INSTRUCTIONS AND PARTS MANUAL

PIPER-PLUS

Please record your equipment identification information below for future reference. This information can be found on your machine nameplate.

Model Number: _____

Serial Number: _____

Date of Purchase: _____

Whenever you request replacement parts or information on this equipment, always supply the information you have recorded above.

LIT-PIPER-PLUS-IPM-0720

Bug-O Systems is committed to empowering our customers by providing operator controlled mechanized solutions for their welding, cutting and custom applications.

BUG-O SYSTEMS

A DIVISION OF WELD TOOLING CORPORATION

280 TECHNOLOGY DRIVE CANONSBURG, PENNSYLVANIA 15317-9564 USA
PHONE: 412-331-1776 http://www.bugo.com FAX: 412-331-0383

SAFETY

PROTECT YOURSELF AND OTHERS FROM SERIOUS INJURY OR DEATH. KEEP CHILDREN AWAY. BE SURE THAT ALL INSTALLATION, OPERATION, MAINTENANCE AND REPAIR PROCEDURES ARE PERFORMED ONLY BY QUALIFIED INDIVIDUALS.

ELECTRIC SHOCK can kill.

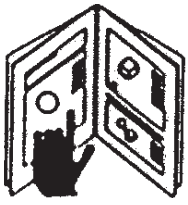
1) The equipment is not waterproof. Using the unit in a wet environment may result in serious injury. Do not touch equipment when wet or standing in a wet location.

2) The unused connectors have power on them. Always keep the unused connectors covered with the supplied protective panels. Operation of the machine without the protective panels may result in injury.

3) Never open the equipment without first unplugging the power cord or serious injury may result.

4) Verify the customer-supplied power connections are made in accordance with all applicable local and national electrical safety codes. If none exist, use International Electric Code (IEC) 950.

5) Never remove or bypass the equipment power cord ground. Verify the equipment is grounded in accordance with all applicable local and national electrical safety codes. If none exist, use International Electric Code (IEC) 950.



READ INSTRUCTIONS.

Read the instruction manual before installing and using the equipment.

EQUIPMENT DAMAGE POSSIBLE.

1) Do not plug in the power cord without first verifying the equipment is OFF and the cord input voltage is the same as required by the machine or serious damage may result.

2) Always verity both the pinion and wheels are fully engaged before applying power or equipment damage may occur.

3) Do not leave the equipment unattended.

4) Remove from the work site and store in a safe location when not in use.

FALLING EQUIPMENT can cause serious personal injury and equipment damage.

Faulty or careless user installation is possible. As a result, never stand or walk underneath equipment.

MOVING PARTS can cause serious injury.

1) Never try to stop the pinion from moving except by removing power or by using the STOP control.

2) Do not remove any protective panels, covers or guards and operate equipment.

HIGH FREQUENCY WARNINGS

SPECIAL PRECAUTIONS ARE REQUIRED WHEN USING PLASMA, TIG OR ANY WELDING PROCESS THAT USES HIGH FREQUENCY TO STRIKE AN ARC.

WARNING: HIGH FREQUENCY CAN EFFECT MACHINE OPERATION AND THEREFORE, WELD QUALITY.

Read the precautions below before installing and using the equipment.

PRECAUTIONS:

1) Some plasma or welding cables are strong sources of high frequency interference. NEVER lay a plasma or welding cable across the controls of the machine.

2) Always physically separate the plasma or welding cable leads from the machine cables. For example, the plasma or welding cable leads should NEVER be bundled with a pendant cable or the machine power cord. Maximize the separation between any machine cables and the plasma or welding cables.

3) Strictly follow the grounding procedures specified for the plasma or welding unit. NOTE: Some plasma and welding units produce exceptionally large amounts of high frequency noise. They may require a grounding rod be driven into the earth within six feet (2 meters) of the plasma or welding unit to become compatible with an automatic cutting or welding process.

4) If the high frequency is produced using a spark gap, adjust the points so the gap is as small as possible. The larger the gap, the higher the voltage and the higher the interference.

5) Some plasma or welding units will inject high frequency interference into the AC power line. Use separate power line branches whenever possible to power the plasma or welding source and the machine. Do not plug them into the same outlet box.

6) High frequency noise may enter the machine through the plasma or welding supply remote contactor leads. Some plasma and welding sources can produce noise spikes of up to several thousand volts. These sources are not compatible with automated cutting and welding equipment. It is recommended that the remote contactor leads on these plasma or welding sources not be connected to the machine. An alternate solution is to purchase a separate remote contactor isolation box.

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SECTION 1.0 TECHNICAL SPECIFICATIONS

Power Requirements:
120VAC or 240VAC / 50-60Hz / 1PH

Weights:
w/o cables- 24.72 lbs (12.44 kg)
w/ 15 ft cables- 47.56 lbs (20.72 kg)

Wire Feeder- 46.1 lbs (20.9 kg)

Operating Temperatures:
-4°F to 122°F (-20°C to 50°C)

Welding Process:
GMAW, GMAW-Pulsed, FCAW, STT®

Travel:
Fwd/Off/Rev (Selectable)

Steering:
2" (50.8mm) Left & Right Of Center
4" (101.6mm) Total

Drive / Brake:
Rack & Pinion Drive / Dynamic Braking

Speed:
Linear- 0 – 80 ipm (0 – 200 cm/m)
Weave- 5 – 130 ipm (12.7 – 330.2 cm/m)

Dwell Times:
0 – 10 Seconds Left & Right, Independently Set

Weave Width:
.01" – 2" (.25 – 50 mm)

Load capacity (in addition to its own weight):
60 lbs (27 kg). Tractor will hold this load without drifting backwards.

Wire Feeder:
See Addendum for your power source type for feeder specifications (Section 18, pages 102-119).

DIMENSIONS:

Piper Plus w/ BRR-3250-xx Rail & Legs

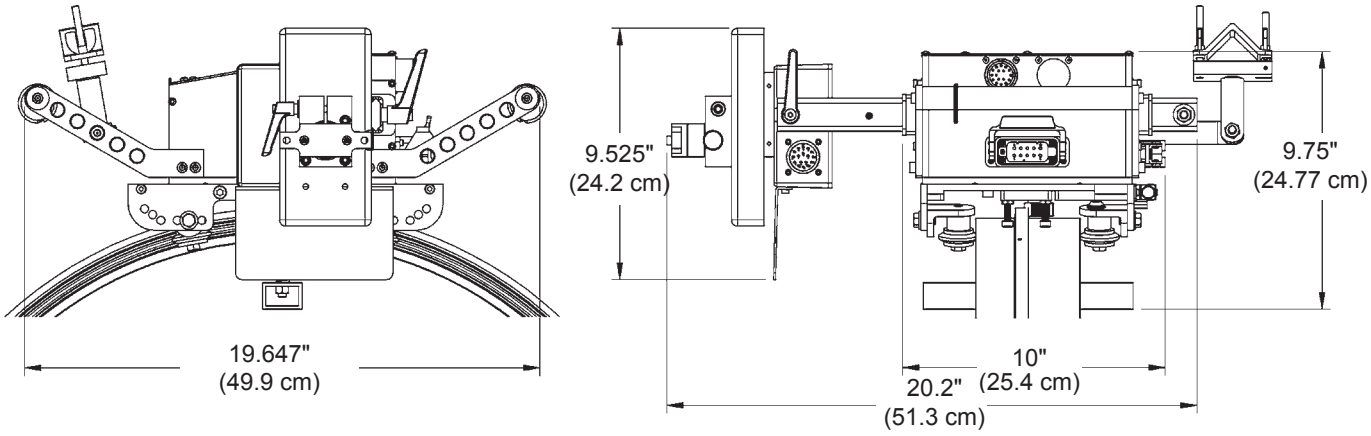


Figure 1.0

Piper Plus w/ PSR-2000-xx Rail & Legs

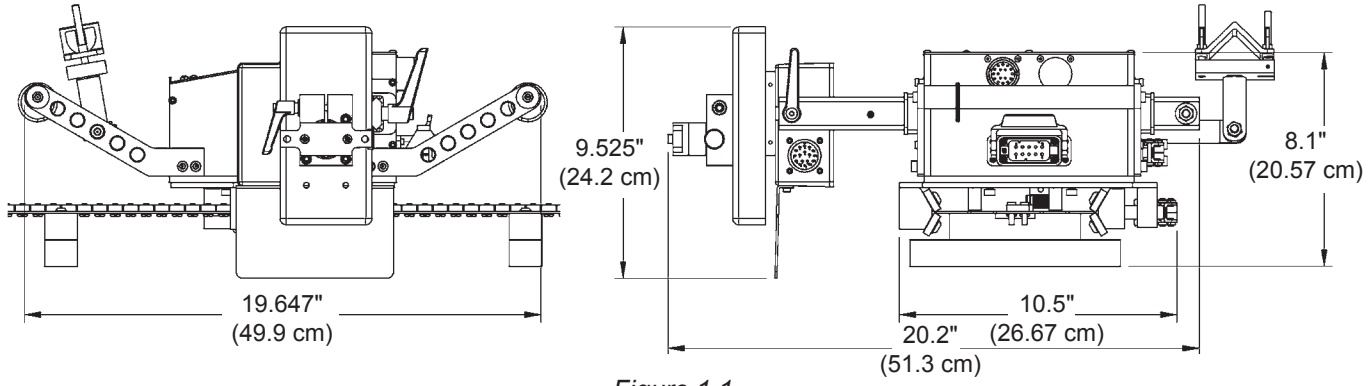


Figure 1.1

SECTION 1.0 TECHNICAL SPECIFICATIONS

RAIL/TRACK OPTIONS:

BRR-3250-XX - Bent Rigid Rail - Aluminum Extrusion built to specific dimensions for given pipe O.D. (Equipped with Spring Loaded Feet, Integral Hinge and Latch Assembly)

PSR-2000-XX - Piper Stainless Rail - Stainless Steel Band, 6 inches in width, designed for specific pipe O.D. (Equipped with Rigidly Adjustable Feet and Latch Assembly)

(Each rail type requires a specific carriage. See factory for details.)

PIPE SIZE:

16" (457.2 mm) minimum Outside Diameter

TORCH OSCILLATION (Built in Linear):

Oscillation Stroke:
.01 - 2" (.25 - 50.8 mm)

Oscillation Speed:
5 - 130 ipm (12.7 - 330 cm/min)

Oscillation Dwell:
0 - 10 seconds, independently set on left and right as needed

Cross Seam Adjustment (Steering):
up to 2" (50.8 mm) left and right with a total of 4" (101.6 mm total)

VERTICAL TORCH MOTION - MOTORIZED

Stroke length (total): 4" (101 mm)
Motor will support 20 lbs (9 kg.)

TORCH POSITION ADJUSTMENT - MECHANICAL

Hand adjustment eliminates the need for tools to make adjustments (torch angle and lead, push lag, drag.)

SECTION 1.0 TECHNICAL SPECIFICATIONS

Memory: Can store greater than 10,000 passes

Management Functions: Password Protected

- Motion calibration ensures accurate surface travel speed
- Unique upper and lower limits can be applied to each and every welding parameter
- Reverse direction changeable and can be locked
- Operator interface can be modified to most computer compatible languages

WIRE FEEDER:

See Addendum for your power source type for feeder specifications (pages 102-119).

CABLE:

- 15' (5m) gun cable to wire feeder
- 25' (7.62m) Standard Length Tractor to Control and Pendant to Control
- Custom length Tractor/Control Cables available upon request

WELDING PROCESSES:

See Addendum for your power source type for feeder specifications (Section 18, pages 102-119).

WELDING WIRE CONSUMABLE OPTIONS:

See Addendum for your power source type for feeder specifications (Section 18, pages 102-119).

SECTION 2.0 CONTROL BOX FRONT PANEL

SYSTEM OPERATION - The user interface is very intuitive and user friendly. Important information about parameters and machine operation is displayed. An operator can have as much or as little interaction with the interface as is required by the application. If the operator is not comfortable with the computer based interface, it is only necessary to choose a pass and then control the machine from the pendant.

SECTION 2.0 – CONTROL BOX FRONT PANEL

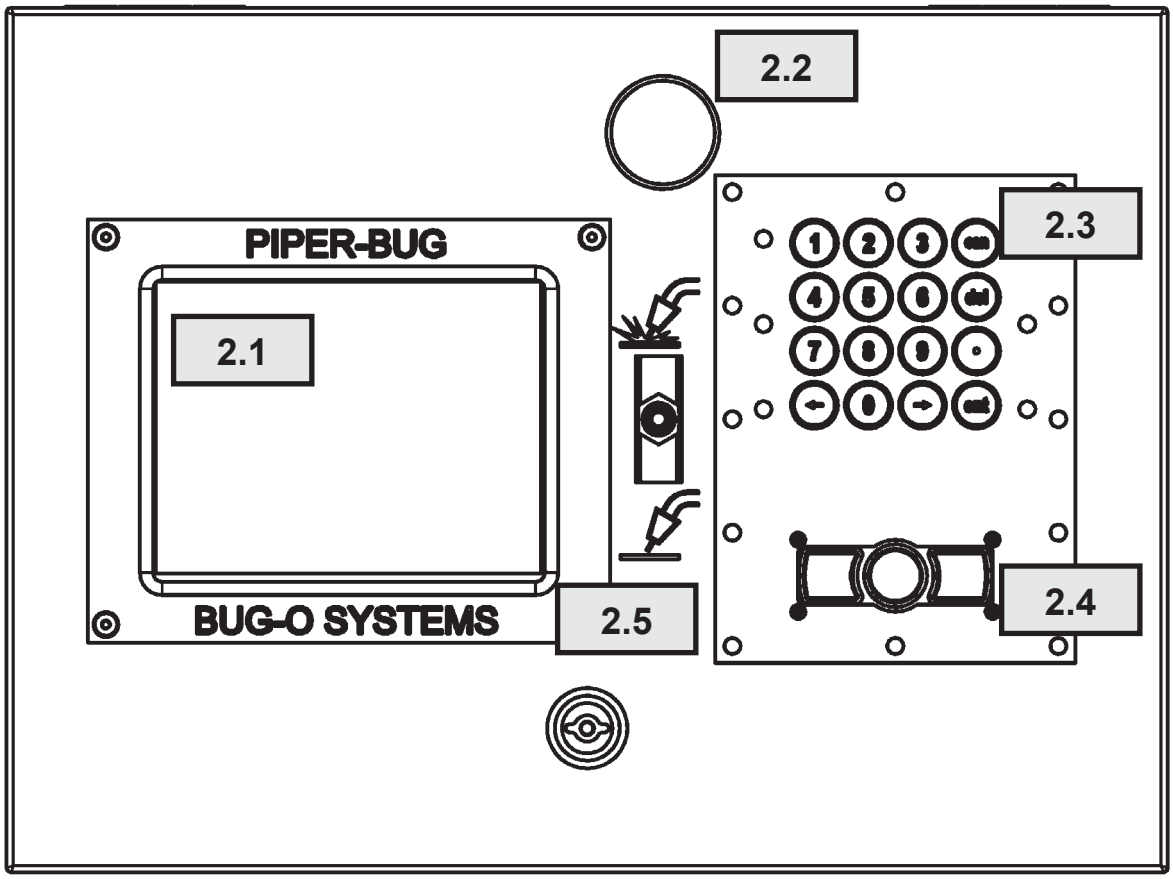


Figure 2.0 – Control Box Front Panel

2.1 **Display Screen** – This screen provides all operation, program, and feedback data to the operator.

2.2 **Emergency Stop Button** – This button, when pressed, provides immediate shutdown of the system. All input power to the system is turned off and all motion and welding functions will cease immediately.

2.3 **Numerical Keypad** – This keypad is used for all input of numerical data along with movement from input box to input box within any given screen. Cancel, Delete and Enter functions are also provided along the right side of the pad.

2.4 **Mouse and Mouse Buttons** – This “Joystick” style Mouse allows the operator to move the cursor around the Display Screen. The buttons to the left and right allow selection of particular input boxes.

2.5 **Hot/Cold Switch** – This switch determines if the welding function is active or inactive. If the switch is positioned to the top, welding is active. If the switch is positioned to the bottom, welding is inactive. When welding is inactive, all other functions will operate; except welding contactor will not close. If this switch is changed during welding, an Emergency Stop will occur.

SECTION 3.0 DISPLAY SCREEN - MAIN SCREEN

This screen is displayed immediately upon turning on the Piper Plus.

