharpShooter electronic programming for proper setup.

The tools required are:

- A computer.
- A nine pin pigtail (male pins) to USB serial cable purchased at a local electronics store.
- Capstan diagnostic software tool. See instructions below to acquire this software.

Capstan Diagnostic Software Tool

This software tool may be downloaded from the Capstan website at www.capstanag.com

- Log in at the dealer log-in.
- Look for the Capstan Diagnostic Tool, and double click to download.
- Elect the “Save As” option to store at a desired location on your computer.
- When the save is complete, select the ”Open Folder” option.
- In the folder, double click the Capstan Diagnostic file to “unzip” and save it as an icon on the computer’s main screen.

Connect the serial cable into both the 9-pin pigtail on the SharpShooter Pulse Generator and the USB port to the computer. If the Pulse Generator is an older version without the 9-pin pigtail, remove the cover to locate the 9-pin connector.

Locate which computer communication port the USB cable is using, by viewing the “Devices”. Typically, you can use the “Control Panel” selection on your computer to view “Devices”.From here, you should be able to see the computer COM Port that the USB cable is using.

Click on the Capstan Diagnostic Tool and enter the proper com port number from the drop-down menu. The Baud Rate should be set at 19200.

You are now able to run the programming diagnostics.

PROGRAMMING PARAMETERS CONT.

Program Information

If the Capstan Diagnostic Tool is running and the SharpShooter Pulse Generator is powered up in the PWM mode, a header file will open and display a message that the EEPROM information is valid.

```
==  TermTestEEprom ()  ==
-Valid Data in EEPROM
```

Next, the header file should describe the program version data and the hour meter value.

```
Module Type……..:     SharpShooter
Software Rev……....:   Rev  1.04  -
Compiler Version……...:  612
Compile Date……..:    Jul 20 2006
Compile Time……..:    15:51:35

Current Run Time……..:  120:25
```

PROGRAMMING PARAMETERS CONT.

Circuit Board Switch Positions

The SharpShooter Pulse Generator internal circuit board switches and their proper settings are listed below:

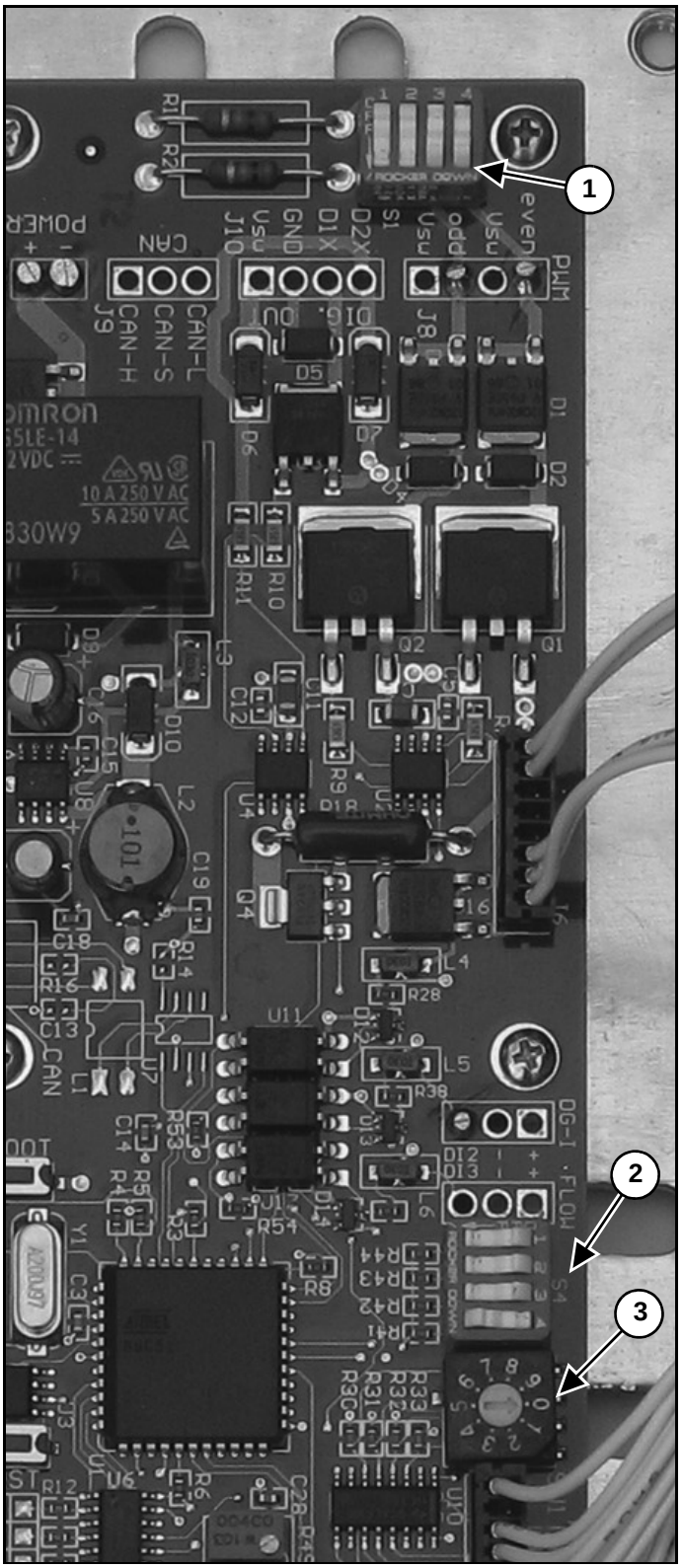
The four “dip” Switches for Switch S1 (Item 1) should be set to the following positions:

- S1 - 1 OFF
- S1 - 2 OFF
- S1 - 3 ON
- S1 - 4 ON

The four “dip” Switches for Switch S4 (Item 2) should be set to the following positions:

- S4 - 1 OFF
- S4 - 2 OFF
- S4 - 3 OFF
- S4 - 4 ON

The rotary switch (Item 3) is set to "0" for Ag.



PROGRAMMING PARAMETERS CONT.

Next a header file will scroll forward to confirm the hardware switch position on the SharpShooter Pulse Generator circuit board. The file should display as seen below: (Values may not be correct, see the default values below):

S1.x	.....	switches 1, 3, and 4 are not monitored
S1.1	.....	NA - DB-9.9 Power (default = OFF)
S1.2	.....	OFF - Run/Hold ENABLED
S1.3	.....	NA - PWM Odd Pullup (default = ON)
S1.4	.....	NA - PWM Even Pullup (default = ON)
SW1	.....	0
S4.1	.....	OFF - Tmr2 Freq = 10.00 Hz
S4.2	.....	OFF - Output is NOT inverted
S4.3	.....	OFF - Low Pressure Shutoff: ENABLED
S4.4	.....	ON - Boost: DISABLED

To change the dip switches, remove the SharpShooter Pulse Generator cover, locate the switches on the circuit board and make the proper changes.

Validating Software Calibration Values

The header file will then confirm that the software calibration values are present on the EEPROM.

== Pressure Control Mode ==	
== PID Parameters ==	
P_GAIN.....	7.23
I_GAIN.....	1.90
D_GAIN.....	0.00
K_GAIN.....	-0.10
== Pressure Txd Parameters ==	
Txd MIN Press.....	0.0
Txd MAX Press.....	100.0
Txd MIN Output.....	0.5
Txd MAX Output.....	5.0
Calc Slope.....	22.2
== Other Parameters ==	
Print Limit.....	2
Controller Rate [mS].....	100
Hold Timeout [mS].....	3040
Pressure Shut Off [PSI].....	8.0
Pressure Turn On [PSI].....	10.0

PROGRAMMING PARAMETERS CONT.

PWM Mode

In PWM mode, the SharpShooter prints a line of data each time that the set-point knob is turned to a new position, this is shown below:

PwmMode: New Pos: 4 EVEN: 39.84 ODD: 39.84
PwmMode: New Pos: 5 EVEN: 49.61 ODD: 49.61
PwmMode: New Pos: 6 EVEN: 59.77 ODD: 59.77
PwmMode: New Pos: 5 EVEN: 49.61 ODD: 49.61
PwmMode: New Pos: 4 EVEN: 39.84 ODD: 39.84
PwmMode: New Pos: 3 EVEN: 29.69 ODD: 29.69
PwmMode: New Pos: 4 EVEN: 39.84 ODD: 39.84

"PwmMode:" indicates that the SharpShooter system is running in PWM mode.

"New Pos: 4" indicates that the knob is turned to position number 4.

"EVEN: 39.84" indicates the pulse duty cycle of the even nozzles.

"ODD: 39.84" indicates the pulse duty cycle of the odd nozzles.

PSI Mode

In PSI mode, the data will start scrolling in columns. Column labels appear every 50 lines.

Act,	SP,	DC,	Freq,	R/H,	RunTime,	Tmo,	Gp,	Gi,	Flow,
41.5,	40.0,	46.3,	10.0,	RUN,	0:01,	1.0,	8.0,	2.0,	4.7,
41.0,	40.0,	46.3,	10.0,	RUN,	0:01,	1.0,	8.0,	2.0,	4.7,
39.6,	40.0,	45.9,	10.0,	RUN,	0:01,	1.0,	8.0,	2.0,	4.5,
42.7,	40.0,	46.7,	10.0,	RUN,	0:01,	1.0,	8.0,	2.0,	4.8,
44.1	40.0,	47.1,	10.0,	RUN,	0:01,	1.0,	8.0,	2.0,	4.9,
42.2,	40.0,	46.7,	10.0,	RUN,	0:01,	1.0,	8.0,	2.0,	4.8,
41.1,	40.0,	46.7,	10.0,	RUN,	0:01,	1.0,	8.0,	2.0,	4.7,
39.6,	40.0,	46.3,	10.0,	RUN,	0:01,	1.0,	8.0,	2.0,	4.6,
39.6,	40.0,	46.3,	10.0,	RUN,	0:01,	1.0,	8.0,	2.0,	4.6,
39.6,	40.0,	46.3,	10.0,	RUN,	0:01,	1.0,	8.0,	2.0,	4.6,

- “Act” is the actual pressure in PSI, that the SharpShooter is reading on the Pressure Sensor.
- “SP” is the pressure set point in PSI, that the SharpShooter is controlling.
- “DC” is the pulse duty cycle (percentage) of the SharpShooter pulsing nozzle.
- “Freq” is the frequency of the nozzle pulses in Hz.
- “R/H” is the state code of the software.
- “Run Time” is the hour meter. It shows the hours and minutes of pulse operation.
- “Tmo” is the run/hold delay time used in the control algorithm.
- “Gp” is the proportional gain value used in the control algorithm.
- “Gi” is the integral gain value used in the control algorithm.
- “Flow” is the calculated flow used to compare with the flow meter.

PROGRAMMING PARAMETERS CONT.

Pushing the "M" key will display a menu of setup information.

Software Calibration Values

The Software Calibration Values may now be modified from the menu that appears below:

Menu:
1. PID Parameters
2. Pressure Txd Parameters
a. Read potentiometers
c. Clock
$. Clock Reset
f. Flow Setup
g. Gains & Tmo on Pots
h. Run-Hold Timeout
m. PWM test
o. Toggle Digital output
p. Pressure Shutoff Limit
q. Quit

Pressure control is suspended whenever the SharpShooter is in menu mode. To re-establish control, exit the menu mode by pressing “q” for quit, and data will begin scrolling as previously described.