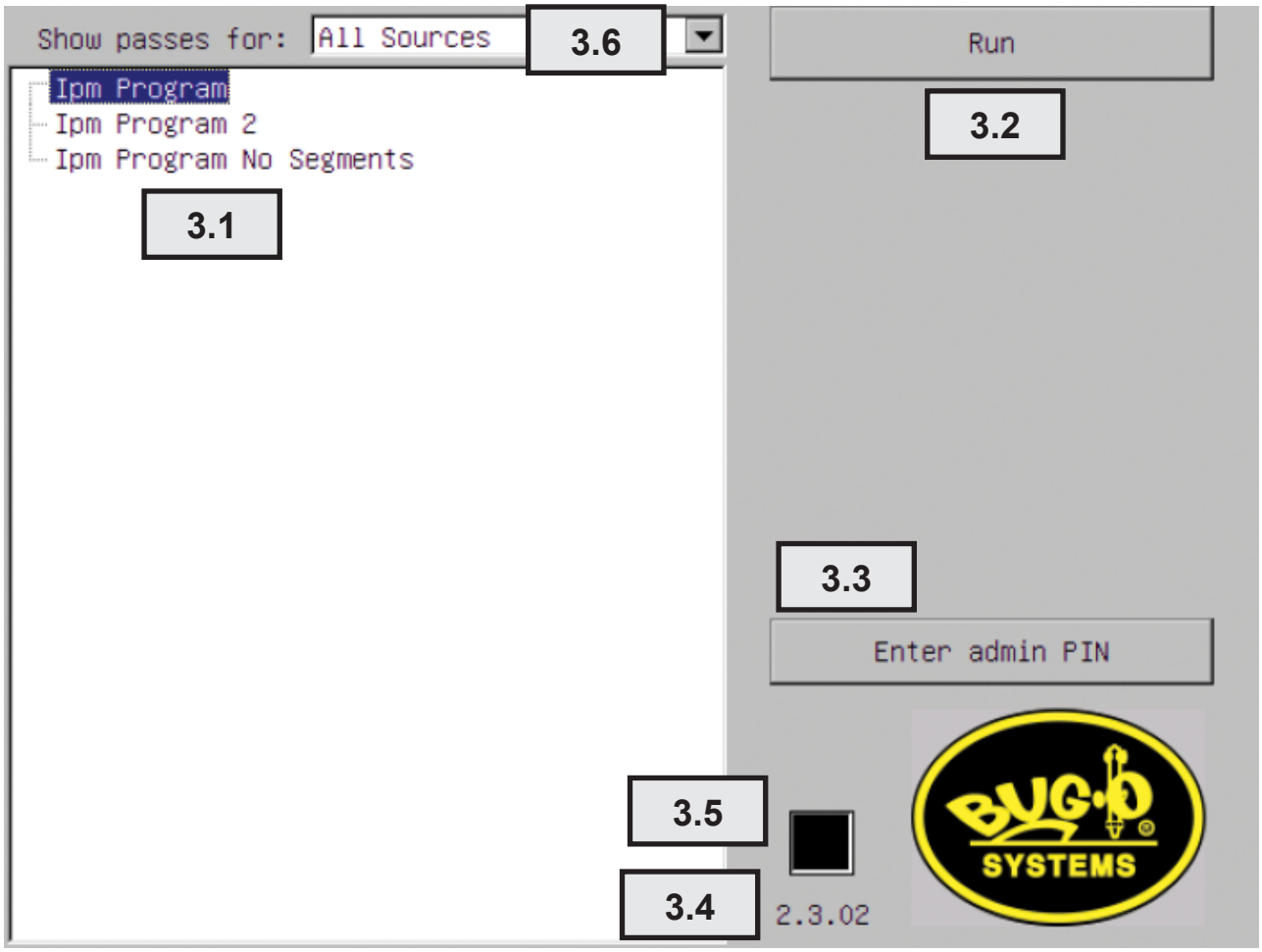


Figure 3.1 – Main Screen

3.1 **DISPLAY** – This area displays a list of all folders available within the machine. Use the MOUSE (See SECTION 2.4) to move the cursor over the required folder. Highlight selection by clicking the Left Mouse button.

3.2 **Run** – Pressing this button will put the machine in RUN MODE. It will load the folder highlighted in the DISPLAY (See SECTION 3.1). When the machine is idle, it is possible to select a new pass. The first pass for a station will be loaded when the run screen is opened. To select a new pass, use the pointer and click on the desired pass, or press the pass change button on the pendant. Any adjustments that were made will be lost and the default values will be loaded. The screen will change to the RUN screen as shown in SECTION 4.0.
PLEASE NOTE: *The system is not capable of any motion unless it is in RUN MODE. This applies to both the jog and automatic modes.*

SECTION 3.0 DISPLAY SCREEN - MAIN SCREEN, CONT'D.

3.3 **Enter Admin PIN** – Clicking on this button allows the operator to enter a PIN (Personal Identification Number). The screen below will appear. (See Figure 3.3)

Enter the appropriate 3 digit PIN. Press 

on the keypad (See Figure 2.0, SECTION 2.3) or move the cursor to the OK box using the MOUSE and click on the LEFT mouse button. If the PIN is correct, the Administration functions become active. (See Figure 3.1.1)

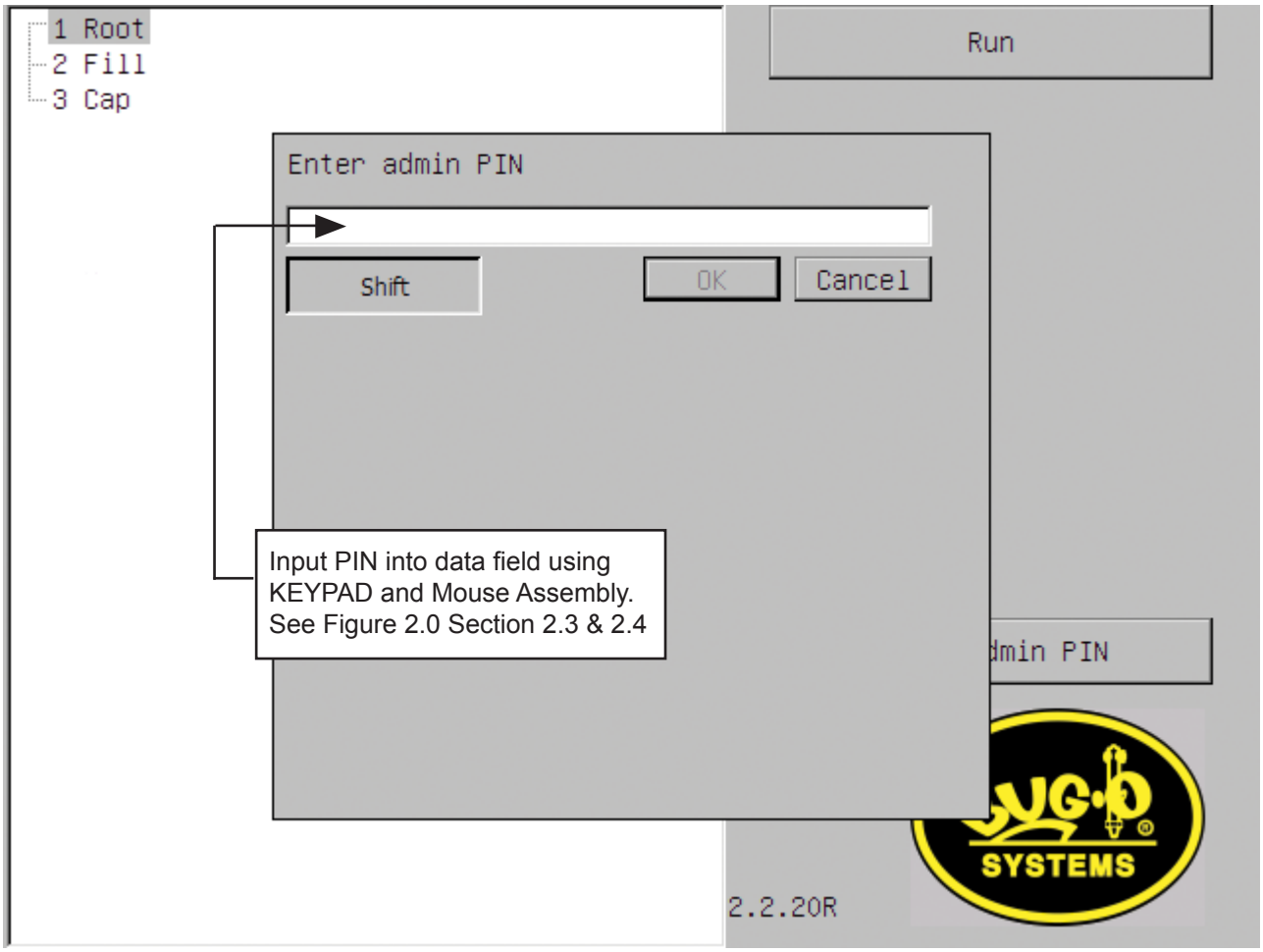


Figure 3.3 – Enter admin PIN

3.4 **Software version** – It may be necessary to have this number available if calling the factory for service support.