PROGRAMMING PARAMETERS (CONT"D)

PID Parameters Menu

Pressing "1" in the main menu will bring up the first line of the PID Parameters menu. Pressing "Enter" will bring up the next line. Default values are shown in parenthesis. To change a value, type the new value and press "Enter".

The complete menu is shown below:

```
Setup PID Parameters
-PID Proportional Gain.(8.0)..... 8.000     NEW:
-PID Integral Gain.(2.0)......... 2.000     NEW:
-PID Derivative Gain.(0.)........ 0.000     NEW:
-PID System Gain.(-0.1).......... -0.100    NEW:
-Print Limit.(2)................. 2          NEW:
-Controller Rate[mS].(100)....... 100       NEW:
-Pots Enabled (YES).............. YES        NEW (Y/N):
          Pots = Disabled

Press a key to exit
```

- "PID Proportional Gain" establishes the speed in which the SharpShooter changes the pressure. A higher number results in faster control.
- "PID Integral Gain" establishes the acceleration in which the SharpShooter changes the pressure. A higher number results in faster control.
- "PID Derivative Gain" establishes the accuracy in which the SharpShooter changes the pressure. A higher number results in faster control.
- "PID System Gain" establishes the sensitivity of the control algorithm.
- "Print Limit" establishes the rate in which the SharpShooter scrolls data.
- "Controller Rate" establishes the rate in which the SharpShooter runs the control algorithm.
- "Pots Enabled" allows the PID Proportional Gain, PID Integral Gain and Run-Hold Timeout to be controlled by adjusting the potentiometers located on the SharpShooter Pulse Generator circuit board. Pots should be disabled. This allows modifications to be made and saved via a computer interface.

PROGRAMMING PARAMETERS CONT.

Pressure Txd Parameters

Pressing “2” in the main menu brings up the first line of the Pressure Transducer Parameters menu.

Setup Pressure Transducer		
-Txd MIN Press(PSI)(0.0).....	0.0	NEW:
-Txd MAX Press(PSI)(100).....	100.0	NEW:
-Txd MIN Output(V)(0.5).....	0.5	NEW:
-Txd MAX Output(V)(5.0).....	-0.100	NEW:
-Print Limit.(2).....	5.0	NEW:
-Calc Slope(PSI/V).....	22.2	NEW:
Press a key to exit		

- "Txd MIN Press(PSI)" is the minimum pressure read by the Pressure Sensor.
- "Txd MAX Press(PSI)" is the maximum pressure read by the Pressure Sensor.
- "Txd MIN Output(V)" is the Pressure Sensor signal voltage when at minimum pressure.
- "Txd MAX Output(V)" is the Pressure Sensor signal voltage when at maximum pressure.
- "Calc Slope(PSI/V)" is automatically calculated by the SharpShooter.

PROGRAMMING PARAMETERS CONT.

Flow Setup

Pressing “f” on the main menu brings up the flow setup menu. The flow setup parameters are required for boost and flow meter calculations.

Setup Flow Calculation Parameters		
-PWM Valve Size (15.5).....	15.50	NEW:
-Tip Size (8).....	8.000	NEW:
-Number of Valves (54).....	54	NEW:
-Specific Gravity (1.0).....	1.000	NEW:
-Boost Tip Size (4).....	4.000	NEW:
-Boost Timeout (3000).....	3000.000	NEW:
Press a key to exit		

- “PWM Valve Size” refers to the size, or flow parameter, of the pulsing valve. That value for Ag applications is 15.5.

- “Tip Size” refers to the size, or flow parameter, of the spray tip downstream of the pulsing valve. Capstan uses the flat fan tip size based on the flow at 40 PSI. This size is generally printed on the tip. If the tip shows "11008", then the tip size is 8. Flood tips are sized at 10 PSI and therefore, the printed tip size must be doubled. European tips may be sized on metric values and should be converted mathematically, or flow tested, to get an accurate value.

- “Number of Valves” refers to the number of the SharpShooter pulsing nozzles on the boom. For instance, on a 90' boom with 20" nozzle spacing, there are usually 54 nozzles, or valves.

- “Specific Gravity” is the density of the product being applied, this is expressed as a ratio to water. Although, the specific gravity of water is 1.0. Liquid fertilizer can vary significantly, generally it is around 1.2. Anhydrous Ammonia varies with temperature / pressure, but is generally around 0.60.

- “Boost Tip Size” is the tip size used on the boost boom (see tip size above). The SharpShooter assumes that the boost boom is a conventional boom without pulsing nozzles. If the boost feature is enabled, the SharpShooter assumes that there are the same number of boost nozzles as SharpShooter pulsing nozzles. If fewer boost nozzles are in use, then the boost tip size can be "faked" for an equivalent flow.

- “Boost Timeout” refers to the time required to turn on the boost boom and is expressed in milliseconds.
  If a 1 second ball valve is used, then the boost timeout would be 1 second or 1000 milliseconds. If solenoid valves are used, then the boost timeout might be ¼ second or 250 milliseconds.

PROGRAMMING PARAMETERS CONT.

Run-Hold Timeout

Pressing “h” on the main menu brings up the hold timeout menu. Hold timeout is the time required for the flow controller to establish rate control and is expressed in milliseconds. If the rate controller takes 5 seconds to establish rate control, then the hold timeout should be set at 5000.

```
Setup Hold Timeout
-Hold Timeout[mS](3000)….: 3000    New:

Press a key to exit
```

The hold timeout value is used by the SharpShooter whenever pressure control is suspended. Pressure control is commonly suspended for power-up, run / hold, open / close valves, low pressure shutoff, etc.

Pressure Shutoff Limit

Pressing “p” on the main menu initiates the pressure shutoff limit menu. The pressure shutoff limit is the pressure value below which the SharpShooter will shut off the pulsing nozzles. This allows the SharpShooter to work like diaphragm drip checks. The pressure turn-on value is different than the shutoff limit. In many cases, a pressure spike is seen when the boom turns off. To prevent inadvertent boom turn-on, the turn-on pressure value should be set higher than the spike value.

```
Setup Pressure Shut Off
-Pressure Shut Off[lbs](8.0)…...:   8.0     New:
-Pressure Turn On[lbs](10.0)....:   10.0    New:

Press a key to exit
```

The low pressure shutoff feature must be enabled on the SharpShooter cab control circuit board. This may be accomplished by flipping the DIP switch S4-3 to OFF.

SHARPSHOOTER TROUBLESHOOTING

Recommended Guidelines

When servicing a SharpShooter and Rate Controller System, Capstan recommends the following three step troubleshooting process:

1. Perform baseline service checks and verify the original SharpShooter setup programming parameters. See PROGRAMMING PARAMETERS on page 59.

2. Identify individual performance problems to determine possible causes and corrections for performance issues. See Troubleshooting Chart on page 71.

3. Troubleshooting components. See pages 73 thru 90.

NOTE: With the SharpShooter, the primary service tool will be a simple mulit-meter that can measure voltage and resistance (ohms).

SharpShooter Baseline Evaluation Protocol

1. Verify the voltage readings. See page 78 thru 88 for individual component testing.

2. Visually check all wire connections, harnesses and connectors for loose, broken, or damaged wires.

3. Tip selection check

4. Hook up the computer with the Capstan diagnostic tool. See PROGRAMMING PARAMETERS on page 59.

   Check Dip Switch settings.

   Check Software Parameters.

5. Check the Rate Controller Cal numbers, the operator can often accidently change these values.

6. Do a “Like Component Swap” to see if the failure follows the component.

7. Wet tests

WET TEST #1 (Normal Mode Test)

- With water in the tank, turn all of the components On.
- Set a test speed in the rate controller.
- Start with the rate controller in manual mode, this locks rate controller into a single rate, then place the SharpShooter in PWM mode at 50% (locks a fixed orifice).

  Increase / decrease the PWM mode (dial) to verify the SharpShooter duty cycle operation. The pulsing at the nozzles should change.

  Increase / decrease the rate to verify the rate controller servo valve operation. The rate should change.

WET TEST #2

- With water in the tank, place the rate controller in AUTOMATIC mode and the SharpShooter Pulse Generator in the PSI mode.
- Set a test speed in the rate controller and then set the SharpShooter to 40 PSI.
- Static spray test control:

  Rate Change (with constant pressure and test speed)

  Pressure Change (with constant rate and test speed)

  Speed Change (with constant rate and constant pressure)

WET TEST #3 (Integration Checks)

- Isolate the Rate Control System from the SharpShooter by turning the SharpShooter Pulse Generator to the PWM mode and then setting the SharpShooter rotary switch to 50%.
- Place the rate controller in AUTOMATIC control mode.
- Set a test speed in the rate controller, and then set the SharpShooter to 40 PSI.
- Increase / decrease the PWM mode (dial) to verify pressure change. The rate controller should maintain the rate. If the problem is eliminated, the issue is with the SharpShooter. If the problem remains, the issue is likely with the rate controller.
- Increase / decrease the rate to verify the rate controller valve operation. If the rate does not change, the issue is with the rate controller.

SHARPSHOOTER TROUBLESHOOTING CONT.

WET TEST #4 (Advanced Integration Checks)

- PSI to PWM Comparison, see Performance Evaluation for Pulsing
- Valve Calibration and PID Parameter Tweaking
- Run / Hold Time to check the timing of rate control changes (in the rate controller) to the pressure control response by the SharpShooter.

SHARPSHOOTER TROUBLESHOOTING CONT.

Troubleshooting Chart

WARNING	**Read and understand the Instruction Manual before operating or servicing system. Follow warnings and instructions in the manuals when making repairs, adjustments, or servicing. Check for correct function after adjustments, repairs or service. Untrained operators and failure to follow instructions can cause injury or death.**

Use the following troubleshooting chart to locate and correct problems which most often occur with the SharpShooter System.

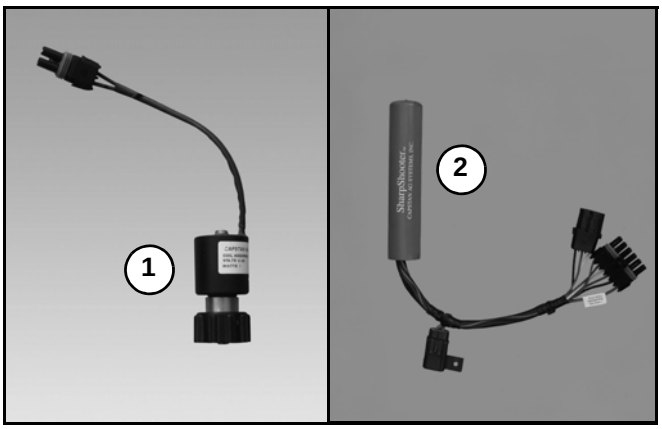
PROBLEM	CAUSE	CORRECTION
Under application	Tips too small	Check for proper tip size
	Plugged tips	Clean or replace tips
	Plugged filter(s)	Clean or replace filter(s)
	Filter(s) not installed correctly	Check all filters for correct installation
	Plugged, kinked, or collapsed hoses	Check all hoses Replace as needed
	Pump not turned on	Turn pump on
	Outrunning sprayer liquid system capability	Slow Down
		Run at optimum pressure (not too low, not too high)
	Incorrect rate controller input settings	Check and adjust settings
	Incorrect calibration settings	Check and adjust settings
	Faulty radar	Replace radar
	Poor GPS satellite signal	Verify that the GPS is working correctly
	Faulty rate controller switch	Locate faulty switch(s) and replace
	Servo valve not working correctly	Check servo valve and replace if needed
Rate instability	Low voltage to rate controller	Test voltage and repair as needed
	Faulty flow meter	Check flow meter and replace if needed
	Faulty pressure dampner on diaphragm pump(s)	Replace pressure dampner(s)
	Faulty speed sensor reading	Check radar and replace if needed
	Collapsed suction hose	Replace suction hose
	Inlet plugged	Check and clean inlet if needed
	Incorrect valve calibration settings	Check and adjust settings See the rate controller's manual
	Incorrect SharpShooter PID Parameters	Check SharpShooter PID Parameters and adjust as needed

SHARPSHOOTER TROUBLESHOOTING CONT.

PROBLEM	CAUSE	CORRECTION
Rate instability	SharpShooter Run / Hold Parameter too short	Adjust SharpShooter Run / Hold Parameter
	Faulty rate controller	Replace rate controller
Pressure instability	Faulty rate controller	Replace rate controller
	Worn or sticky poppets	Check and replace poppets as needed
	Incorrect SharpShooter PID Parameters	Check SharpShooter PID Parameters and adjust as needed
	Faulty pressure sensor	Replace pressure sensor
Single nozzle valve drips when shutoff	Plunger is lodged with debris	Clean nozzle valve See Nozzle Valve Cleaning on page 75
	Plunger is worn	Replace plunger. See Plunger Seal Inspection on page 75
Single nozzle valve sprays erratically	Plunger is worn	Replace plunger See Plunger Seal Inspection on page 75
	Incorrect dip switch settings	Check dip switch settings and adjust as needed
Single nozzle valve will not shut off	Plunger is lodged with debris	Clean nozzle valve See Nozzle Valve Cleaning on page 75
Section will not spray	Blown fuse on Valve Driver	Replace fuse on Valve Driver
	Faulty Valve Driver	Replace Valve Driver
Pulse generator not functioning properly	Low voltage at Pulse Generator	Perform system voltage checks
		Check circuit board setups
Every other nozzle pulses	Faulty Valve Driver	Replace Valve Driver
	Incorrect dip switch settings	Check dip switch settings and adjust as needed
	Faulty harness	Replace harness
No pulse - PSI mode (PWM mode: Pulses)	Incorrect pressure sensor input and output settings	Check and adjust settings
No Pulse - PSI mode (PWM mode: No Pulse)	Faulty Pulse Generator	Replace Pulse Generator

Swapping Components

Figure 49



SharpShooter systems are comprised of a number of components. Some of these components are used in multiples. Components with multiple uses are:

- Nozzle Valves (Item 1) **[Figure 49]**.
- Valve Drivers (Item 2) **[Figure 49]**.
- Extension Harnesses (Not Shown).

When troubleshooting failed components, it can be helpful to swap the failed part with a part that works from 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. Other troubleshooting means may need to be followed.

NOTE: Use caution when swapping failed components, as in rare cases, the failed component may cause other components to fail.

Fuses

Fuses are located in three places within the SharpShooter system.

FUSE LOCATION	RATING	TYPE	COLOR
Pulse Generator	10 AMP.	ATO/ATC	Red
Valve Drivers	10 AMP.	ATO/ATC	Red

Blown fuses are indicators of a short or overload condition. Never replace a fuse with a larger fuse. Larger fuses may result in costly component failures.

NOTE: Only 14 nozzle valves may be installed with a single Valve Driver. Seven valves must be installed on the even circuit and seven must be installed on the odd circuit. Additional valves will result in a blown Valve Driver fuse.

Circuit Breaker

A circuit breaker is located near the battery in the Power Hub power cable.

CIRCUIT BREAKER LOCATION	RATING	TYPE
Battery	50 AMP.	Manual Reset

A tripped circuit breaker is an indicator of a short or overload condition.

SHARPSHOOTER TROUBLESHOOTING CONT.

Nozzle Valves

Plugged nozzle valves can be classified in two categories:

- Plunger blockage.
- Plunger stuck.

Plunger blockage results when larger debris catches between the orifice and the 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 into place.

Symptoms of a blocked or stuck plunger are:

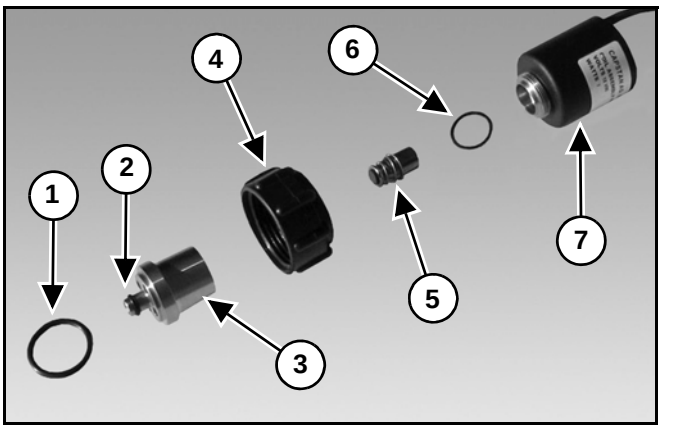
- Constant spray.
- Dripping when the nozzle is shut off.

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

NOTE: Operating a plugged nozzle valve for extended periods may result in a nozzle valve coil failure. Clean any plugged nozzle valves immediately.

NOTE: If plugged nozzles are a frequent problem in a particular boom section, inspect the machine's boom filter screens for plugged or damaged screens. An 80 mesh screen is recommended to prevent the nozzles from plugging. Check the mesh size of the strainers and replace them if they are too coarse.

Figure 50



Nozzle component identification **[Figure 50]**

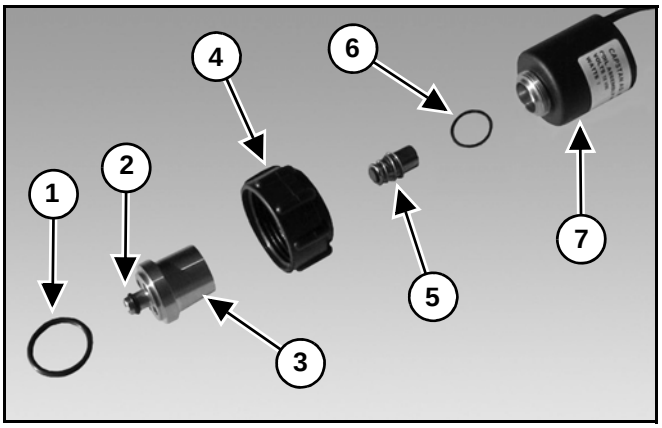
1. O-ring
2. O-ring
3. Valve Body
4. Flynut
5. Plunger
6. O-ring
7. Coil

Nozzle Valves Cont.

Nozzle Valve Cleaning

> **WARNING**
>
> **Before removal or installation of nozzle valves, make sure that the pressure has been released from the sprayer lines.**

Figure 51



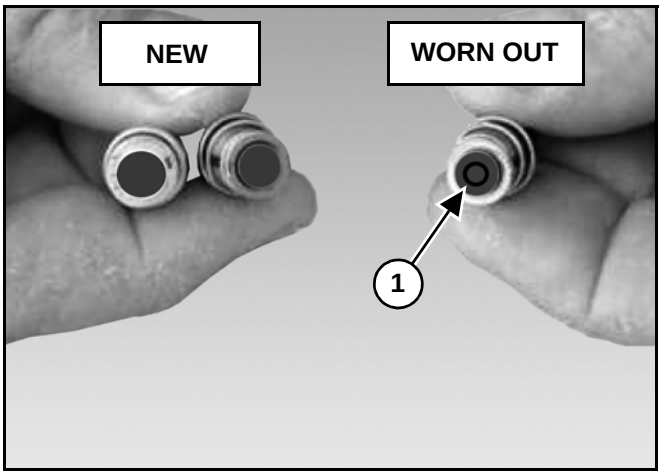
Remove the O-ring (Item 1), O-ring (Item 2), valve body (Item 3), flynut (Item 4), plunger (Item 5) and O-ring (Item 6) from the coil (Item 7) **[Figure 51]**.

Inspect the plunger for wear or damage. Replace the plunger if worn or damaged.

NOTE: Remove debris from the nozzle components by washing the components with clean water.

Plunger Seal Inspection

Figure 52



After extended use, the soft plunger seal (Item 1) **[Figure 52]** will wear a groove 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 sprayer. The result is erratic pulsing, often described as “flickering”.

PinPoint will operate normally at lower pressures until replacement parts can be acquired. High operating pressures and abrasive spray solutions will accelerate the wear of the plunger seal material.

SHARPSHOOTER TROUBLESHOOTING CONT.

Nozzle Valves Cont.

Coil Failure

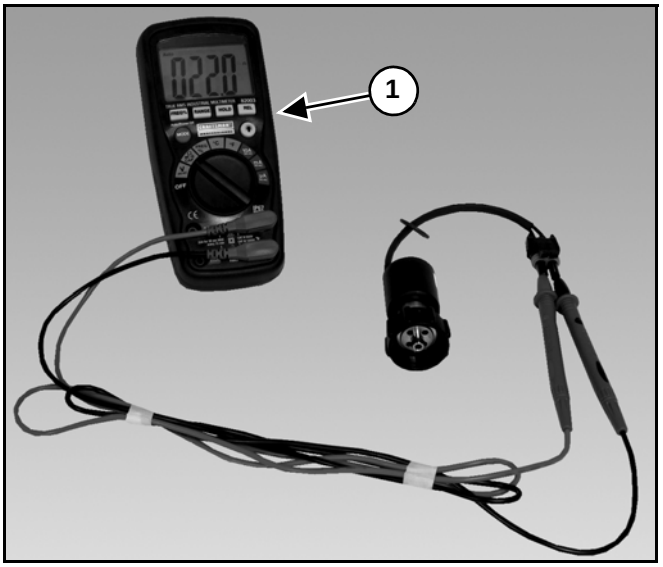
Coil failures are often the result of:

- Extended valve use with a plugged nozzle.
- Extended use in liquid fertilizer overspray environments.

NOTE: Capstan recommends washing the outside of the coils with clean water on a regular basis.

Disconnect the nozzle valve from the nozzle harness pigtail (connector) by unplugging the 2-pin Packard connector which is located on the spray boom.

Figure 53



Use a voltmeter (Item 1) **[Figure 53]** to observe that there is 19 to 22 ohms of resistance across pins A and B on the nozzle valve connector.

If proper resistance is not found:

- Clean the connector terminals.
- Replace the coil.

Coil failures are often the result of two factors:

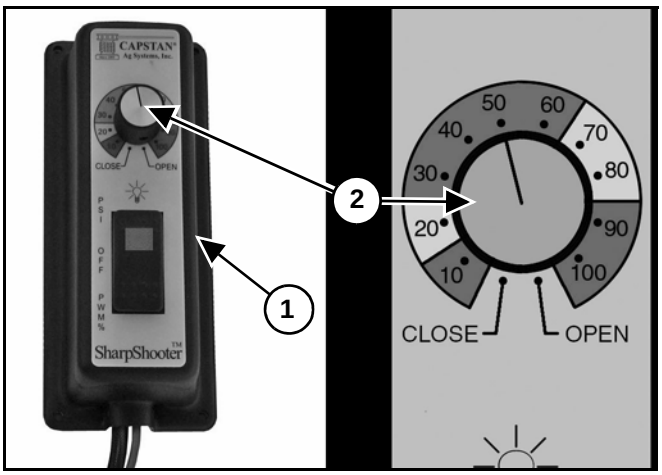
1. Extended valve use with a plugged plunger.
2. Extended use in liquid fertilizer overspray environments.