3.5 **Connection Indicator** – This square is green when the power source is connected, black when it hasn't made contact or has lost contact, and blinks between black and green when it has made contact but hasn't yet finished establishing the connection. When green, the machine is ready to enter the "Run" screen.

3.6 **Power Source Filter** – This dropdown allows for the passes displayed to be filtered according to power source type. This is helpful if you have passes for more than one power source on your machine, and don't want to see any that can't be used with your power source.

SECTION 3.1.0 DISPLAY SCREEN - MAIN SCREEN - ADMIN. FUNCTION ACTIVE

The system allows managers and engineers to have total control over the system and how it is used. They have the option to set up the structure of the configurations, making it possible to have one configuration set for all of the machines worldwide. It is also possible to have a separate configuration for every machine. Users can be given enough control to adjust all welding parameters, or have nothing available to them except for start, stop and steering.

To enter administration mode, click on “Enter Admin PIN” and enter the pin number or password and press Enter (See SECTION 3.3). This will reveal the hidden administrator buttons.

The default PIN number is 123.

This screen is displayed once the Admin Function has been enabled.

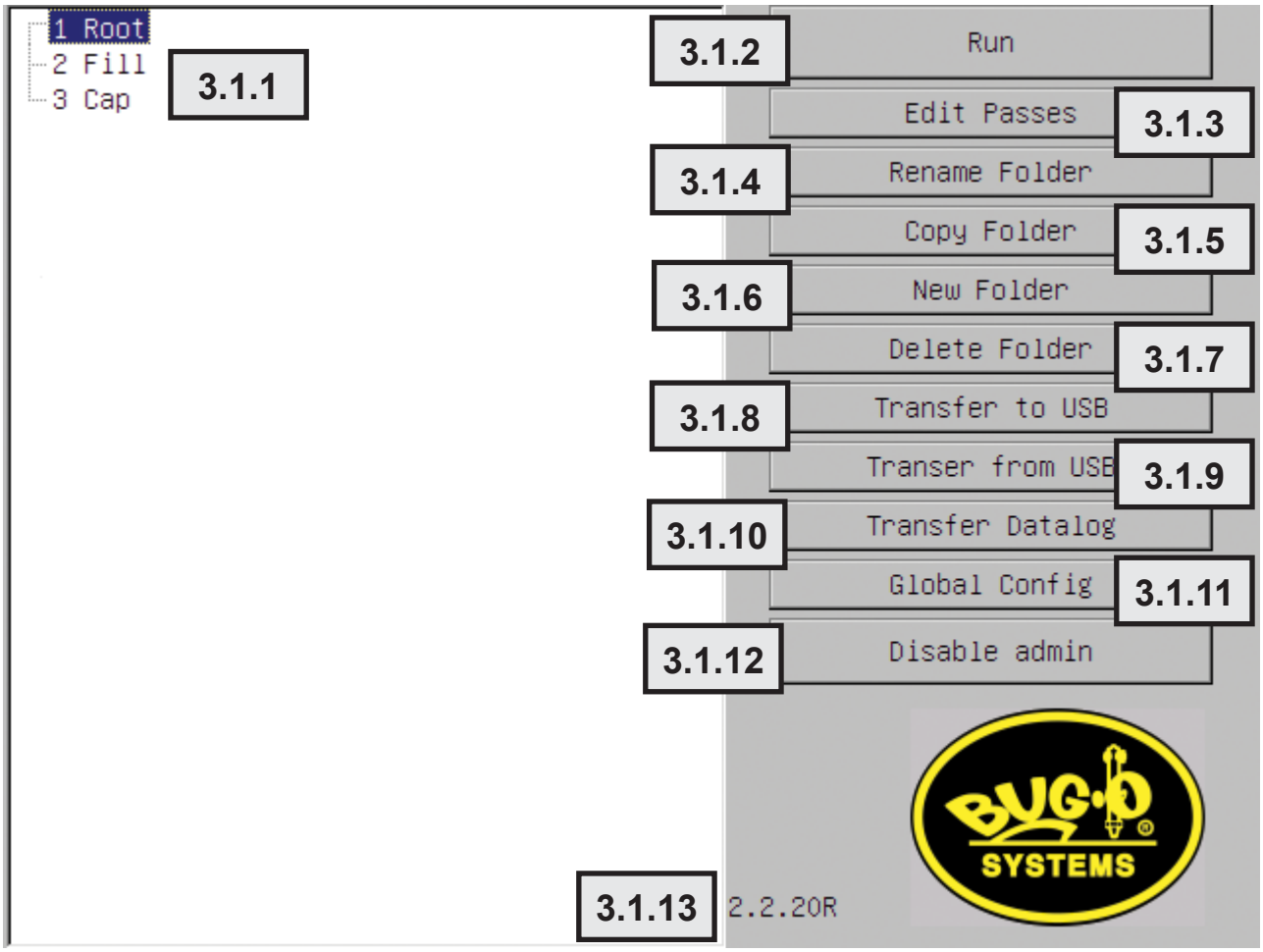


Figure 3.1.1 – Main Screen – Admin Function Active

3.1.1 **DISPLAY** – This area displays a list of all folders available within the machine. Use the MOUSE (See 2.4) to move the cursor over the required folder. Highlight selection by clicking the Left Mouse button.

3.1.2 **Run** – Clicking on this button will put the machine in RUN MODE. It will load the folder highlighted in the DISPLAY (See SECTION 3.1.1). The screen will change to the RUN screen as shown in SECTION 4.0. ***PLEASE NOTE:*** *The system is not capable of any motion, jog or automatic, unless it is in RUN MODE.*

SECTION 3.1.0 DISPLAY SCREEN - MAIN SCREEN - ADMIN. FUNCTION ACTIVE

3.1.3 Edit Passes – Clicking on this button allows the operator to modify data stored within the folder highlighted in the DISPLAY (See SECTION 3.1.1). The screen below will appear. See SECTION 9.0 for details regarding editing of data.