Capstan recommends cleaning any plugged nozzle valves immediately. Capstan also recommends rinsing the inside of the boom with clean water and washing the outside of the coils with clean water on a as needed basis.

SHARPSHOOTER TROUBLESHOOTING CONT.

Pulse Generator

Figure 54



Connect the Pulse Generator (Item 1) to the Power Hub, turn the rotary switch (Item 2) **[Figure 54]** to 50 and then place the SharpShooter in PWM mode by pressing the rocker switch downward.

Check to see that the rocker switch light is flashing two times per second. This confirms that the Pulse Generator fuse is functioning, that power is being received by the circuit board, and that the rocker switch is functioning.

Turn ON the boom and observe that the nozzles are pulsing at 50% duty cycle. Turn the rotary switch down to 20 and observe a decrease in flow and an increase in pressure.

Turn the rotary switch up to 80 and observe an increase in flow and a decrease in pressure. This confirms that the Pulse Generator is functioning in PWM mode.

Switch the spray rate controller to MANUAL mode and the SharpShooter Pulse Generator to the PSI mode. Then, decrease the flow until the SharpShooter reaches the minimum pulse duty cycle and begins to flash the rocker switch light one time per second.

Use the spray rate controller to increase the flow until the SharpShooter reaches maximum duty cycle (100% or open flow) and begins to flash the rocker switch light one time per second. This confirms that the Pulse Generator is operating in PSI mode.

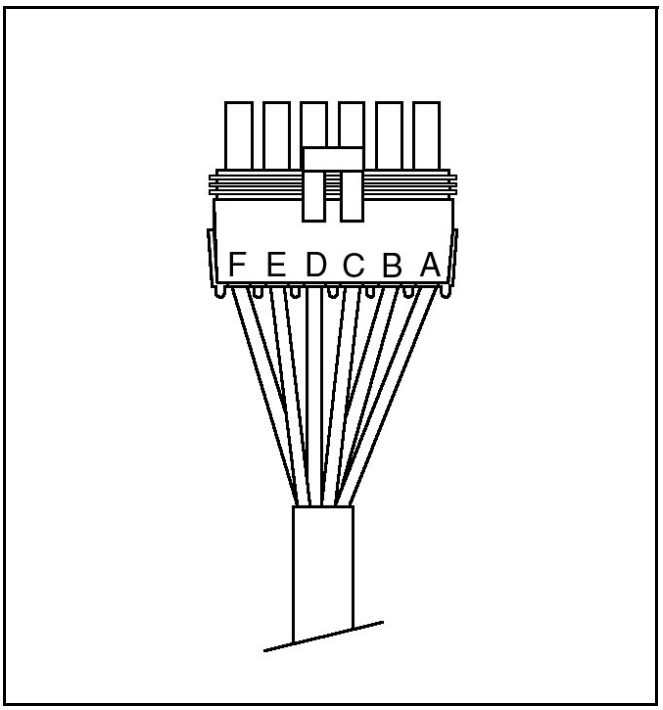
If the SharpShooter system is not operating properly:

- Check the circuit breaker near the battery and the fuse near the Pulse Generator.
- Check circuit board setups. See Circuit Board Setup on page 89.
- Check serial setups.
- Use serial diagnostics to check rocker and rotary switch functions.
- Use serial diagnostics to check pressure sensor function.
- Perform system voltage checks. See page 79 thru page 86.

SHARPSHOOTER TROUBLESHOOTING CONT.

Pulse Generator Pinout Identification

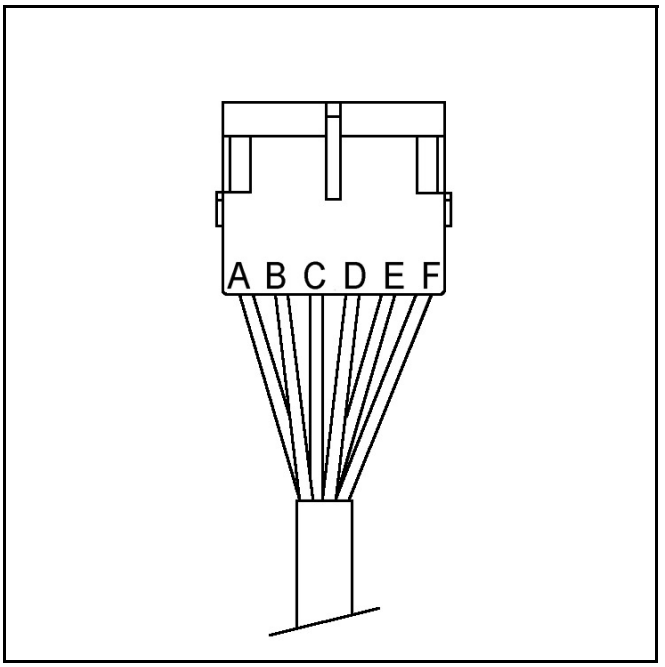
Figure 55



A	POWER - (RED)
B	GROUND - (BLACK)
C	PSI - (BLUE)
D	EVEN - (YELLOW)
E	ODD - (GREEN)
F	RUN / HOLD - (BROWN)

Valve Driver Pinout Identification

Figure 56

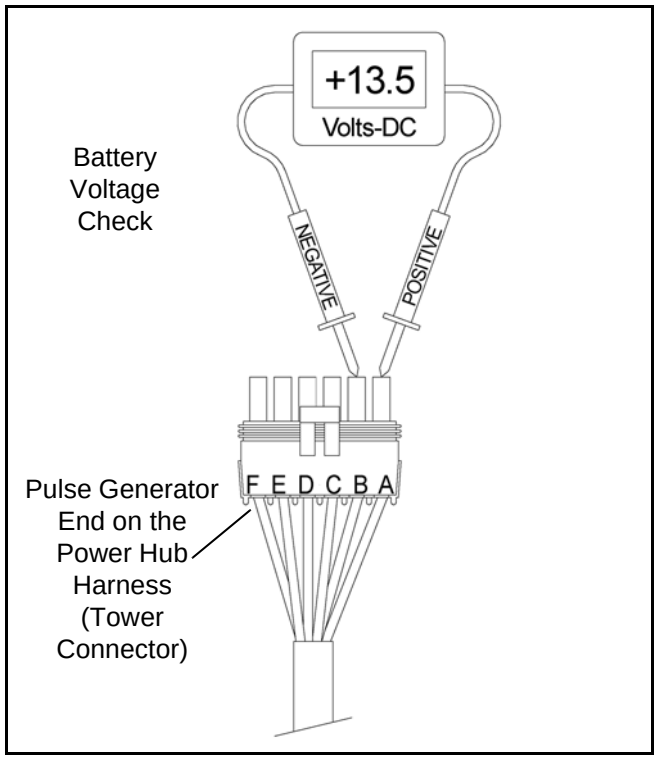


A	POWER - (RED)
B	GROUND - (BLACK)
C	PSI - (BLUE)
D	EVEN - (YELLOW)
E	ODD - (GREEN)
F	RUN / HOLD - (BROWN)

Battery Voltage Check

Disconnect the Pulse Generator from the extension harness by disconnecting the 6-pin connector. The connector is generally located in the cab.

Figure 57



Use a voltmeter to observe that there is 13.5 vdc between pins A and B with the engine running, or 12.0 vdc without the engine running **[Figure 57]**.

Be sure that the polarity is accurate by observing the positive voltage when the red (positive) probe is connected to pin A and the black (negative) probe is connected to pin B.

If no voltage is present:

- Check the 50 AMP. circuit breaker located at the battery.
- Check the Power Hub battery connections.
- Check the condition of the battery.
- Check the condition of the alternator.

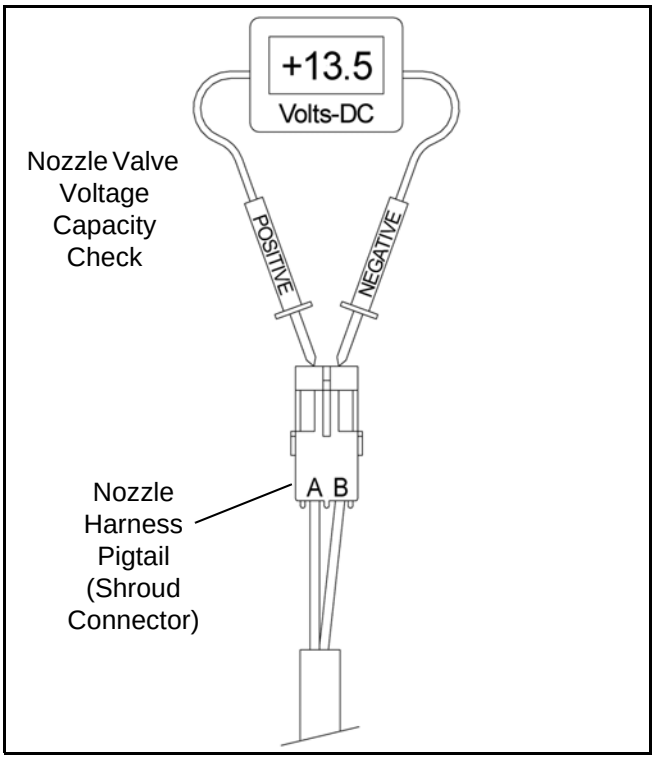
System Load Capacity Check

Disconnect the nozzle valve 2-pin connector that is located on the spray boom farthest from the battery.

Turn OFF the SharpShooter Pulse Generator, and then turn ON all boom sections.

Start the engine and turn ON all electrical loads' including air conditioning, foam markers, monitors, etc.

Figure 58



Use a voltmeter to observe the system voltage between pins A and B **[Figure 58]**.

The SharpShooter 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, check nozzle valves for worn plunger seals. See Plunger Seal Inspection on page 75.

If low voltage is observed:

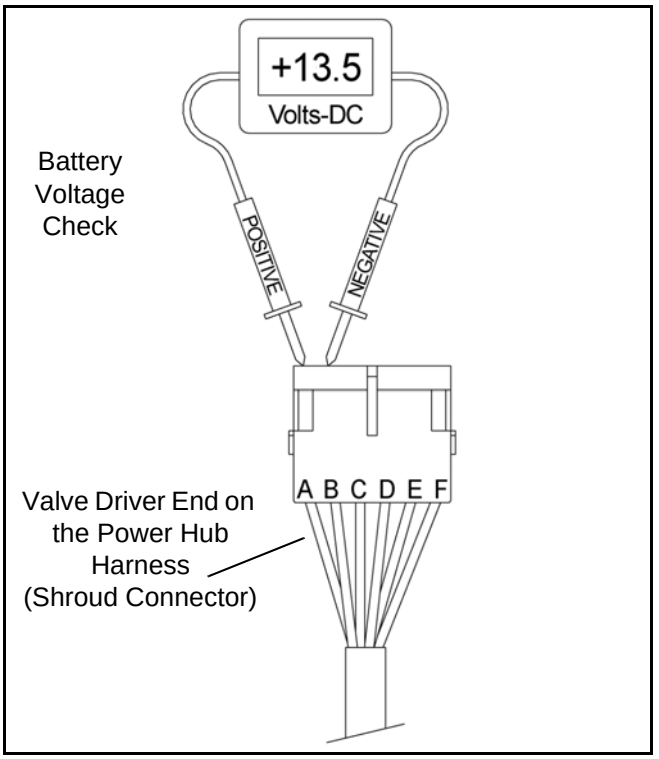
- Check and clean the battery terminals.
- Check the battery condition.
- Check the alternator condition.
- Check the condition of connections.

SHARPSHOOTER TROUBLESHOOTING CONT.

Valve Driver Voltage Check

Disconnect the Valve Driver from the extension harness by disconnecting the 6-pin Packard connector. the connection is generally located at each boom section.

Figure 59



Use a voltmeter to observe that there is 13.5 vdc between pins A and B with the engine running, or 12.0 vdc without the engine running **[Figure 59]**.

Be sure the polarity is accurate by observing the positive voltage when the red (positive) probe is connected to pin A and the black (negative) probe is connected to pin B.

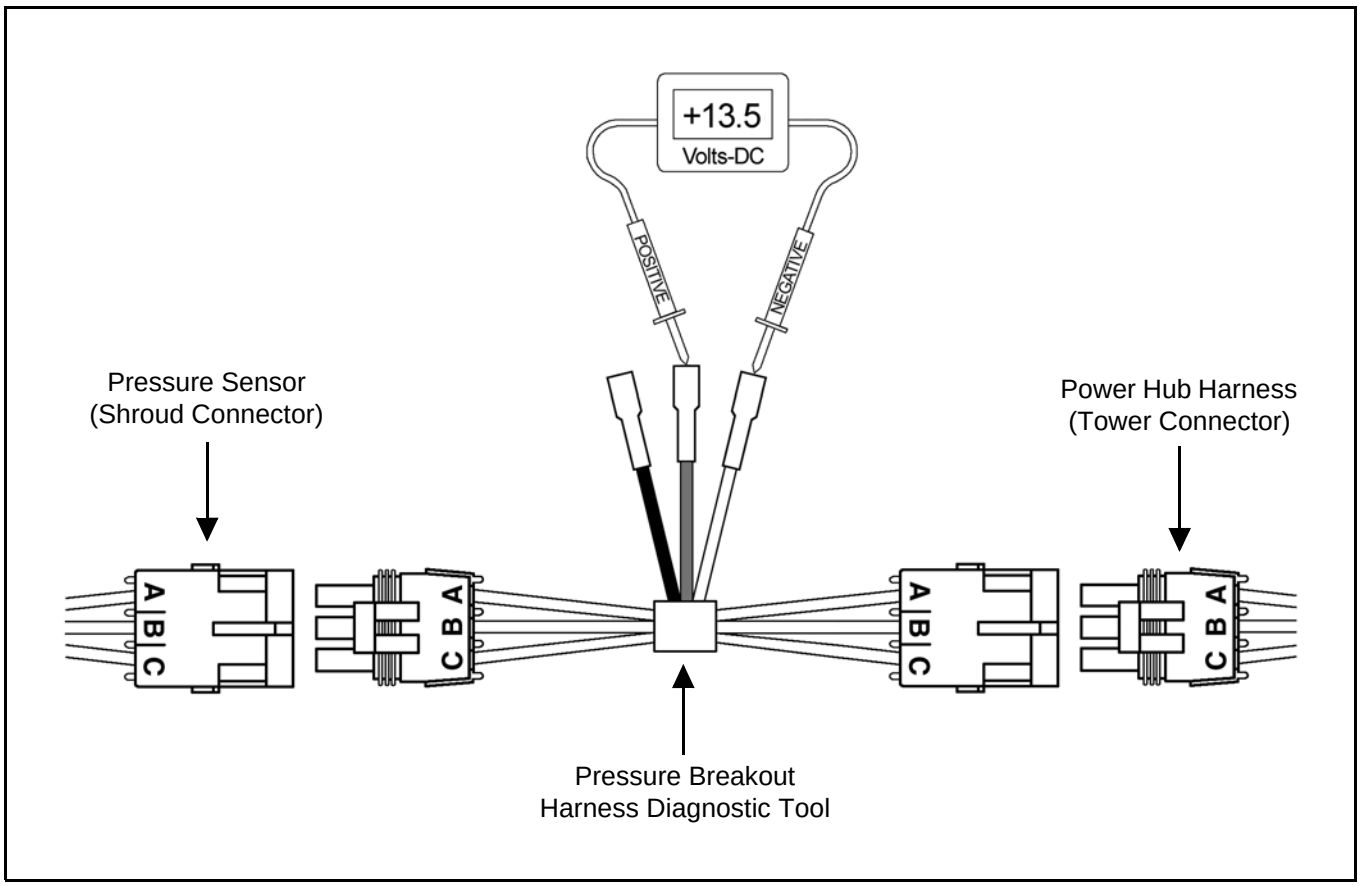
If no voltage is present:

- Check the 50 AMP. circuit breaker located at the battery.
- Check the Power Hub battery connections.
- Check the Power Hub Valve Driver extension connection.
- Check the condition of the battery.
- Check the condition of the alternator.

Pressure Sensor Input Power Check

Disconnect the pressure sensor 3-pin connector from the Power Hub harness, and then insert the Capstan pressure breakout harness diagnostic tool.

Figure 60



Use a voltmeter to observe that there is 13.5 vdc between the White and Red wire on the pressure breakout harness with the engine running, or 12.0 vdc without the engine running **[Figure 60]**.

Be sure the polarity is accurate by observing that there is positive voltage when the Red (positive) probe is connected to Red pressure breakout harness wire and the Black (negative) probe is connected to White pressure breakout harness wire.

If no voltage is present:

- Check the 50 AMP. circuit breaker located at the battery.
- Check the Power Hub battery connections.
- Check the condition of the battery.
- Check the condition of the alternator.

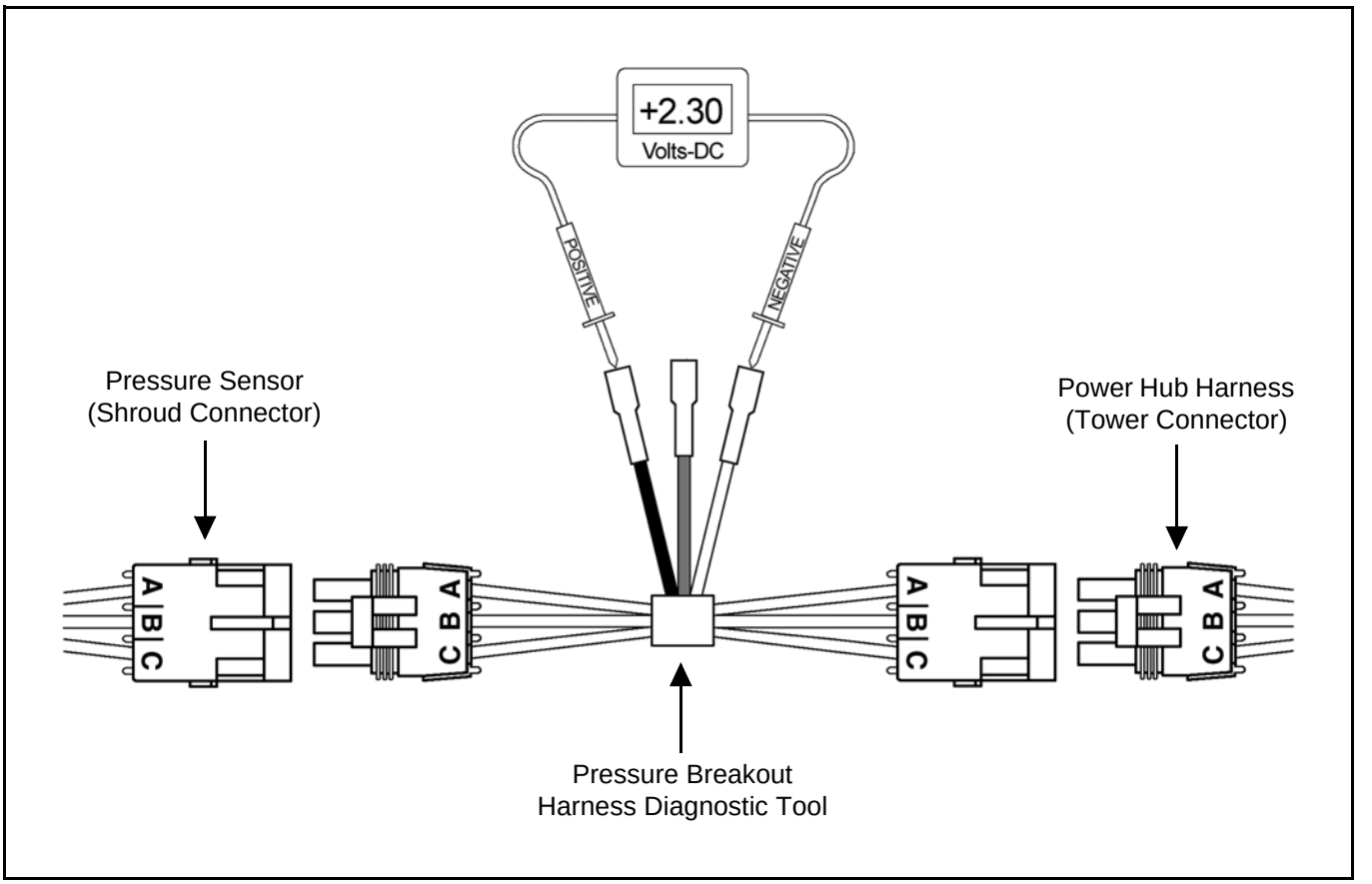
SHARPSHOOTER TROUBLESHOOTING CONT.

Pressure Sensor Signal Test

Disconnect the pressure sensor 3-pin connector from the Power Hub harness and then insert the Capstan pressure breakout harness diagnostic tool.

With the engine running and the pump turned on, use the spray rate controller to establish 40 PSI on the pressure gauge.

Figure 61



Use a voltmeter to observe that there is 2.30 vdc between the Black and White wire on the pressure breakout harness **[Figure 61]**.

Using the spray rate controller, adjust the pressure to 100 PSI and observe 5.0 vdc on the voltmeter.

If accurate voltage is not present:

- Verify the accuracy of the sprayers pressure gauge.
- Check for power to the pressure sensor. See Pressure Sensor Input Power Check on page 81.
- Check the pressure sensor calibration using the serial diagnostics.
- Replace the pressure sensor.

SHARPSHOOTER TROUBLESHOOTING CONT.