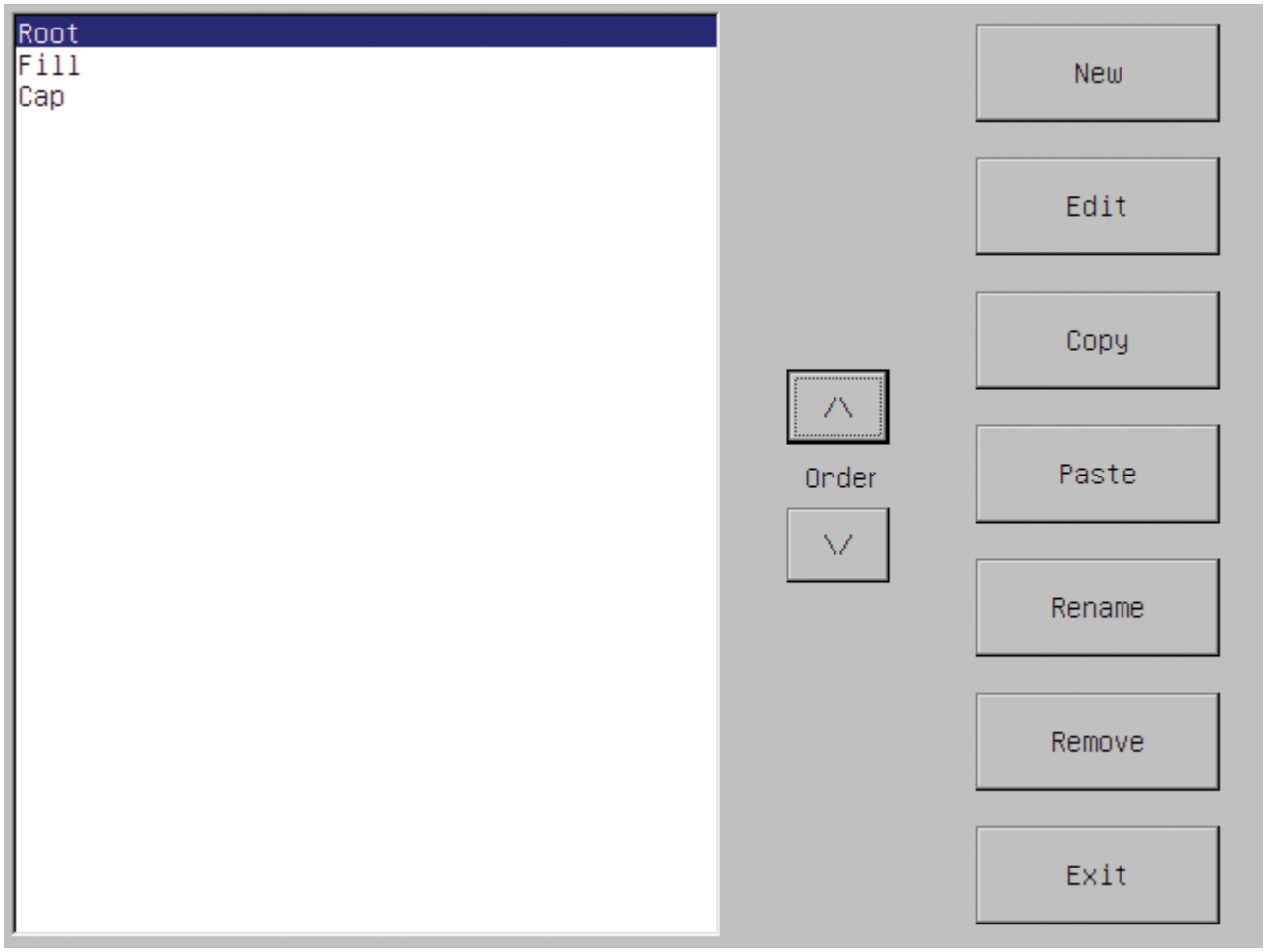


Figure 3.1.3 – Edit Passes Screen

3.1.4 Rename Folder – Clicking on this button allows the operator to change the name associated with the highlighted folder. The screen below will appear. (See Figure 3.1.4) Enter the new name of the folder using the MOUSE (See 2.4) by hovering the cursor over the desired letter and clicking on the LEFT mouse button. The SHIFT button can be used for capital letters. Once the name is displayed in the text box, click on OK using the LEFT mouse button. The folder, with the new name, will appear in the DISPLAY (See 3.1.1).

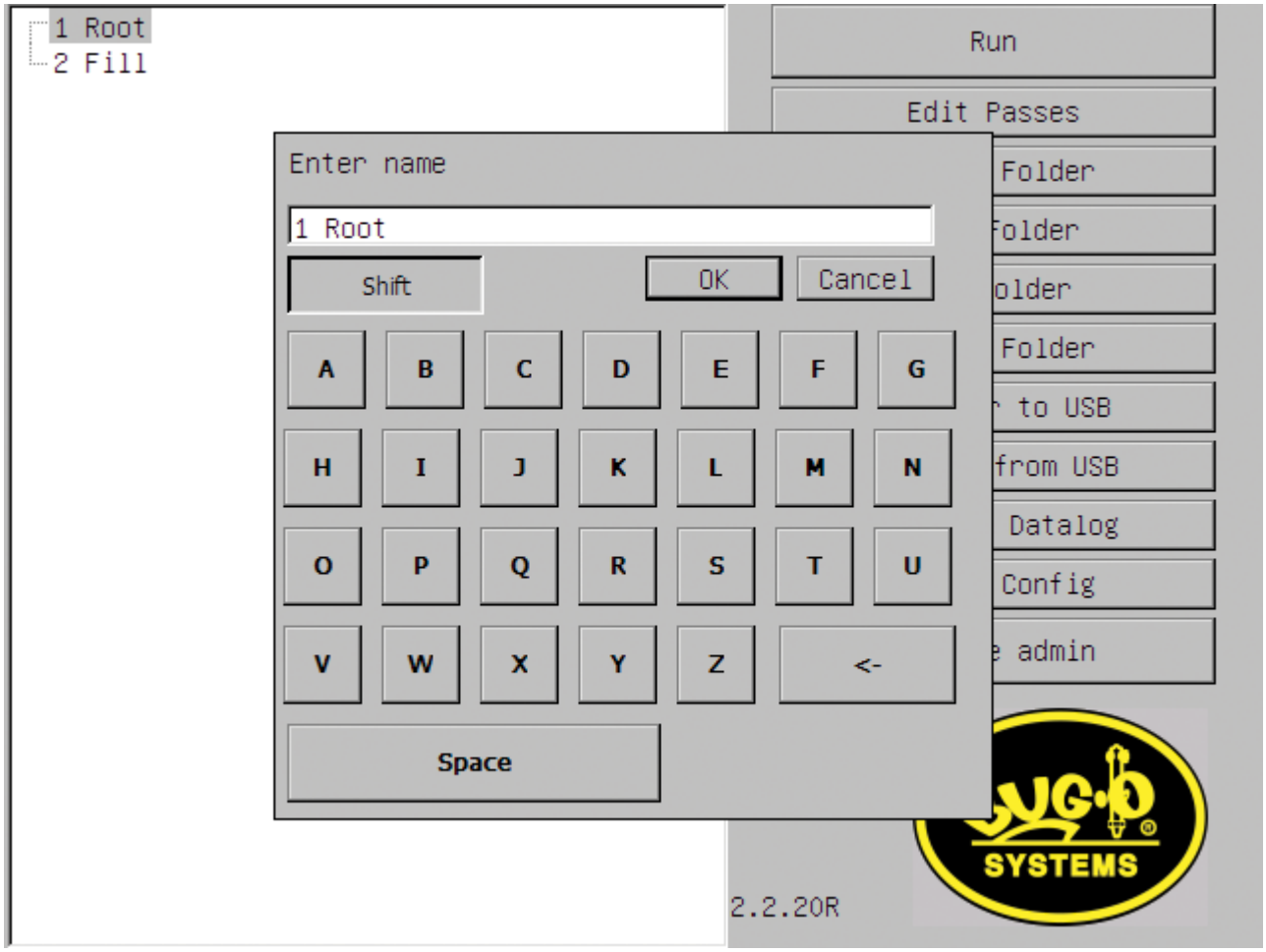


Figure 3.1.4 – Rename / Copy Passes Screen

3.1.5 Copy Folder – Clicking on this button allows the operator to copy all of the data contained within a particular folder to a new folder. The screen shown in Figure 3.1.4 will appear. The highlighted folder from the DISPLAY (See 3.1.1) will be displayed in the text box. Enter the name of the new folder using the MOUSE (See 2.4) by hovering the cursor over the desired letter and clicking on the LEFT mouse button. The SHIFT button can be used for capital letters. Once the name is displayed in the text box, click on OK using the LEFT mouse button. The new folder name will appear in the DISPLAY (See 3.1.1).

3.1.6 New Folder – Clicking on this button allows the operator to create an entirely new folder. The screen shown in Figure 3.1.4 will appear. Enter the name of the new folder using the MOUSE (See 2.4) and then click on OK using the LEFT mouse button. The new folder name will appear in the DISPLAY (See 3.1.1).

3.1.7 Delete Folder – By clicking on this button the operator can delete the highlighted folder. A window will open to confirm that the operator does indeed intend to delete the selected folder.

SECTION 3.1.0 DISPLAY SCREEN - MAIN SCREEN - ADMIN. FUNCTION ACTIVE

3.1.8 Transfer to USB – This allows data to be transferred from the Control Box to a USB drive. This data can then be loaded onto another system, saved on a PC or emailed anywhere it is needed. When this button is clicked, a screen similar to the one in Figure 3.1.4 is displayed. Enter the name of the new folder using the MOUSE (See 2.4) by hovering the cursor over the desired letter and clicking on the LEFT mouse button. The SHIFT button can be used for capital letters. Once the name is displayed in the text box, click on OK using the LEFT mouse button. Once OK is clicked, the screen will remain for a short time while the data is written to the USB drive. Once the data is written, the screen will disappear.

3.1.9 Transfer from USB – This function allows data stored in a PC or on a USB drive to be transferred to the Control Box. This data must be from a similar system. Passes from a Piper-Bug or passes containing unlicensed or unavailable functionality may not work properly, may not allow entering the run screen, and may not be transferrable. A USB Drive that contains a file folder with the necessary data must be plugged into the USB port (See Page 60, 61 – Item 32) When this button is clicked, the screen shown in Figure 3.1.9 appears. You have two choices: Merge or Replace.