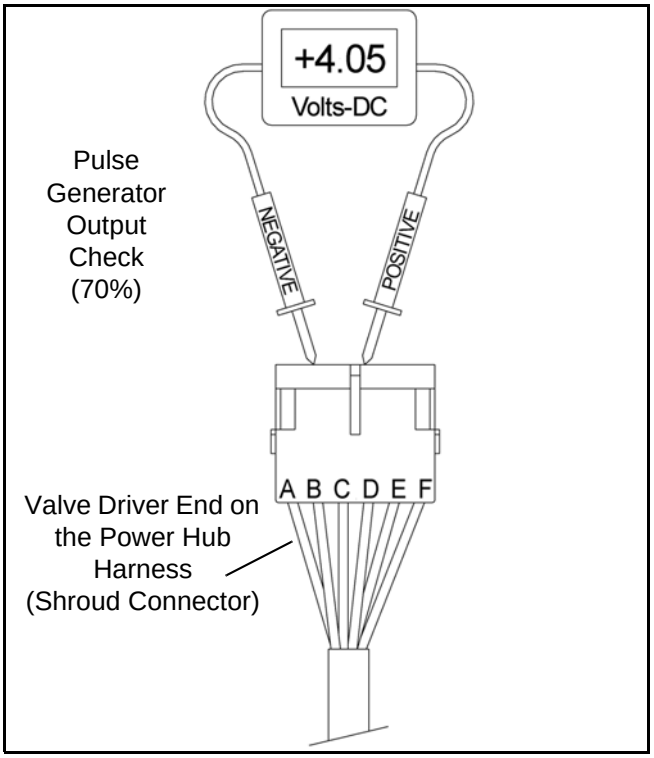
Pulse Circuit Test

Pulse Generator Output Check

Disconnect the Valve Driver from the extension harness by disconnecting the 6-pin Packard connector. The connector is generally located at each boom section.

Place the Pulse Generator in the PWM mode and then select 70 on the rotary knob. The rocker switch light should flash two times per second.

Figure 62



Use a voltmeter to observe that there is 4.05 vdc between pins B and D **[Figure 62]**.

Most voltmeters measure signal as 12 vdc 10hz square wave which is a low voltage. In addition, the signal is inverted, so the 70% duty cycle selected on the knob will actually be a 30% duty signal at the Valve Driver. Measurements may vary depending on the voltmeter used. This tests the even pulse.

Make the same measurement between pins B and E. This tests the odd pulse.

If accurate voltage is not found:

- Check the Valve Driver extension connections.
- Check the Pulse Generator extension connections.
- Check the Pulse Generator serial diagnostics.

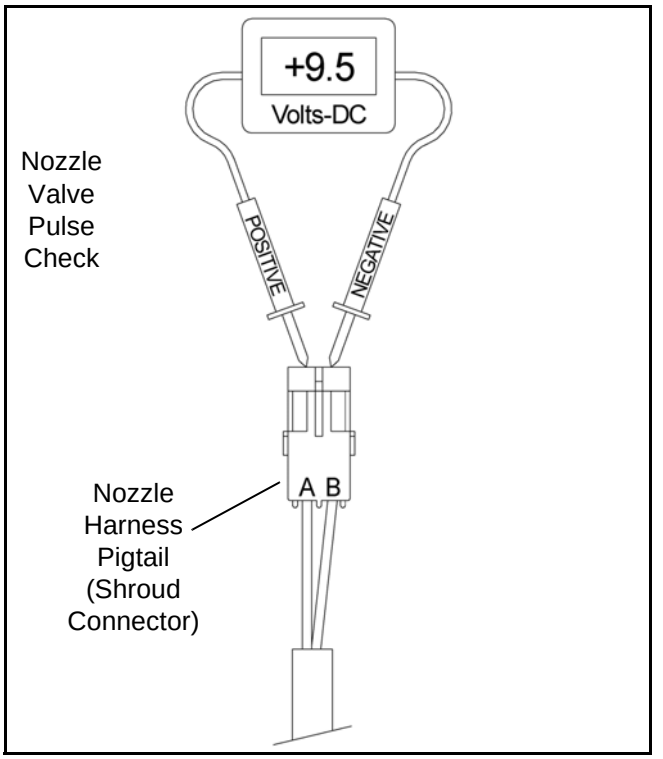
SHARPSHOOTER TROUBLESHOOTING CONT.

Valve Driver Output Check

Disconnect the nozzle valve 2-pin connector from the nozzle harness pigtail (connector) located on the spray boom.

Place the SharpShooter Pulse Generator in the PWM mode and select 70 on the rotary switch. The rocker switch light should flash two times per second. Turn ON the boom section, corresponding to the nozzle harness pigtail (connector) being tested.

Figure 63



Use a voltmeter to observe that there is 9.5 vdc between pins A and B **[Figure 63]**.

Most voltmeters measure signal as 12 vdc 10hz square wave which is a low voltage. Measurements may vary depending on the voltmeter used. Note the color of the wire in position B as either White or Green.

Make the same measurement on an adjacent nozzle harness pigtail (connector). The wire color in position B should change from White to Green or from Green to White.

If accurate voltage is not found:

- Check the nozzle harness extension connections.
- Check the Valve Driver extension connections.
- Check the Pulse Generator extension connections.
- Check the Pulse Generator serial diagnostics.

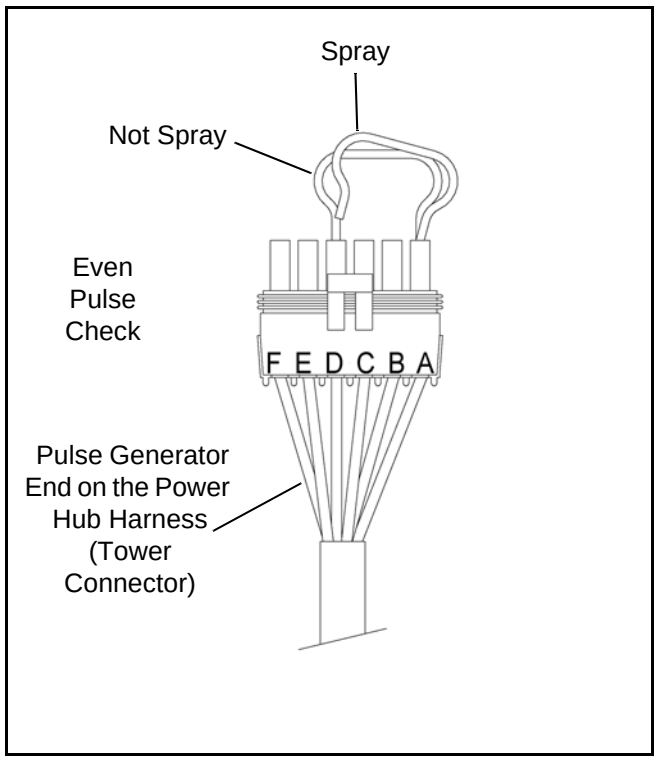
SHARPSHOOTER TROUBLESHOOTING CONT.

Valve Driver Input Check

Disconnect the Pulse Generator from the extension harness by disconnecting the 6-pin Packard connector which is generally located in the cab.

Start the engine, turn ON the pump and boom, then use the spray rate controller to establish 40 PSI on the pressure gauge. The boom should now be spraying.

Figure 64



Tap a jumper wire, several times per second, between pins A and D on the extension harness connector. Observe every even nozzle valve turn off as the jumper connects and turn on as the jumper disconnects **[Figure 64]**.

Tap a jumper wire, several times per second, between pins A and E on the extension harness connector. Observe that every odd nozzle valve turn on as the jumper connects and turn off as the jumper disconnects **[Figure 64]**.

Observe the nozzle pulsing on each boom section.

If the boom sprays, but does not pulse, when the jumper wire is tapped:

- Check the Power Hub Pulse Generator extension connection.
- Check the Valve Driver extension connections.

SHARPSHOOTER TROUBLESHOOTING CONT.

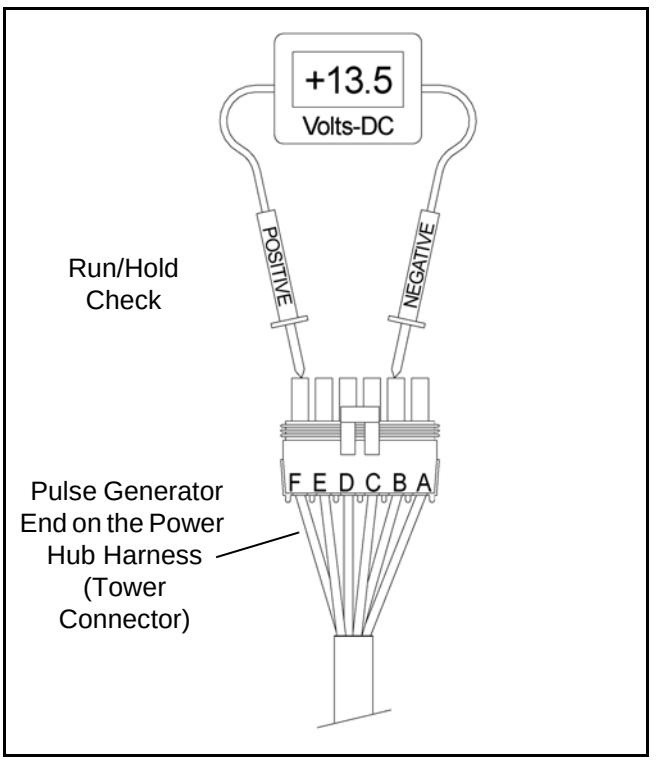
Boom Shutoff and Run / Hold Signal Test

Run / Hold Signal

Disconnect the Pulse Generator from the extension harness by disconnecting the 6-pin Packard connector which is generally located in the cab.

Start the engine, then turn ON the pump and turn OFF the boom, then use the spray rate controller to establish 40 PSI on the pressure gauge. The boom should NOT be spraying.

Figure 65



Turn ON boom section number one to observe that the nozzle valves on boom section number one turn on and spray fully open. Use a voltmeter to observe that there is 13.5 vdc between pins B and F with the engine running, or 12.0 vdc without the engine running **[Figure 65]**.

Turn OFF boom section number one and then observe the spray and voltage disappear. Repeat the test for boom sections two thru six.

If no spray or voltage is observed:

- Check the boom shutoff adapter connections.
- Check the boom shutoff extension connections.
- Check the Valve Driver extension connections.

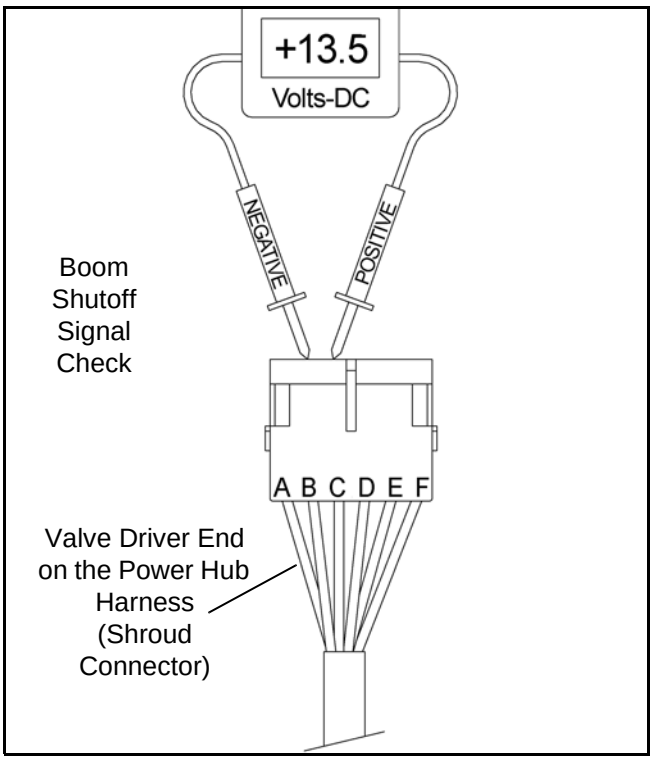
SHARPSHOOTER TROUBLESHOOTING CONT.

Valve Driver Shutoff Signal

Disconnect the Valve Driver from the extension harness by disconnecting the 6-pin Packard connector. The connector is generally located at each boom section.

Turn ON the boom shutoff switch that corresponds with the Valve Driver extension being tested.

Figure 66



Use a voltmeter to observe that there is 13.5 vdc between pins A and C with the engine running, or 12.0 vdc without the engine running **[Figure 66]**.

Turn OFF the boom shutoff switch to observe the voltage disappear.

If no voltage is present:

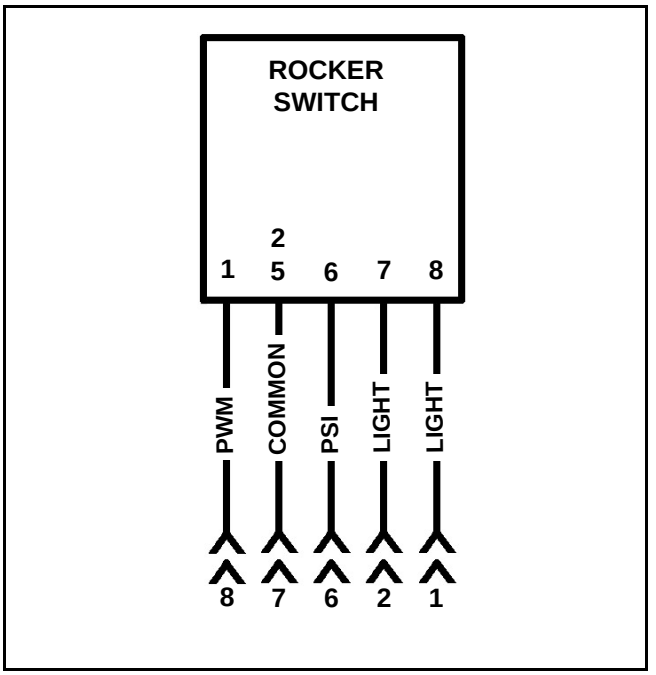
- Check the boom shutoff adapter connections.
- Check the boom shutoff extension connections.
- Check the Power Hub Valve Driver extension connection.
- Check the boom shutoff switches.

SHARPSHOOTER TROUBLESHOOTING CONT.

Rocker Switch

Remove the Pulse Generator cover by removing the four corner screws. Disconnect the rocker switch from the circuit board by disconnecting the 8-pin connector.

Figure 67



Place the rocker switch in the OFF mode. Use a voltmeter to verify that there is no continuity between connector pins 7 and 8 (switch terminals 1 and 5) or between connector pins 6 and 7 (switch terminals 5 and 6). Verify that there is approximately 19 ohms resistance between connector pins 1 and 2 (switch terminals 7 and 8) **[Figure 67]**.

Place the rocker switch in the PWM mode. Use a voltmeter to verify that there is continuity between connector pins 7 and 8 (switch terminals 1 and 5).

Place the rocker switch in the PSI mode. Use a voltmeter to verify that there is continuity between connector pins 6 and 7 (switch terminals 5 and 6).

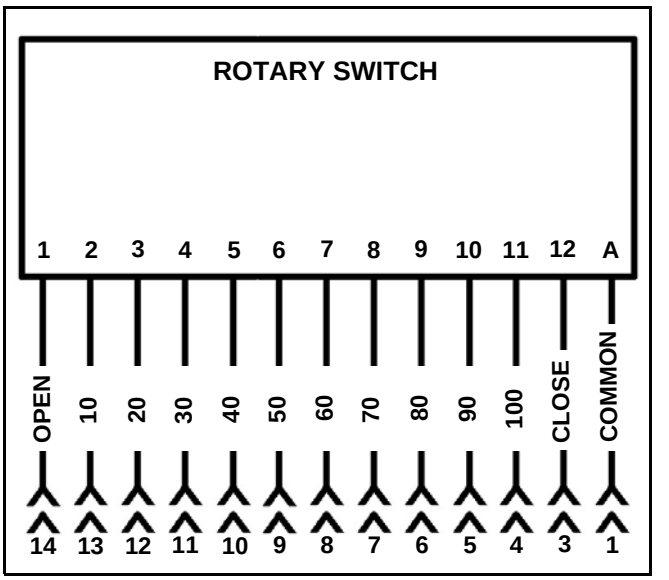
If the switch does not function properly:

- Replace the rocker switch and connector assembly.

Rotary Switch

Remove the Pulse Generator cover by removing the four corner screws. Disconnect the rotary switch from the circuit board by disconnecting the 14-pin connector.

Figure 68



Rotate the rotary switch to the “OPEN” position. Use a voltmeter to verify that there is continuity between connector pins 1 and 14 (switch terminals A and 1) **[Figure 68]**.

Rotate the rotary switch to the 10 position. Use a voltmeter to verify that there is continuity between connector pins 1 and 13 (switch terminals A and 2).

Use the diagram above to check each position of the 12-position rotary switch.

If the switch does not function properly:

- Replace the rotary switch and connector assembly.

SHARPSHOOTER TROUBLESHOOTING CONT.

Circuit Board Setup

To access the Pulse Generator circuit board setups, remove the four screws from the Pulse Generator and lift the lid away from the back panel.

S1 Dip Switch (Item 1)

- #1:OFF = DB9 Power
- #2:OFF = Run / Hold
- #3:ON = Odd Resistor
- #4:ON = Even Resistor

S4 Dip Switch (Item 2)

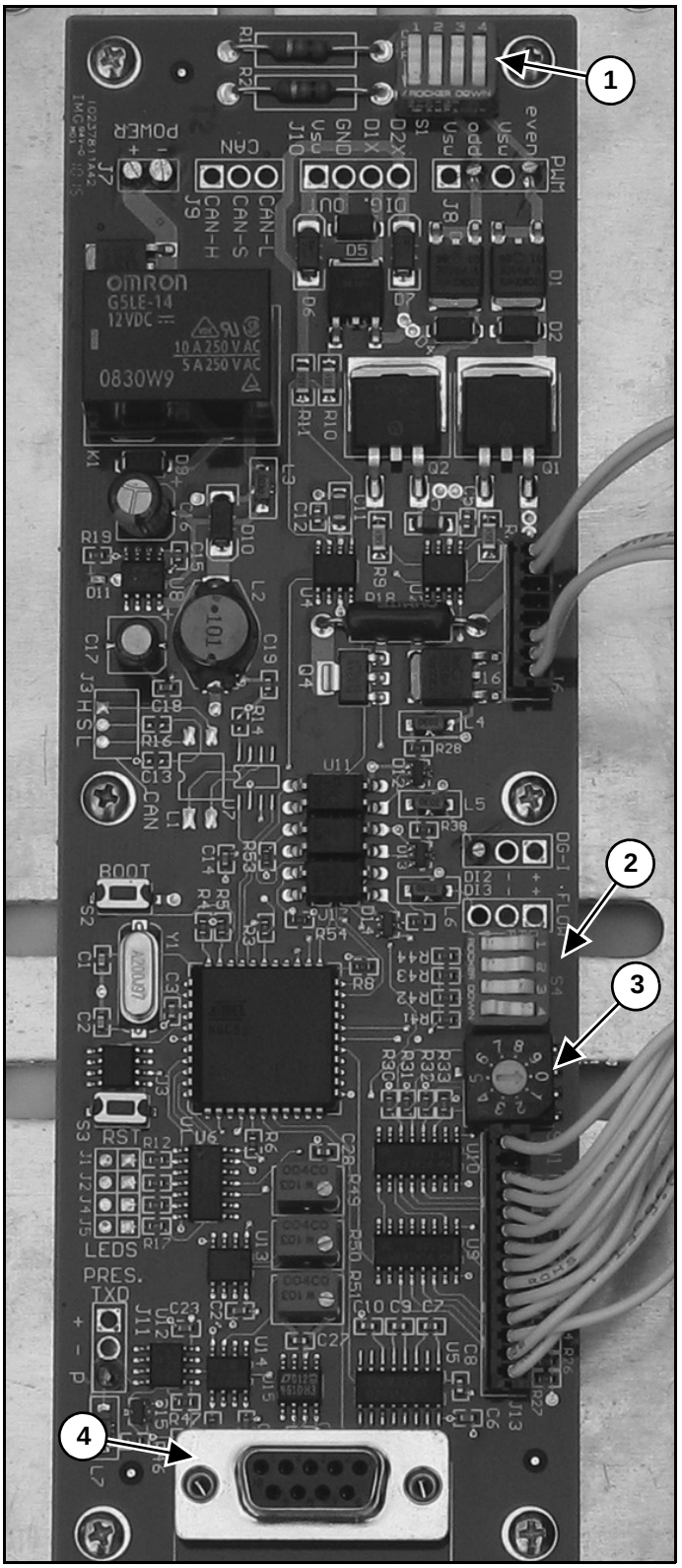
- #1:OFF = Freq. x Multiplier
- #2:OFF = Invert
- #3:OFF = PSI Shutoff
- #4:ON = Boost Disabled

SW1 Rotary Detent Switch (Item 3)

- #1: = 1Hz
- #2: = 2 Hz
- #9: = 9 Hz
- #0: = 10 Hz
- Etc.

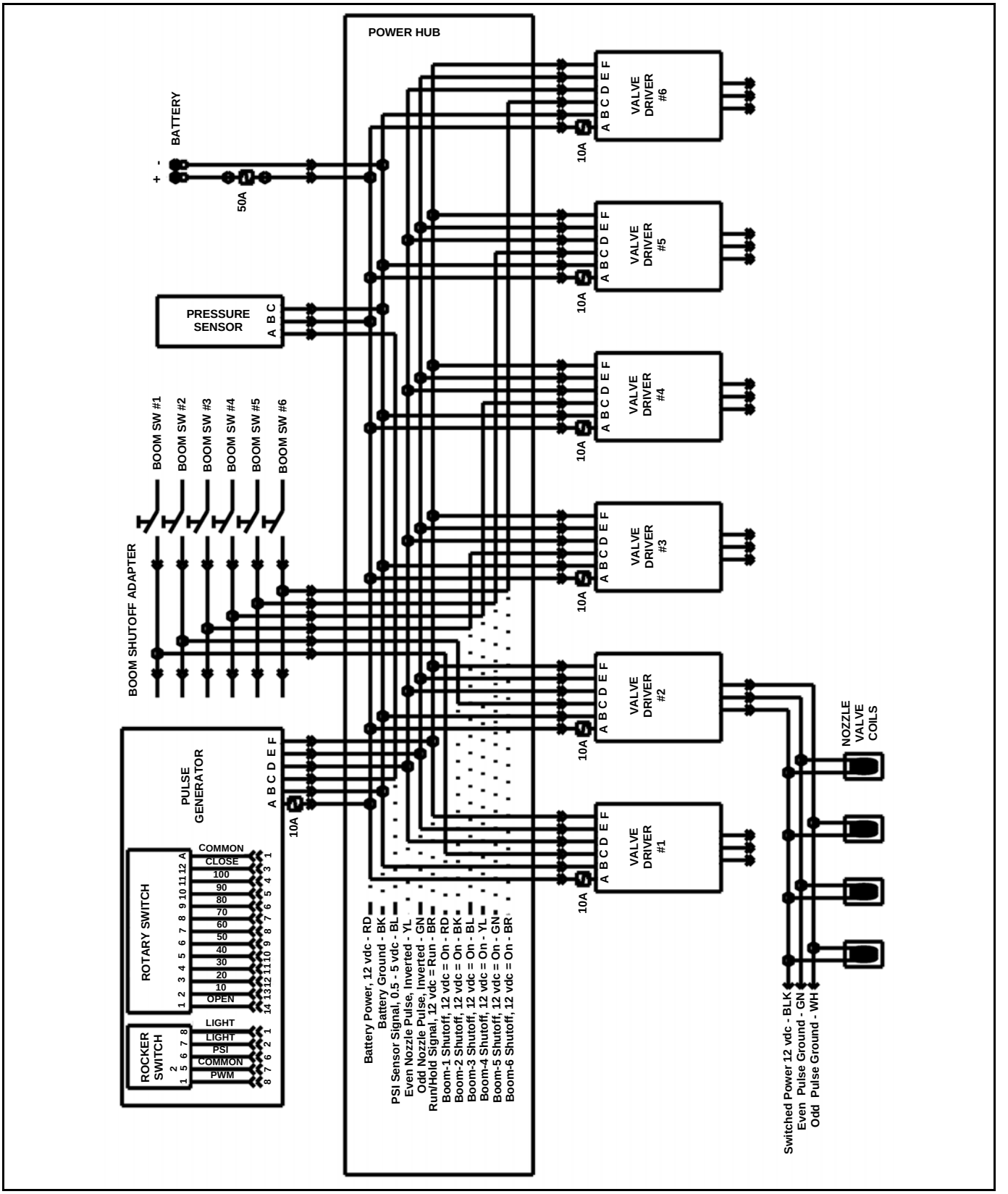
NOTE: The Rotary Switch (Item 3) is set to "0" for Ag.