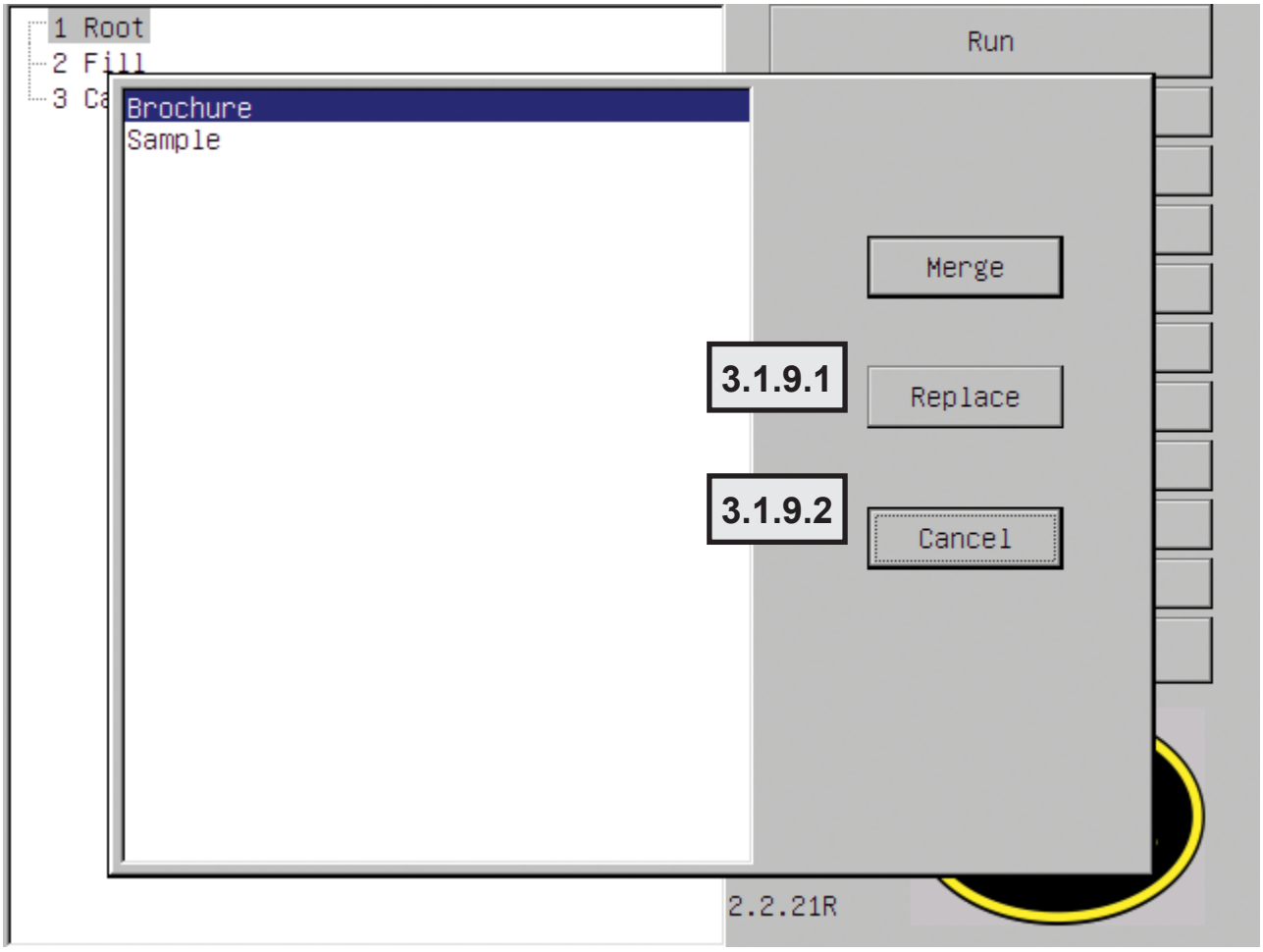


Figure 3.1.9 – Transfer from USB Screen

3.1.9.1 Merge – If this option is selected, the data on the USB Drive will be merged together with the data already in the Control Box. After clicking the Merge button on the screen shown in Figure 3.1.9, the screen in Figure 3.1.9.1 will appear which explains what will happen with the transferred data. Clicking Yes will cause the data to be transferred.

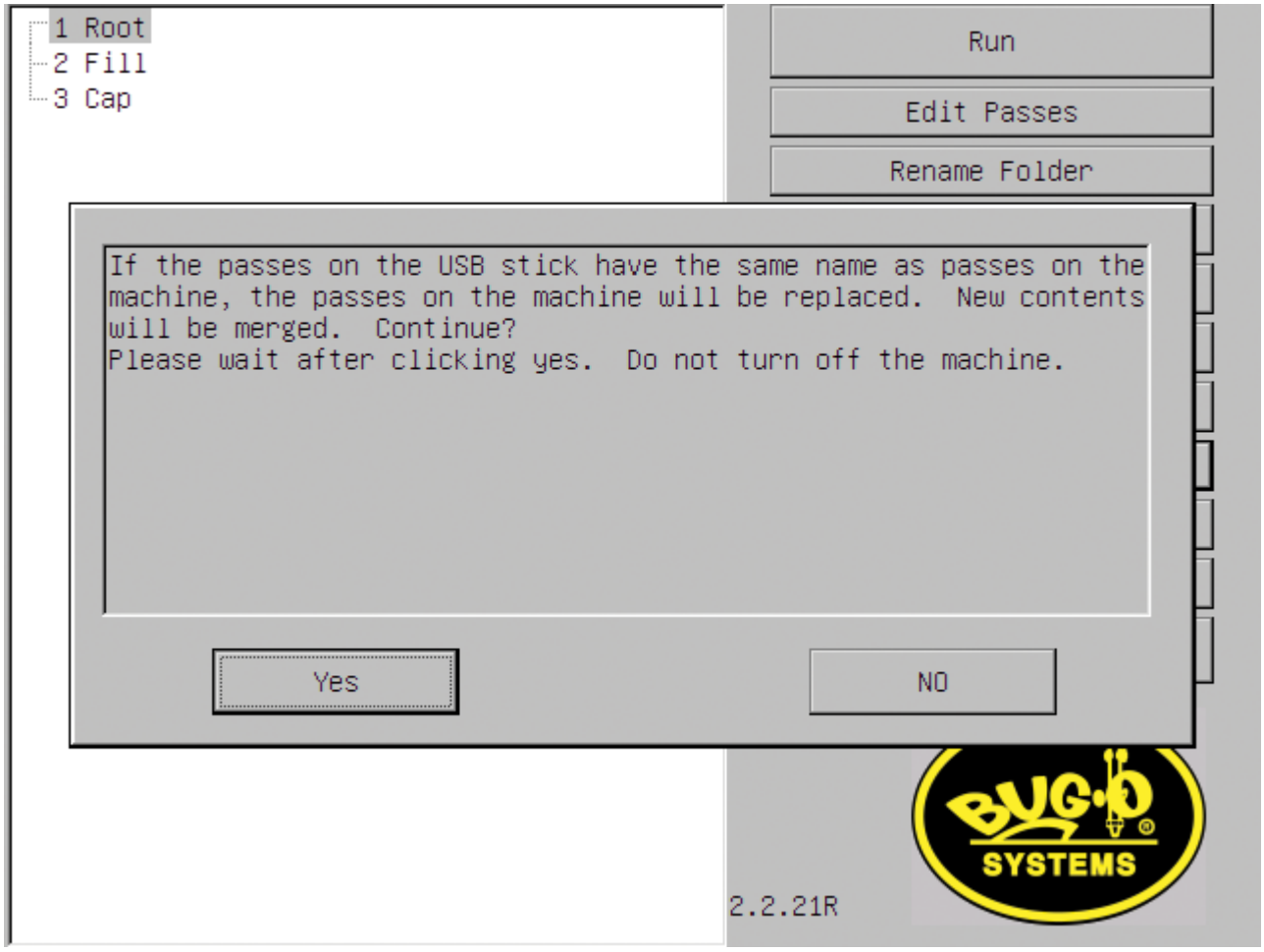


Figure 3.1.9.1 – Transfer Merge USB Screen

3.1.9.2 Replace – If this option is selected, the data on the USB Drive will replace all of the information presently stored in the Control Box. After clicking the Replace button on the screen shown in Figure 3.1.9, the screen in Figure 3.1.9.2 will appear which explains what will happen with the transferred data. Clicking Yes will cause the data to be transferred.