DB9 = Serial Port (Item 4)



SHARPSHOOTER TROUBLESHOOTING CONT.

Electrical Schematic



RATE CONTROLLER TROUBLESHOOTING

Basic Rate Controller

Symptom: Under Application

1. Tips too small

- Verify that all nozzle valves have correct tips, and are the correct size.

- Verify the low rates with a Wilger Quick Calibrator or with a catch / time test at each nozzle.

  Oz / min per nozzle = GPA x Test Speed in mph x Nozzle Spacing in inches / (5940 x 128).

  Oz / min per nozzle = G/1000 ft² x Test Speed in mph x Nozzle Spacing in inches / (136 x 128).

2. Plugged filters

- Check the filters and replace any plugged or restricted filters.

- Verify that each filter is correctly installed.

3. Plugged lines

- Verify that each line is clear and free of kinks.

4. Shut-off valves partially closed

- Verify that each shut-off valve is fully open.

5. Pressure set too low on flow by-pass lines

- Verify settings on each pressure-controlled by-pass valve.

6. In-line servo flow control valve stuck

- Verify that the servo flow control valve is operating correctly.

7. Electric servo valve pump control stuck

- Verify that the electric servo pump control is operating correctly.

8. Servo signal wire polarity switched

- Verify that the valve opens with a rate increase.
- Verify that the valve closes with rate a decrease.

9. Top PWM value set too low

- Adjust the rate controller PWM valve to the desired setting.

10. PWM spool stuck

- Change the rate to observe whether the rate change is slow, limited or doesn't change at all. Replace as needed.

11. Worn flow meter

- Remove the rate smoothing feature.

- Place the rate controller in manual mode at a test speed.

NOTE: Placing the rate controller in manual mode will lock the servo valve position (unless manually changed).

If the rate becomes stable, then it is either a worn servo valve or PWM valve.

If the rate continues to be unstable, it is likely flow meter signal instability.

- Manually increase the rate.

  The rate and pressure should increase.

  If the rate does not increase, then it is either a worn servo valve or PWM valve.

- Manually decrease the rate.

  The rate and pressure should decrease.

  If the rate does not decrease, then it is either a worn servo valve or PWM valve.

12. Worn pump

- Speed data error

  Incorrect speed calibration number

  Poor GPS satellite reception / number of satellites

- Spraying too fast which outruns the liquid system capability.

RATE CONTROLLER TROUBLESHOOTING CONT.

Basic Rate Controller Cont.

Symptom: Over Application

1. Worn tips or tips too large

- Verify that all nozzle locations have the correct size and type of tips.

- Verify the low rates with a Wilger Quick Calibrator or with a catch / time test at each nozzle.

  Oz / min per nozzle = GPA x Test Speed in mph x Nozzle Spacing in inches / (5940 x 128).

  Oz / min per nozzle = G/1000 ft² x Test Speed in mph x Nozzle Spacing in inches / (136 x 128).

- Incorrect speed calibration number

  Adjust the speed calibration setting.

Symptom: Rate Instability

1. Check the rate controller calibration numbers

   Valve Type - Standard, Fast, PWM, PWM Close, etc.

   Valve Calibration - Check the calibration number for the valve type.

- Change the Valve Calibration numbers one at a time (Standard Servo - 2123).

  4th digit - Dead-Band width around target rate (size of bulls-eye) (1 = 1% 9 = 9%).

  3rd digit - Percent away from target rate where the response is slowed (0 = 5% 1 = 1% 9 = 9%).

  2nd digit - Response Time (1 = Slow 9 = Fast)

  1st digit - Valve over-shoot correction response time (1 = Slow 9 = Fast)

- Change the Valve Calibration numbers one at a time (PWM - 43)

  2nd digit - Dead-Band

  1st digit - Response Time

2. Worn or sticking servo valve.

- Check the servo valve and replace if needed.

3. Worn or sticking PWM valve

- Check the PWM valve and replace if needed.

4. Flow meter signal instability

- Verify the flow meter signal.

5. Hose integrity

- Check for plugged, kinked, or collapsed hoses. Replace as needed.

6. Controller Pressure Instability

- To isolate SharpShooter from rate controller, put the SharpShooter in PWM mode at 50%.

  Faulty controller pressure sensor

  Check the rate controller calibration numbers.

MAINTENANCE

Inspecting the Spray System

- Inspect spray system hoses for cuts, nicks or abrasions before each use. Replace any damaged hoses immediately.
- Make sure boom strainers are clean.
- Make sure all hoses and wiring is secure.
- Check for loose hoses, mounting hardware and components. Tighten if necessary.
- Disconnect the rate controller and SharpShooter power wires before jump starting or welding on the sprayer.
- Check for damaged or missing decals. Replace decals if damaged or missing.

Cleaning The Spray System

- Flush the spray system with clean water after each use.
- Avoid high pressure spray when cleaning the spray system components, valves and wiring connectors.

Storage

- Thoroughly clean the spray system before winter storage.
- Flush the spray system with clean water.
- Winter the spray system with RV antifreeze for winter storage.

WARRANTY POLICY

Capstan Ag Systems, Inc., the Seller, warrants to the original Purchaser/User, its products to be free from defects in material and workmanship in normal use and service for a period of one year from the date of purchase.

The Purchaser, by acceptance of the Seller's product, assumes all risk and liability of the consequences of any use or misuse by Purchaser, its employees, or others.

The Seller's obligation under this warranty shall be limited to the repairing or replacing (at the Seller's option), at no cost to the Purchaser, the product or part thereof which the Seller's inspection discloses to be defective, FOB point of manufacture, provided the Buyer; (i) Notify Seller of defect within thirty (30) days of failure; (ii) Returns the defective product to Seller, transportation prepaid; and (iii) Establishes that the product has been properly installed, maintained and operated in accordance with the Seller's instructions or instructions contained in its operations or maintenance manuals and within the limits of normal usage.

All replacement products, or parts thereof, furnished under this warranty, will be invoiced in the usual manner and adjustments will be made after the product, or part thereof, claimed to be defective has been returned to and inspected at the Seller's factory.

Replacement products, or parts thereof, furnished under this warranty shall be FOB Buyer's location, and the Seller shall not be responsible for installation costs. (For all international transactions, replacement products shall be furnished FOB Seller's factory and the Buyer shall be responsible for all customs and brokerage fees). The Buyer shall be liable for all freight, inspection, and handling costs if such product or such parts do not prove to be defective. In no event will any claim for labor or incidental or consequential damages be allowed for removing or replacing a defective product. No warranty is made as to any product or part which has been subject to misuse, abuse, accidents, alterations, improper or negligent use, in maintenance, storage, or transportation, and handling.

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

The terms of this warranty do not in any way extend to any product which was not manufactured by the Seller or an affiliate of the Seller.

This warranty shall be void, and the Seller shall not be liable for any breach of warranty, if the product or parts shall have been repaired or altered by persons other than the Seller, unless it was expressly authorized by the Seller in writing.

The foregoing warranty is exclusive and is in lieu of all other warranties expressed or implied. All implied warranties of merchantability and fitness for a particular purpose are hereby disclaimed by the Seller and are excluded from this agreement. The Seller shall not be liable for any incidental or consequential damages resulting from any breach of warranty.

Limitation of Liability – The Buyer's exclusive remedy for breach of warranty shall be to repair or to replace defective products: Provided, the products are incapable of being repaired or replaced, the Buyer's exclusive remedy shall be money damages. Such damages shall not exceed the purchase price of the products.

Any claim for breach of the Seller's warranty must be in writing and addressed to the Seller. It must set forth the alleged defect in sufficient detail to permit its easy identification by the Seller. 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. The applicable time periods are set forth in the above warranty term. Any breach of warranty claim not timely made will not be honored by the Seller and will be of no force and effect.

WARRANTY POLICY CONT.

On any claim of any kind, including negligence, the Seller's liability for any loss or damage arising out of, or from the design, manufacture, sale, delivery, resale, installation, technical direction of installation, inspection, repair, or operation of use of any products shall in no case (except as provided in the terms of the Patent Indemnity) exceed the purchase price allocable to the products.

In no event, whether as a result of breach of contract, warranty, or alleged negligence, shall the Seller 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 the Buyers for such damages.

Patent Indemnity. The Seller retains for itself any and all property rights in and to all designs, inventions, and improvements pertaining to any products and to all patents, trademarks, copyrights and related industrial property rights arising out of work done in connection therewith. The Buyer expressly agrees that it will not assert any rights to property rights retained herein by the Seller.

WARRANTY AND REPAIR EVALUATIONS

Any part or module that needs to be repaired or evaluated for warranty must be authorized before return. Contact the factory (785-232-4477) for a Return Materials Authorization (RMA #). This tracks 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 the warranty will be denied.

If warranty repair or evaluation is requested on a nozzle valve, the entire valve must be returned to the factory. The Warranty will not be offered on individual valve parts.

After receiving the RMA#, package the part. Include the RMA#, your name, address, phone number, customer name and description of the problem or failure. Then ship the package to:

Capstan Ag Systems, Inc.
Attn: Warranty & Repair
4225 S.W. Kirklawn Ave.
Topeka, KS 66609

Toll-free number: (855) 628-7722
Topeka Office Phone: (785) 232-4477
Topeka Office Fax: (785) 232-7799
Hours: 8 a.m. - 4:30 p.m. CST

On-Line: www.CapstanAg.com
Orders@CapstanAg.com

Upon receipt of the part in question, the part will be evaluated for warranty, then repaired and returned.

www.CapstanAg.com

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Topeka, KS 66609

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Online: www.CapstanAg.com
Email: Marketing@CapstanAg.com