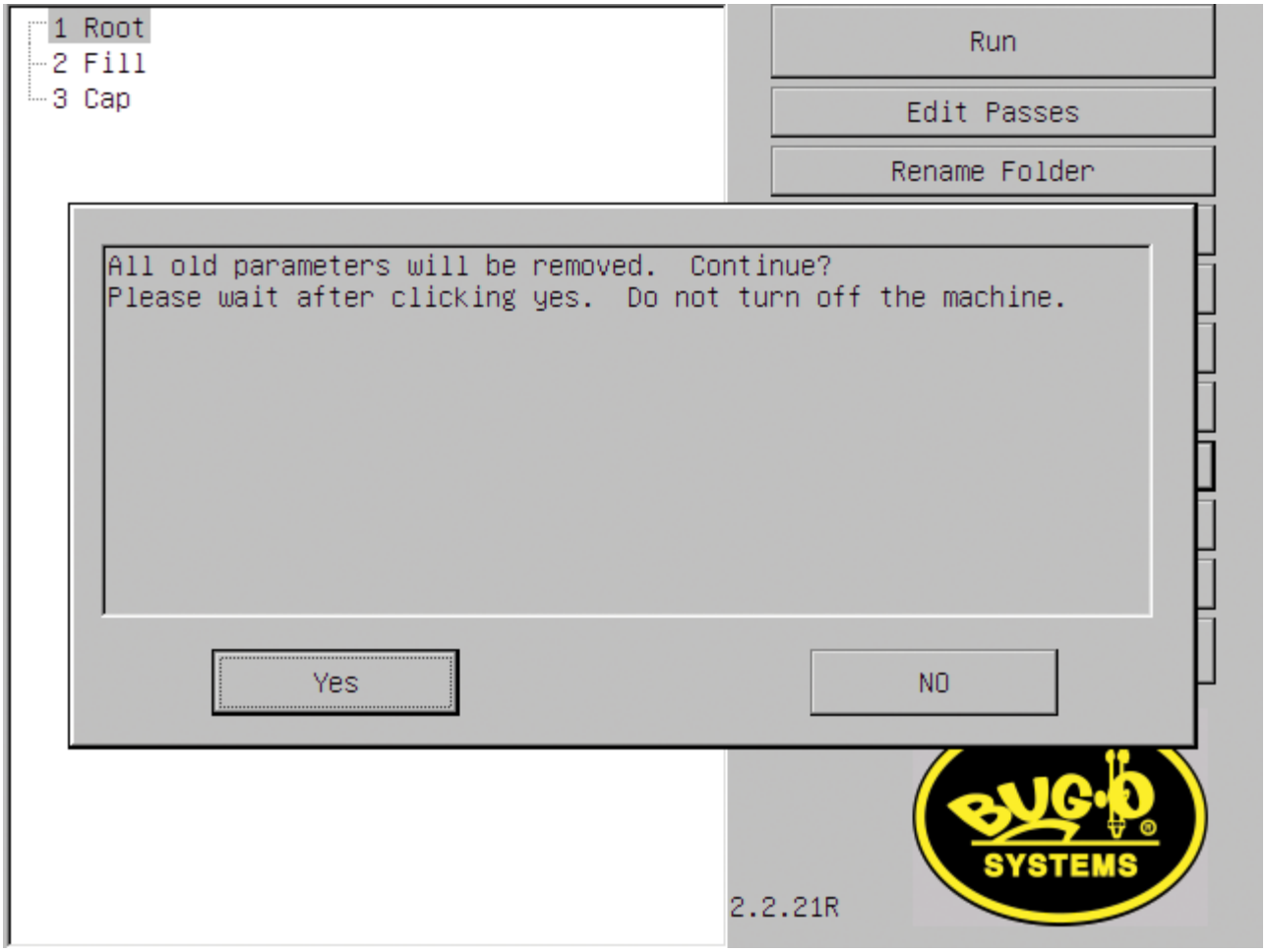


Figure 3.1.9.2– Transfer Replace USB Screen

3.1.10 Transfer Datalog – This function is only available in specific cases. Please contact Bug-O Systems factory for details.

3.1.11 Global Config – This button allow the Administrator to enter the Global Configuration Screen. See SECTION 7.

3.1.12 Disable Admin – Clicking this button turns off the Administration function and returns to the Main Screen. See Figure 3.1.

3.1.13 Software version – It may be necessary to have this number available if calling the factory for service support.

SECTION 4.0 RUN SCREEN

The run screen is displayed after clicking run. This screen displays information to the welder and allows selection of passes that are stored in the chosen folder. Adjustments can be made on both the pendant and the control box, if the pass configuration allows it.

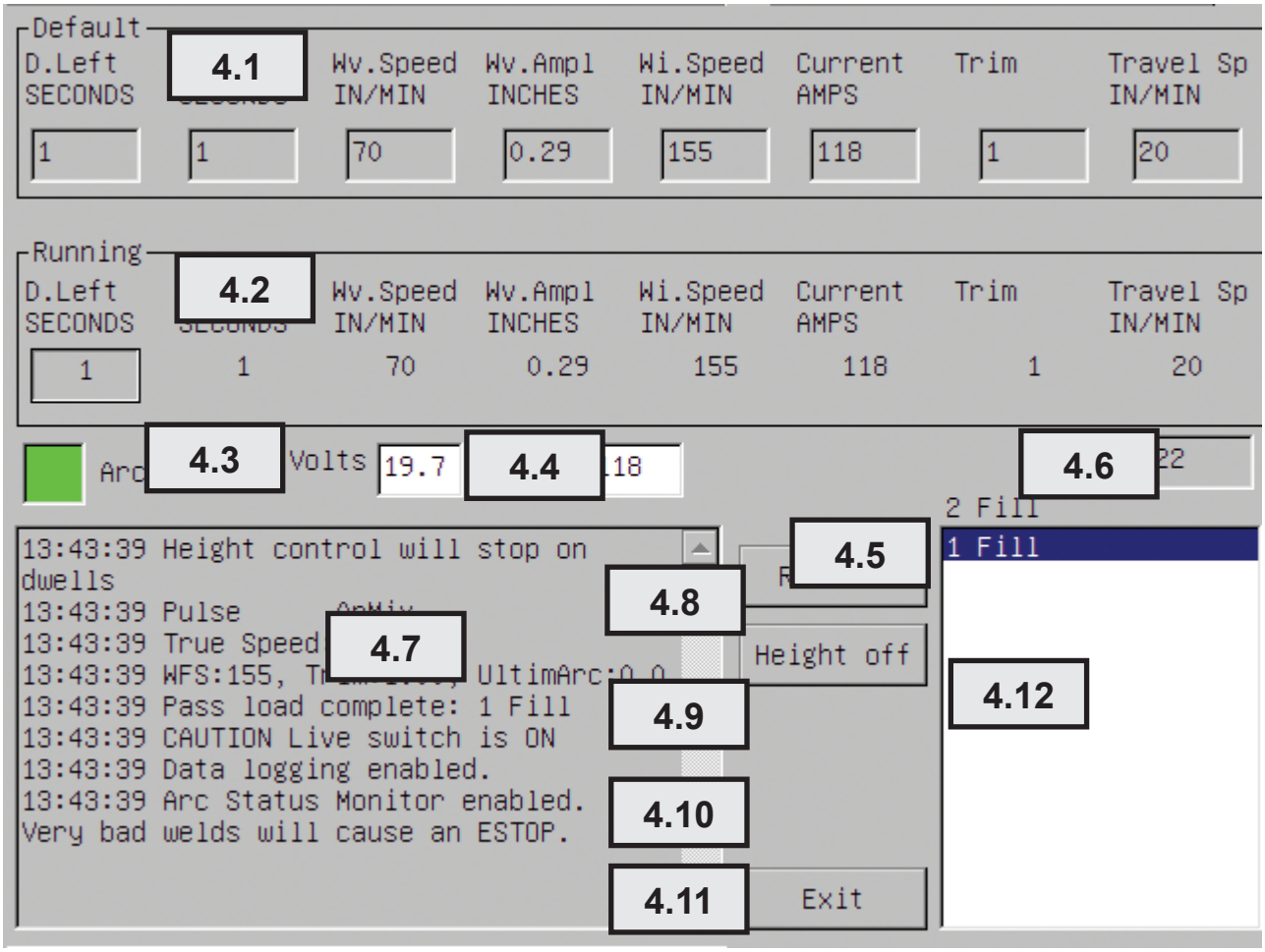


Figure 4.0– Run Screen

4.1 **Default** – This area of the Run Screen displays the programmed settings for this pass. This will display the original parameters loaded from the configuration file.

4.2 **Running** – This area of the Run Screen displays the actual settings that are running for this pass. These reflect the changes the user has made and are the parameters that the machine is using. The running values will be set to the default values when the pass is changed.

4.3 **Connection –** This box provides information regarding the status of the communication with the power source. The box displays Green while connected and all functions are correct. While connecting, the box will flash between black and green. This would occur if the welding power source were to lose power while in the Run Mode. If this occurs, it is necessary to wait until the box is Green before proceeding.

4.4 **Volts Amps** – When the system is idle, these boxes display the Volts and Amps that were sensed at the end of the last weld. When the system is active, these boxes will grow very large during the weld to make them easier to read.

SECTION 4.0 RUN SCREEN

4.5 **Folder** – The name of the current folder that was selected from the Main Screen is displayed here. See Figure 3.1.

4.6 **Mode** – This box displays the Welding Mode selected in the Lincoln Electric Power Wave® Power Source.

4.7 **Status** – This box displays important events, errors and machine status. Any time a new pass is loaded the full set of ArcLink® parameters for the given pass are displayed. ***If the system stops unexpectedly, it is critical to check for any error messages that may be displayed in this Status Box.***

4.8 **Reverse** – Clicking this button will cause the system to operate in Reverse. This function can only be changed when the machine is idle. Initiating this function will reload the default parameters for the selected pass. This function also reverses the steering direction so you will not have to turn the steering knob backwards. This function is particularly useful when two tractors are operating on the same ring rail, each welding one side of a pipe joint. When this function is active the box will be surrounded by a red outline. When this function is turned off, no red outline will appear.

4.9 **Height off** – Clicking this button will cause the Automatic Height Control to no longer be active. This can only be changed when the machine is idle. If this function has been activated, the Automatic Height Control will not adjust the welding gun position with respect to the work piece surface. As a result, if the gun position is not monitored and adjusted by the operator, faulty welds or damage to the system could occur. When this function is active the box will be surrounded by a red outline. When this function is turned off, no red outline will appear.

4.10 **Save As** – This button is only visible if you run while logged in as an admin (See SECTION 3.3). This function allows the Administrator to save welding parameter data that has been modified during the welding operation. After a weld pass has been completed and the Administrator would like to save the pass with the changes that have been made, this button can be clicked. A text box will appear similar to that displayed in Figure 3.1.4. The Administrator will be asked to input the name for the new welding pass. Upon clicking OK the newly named pass will be added to the display in the Pass Selection Box (See SECTION 4.12) The new pass will be saved with the modified welding parameters but it will use the same startup/crater/adjustment limit values of the pass being copied.

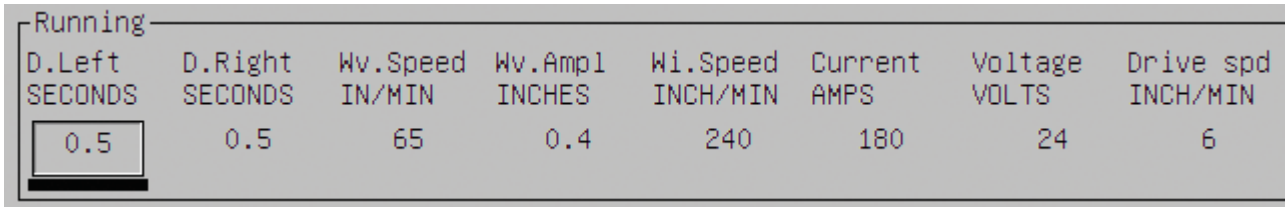
4.11 **Exit** – Clicking on this button returns the system to the Main Screen (See SECTION 3.0).

4.12 **Pass Selection** – This box displays the individual passes that are stored within the folder selected. The pass that is active is highlighted. Selecting a new pass will load all of the default parameters for that pass. Loading of a new pass can be accomplished by using the MOUSE (See SECTION 2.4) to move the cursor over the required pass and then clicking the LEFT Mouse button. You can also toggle from pass to pass by pressing the Pass Select Button on the Full Function Operator Pendant (See SECTION 5.2.A). Changing of the pass can be done while the system is in operation. Be cautious if this is to be attempted as all welding parameters will change immediately.

SECTION 4.1 RUN SCREEN - ADJUSTING PARAMETERS

Depending on the configuration, it may be possible to make adjustments to the machine's welding parameters. Adjustments can be made on both the pendant and the control box. These adjustments are limited by the configuration. It is not possible to make adjustments beyond the set limits.

4.1.1 Using the Run screen – By pressing the left and right arrow keys on the keypad you can select a parameter. Pressing the center "0" button on the keypad will cause the selected parameter to become active. The active parameter will be underlined to show it is active. Pressing left or right will adjust the parameters up or down if possible. Pressing the center button again will allow the arrows to switch between parameters again. This allows a manager or assistant to make adjustments within the bounds of the parameters, even if the operator has a limited function pendant. These changes are shown on the display of the full function pendant.



4.1.2 Using the pendant – Press the switches up and down to change the associated values. Each press will adjust the parameters by a set amount. The first time a switch is pressed it will display the current value on the pendant. The next time the switch is pressed it will adjust the value up or down. You will not be able to make adjustments during the startup and shutdown procedures (See SECTION 5.0).

SECTION 5.0 PENDANT OPERATIONS

Two pendants are available: A Full Function pendant with a display screen, and a smaller Limited Function pendant. Both pendants are limited by the settings of the current pass. The larger pendant does not unlock any hidden functions. If an operator is using the limited pendant, adjustment of parameters can still be done at the Control Box; if the pass configuration being run allows these changes. (See SECTION 4.1.1)

5.1 Limited Function Pendant – (*Figure 5.1.)* The pendant is used to control the machine. It can also be used to make adjustments while the machine is idle or welding. It cannot make adjustments while the machine is starting up or stopping. The top four switches move the machine while it is idle. The lower four switches will allow the user to adjust parameters, bound by the limits in the configuration of the pass. The first time an adjustment switch is pressed it will display the current value of that parameter on the display. Each press after that will adjust the value of the parameter, if the pass settings allow it. If an operator is using the limited pendant, they can still adjust parameters at the control box if the pass they are running allows it.

5.1.A **Height Jog** – Activating this switch moves the height axis up and down while the machine is idle. If the Automatic Height Control is disabled it will allow you to adjust the height while welding. Pushing this switch toward the top of the pendant causes the height slide to move away from the work piece. Pushing this switch toward the bottom of the pendant causes the height slide to move toward the work piece.

5.1.B **Wire Jog** – Activating this switch jogs the welding wire up or down while idle. Pushing this switch toward the top of the pendant causes the welding wire to move away from the work piece. Pushing this switch toward the bottom of the pendant causes the welding wire to toward the work piece.

5.1.C **Weave Jog** – Activating this switch in either direction will cause the weaver to oscillate. Releasing it will make it center. (You can use this switch along with the Tractor Jog (See 5.1.D) switch to see how the motion will look without welding.)

5.1.D **Tractor Jog** – Activating this switch causes the tractor to travel forward or backward. Normally it will be set up to move faster in reverse. (See SECTION 7.0 – Global Configuration) (The tractor will move forward at the welding speed for 5 seconds, then switch into a high speed mode.)

5.1.E **Current** – Adjusts the target current. Pushing this switch toward the top of the pendant causes the current value to increase. Pushing this switch toward the bottom of the pendant causes the current value to decrease. This will have no effect if the height control is disabled.

5.1.F **Wire Feed Speed** – Adjusts the wire feed speed. Pushing this switch toward the top of the pendant causes the Wire Feed Speed to increase. Pushing this switch toward the bottom of the pendant causes the Wire Feed Speed to decrease.

5.1.G **Weave Width** – Adjusts the weave amplitude. Pushing this switch toward the top of the pendant causes the weave amplitude to increase. Pushing this switch toward the bottom of the pendant causes the weave amplitude to decrease.

5.1.H **Tractor Travel Speed** – Adjusts the tractor travel speed. Pushing this switch toward the top of the pendant causes the tractor travel speed to increase. Pushing this switch toward the bottom of the pendant causes the tractor travel speed to decrease.

SECTION 5.0 PENDANT OPERATIONS, CONT'D.

5.1.I **START** – Starts the welding process. All other switches must be released. If the Hot/Cold switch on the front of the control box is in the upper position (Hot) the machine will weld. If the Hot/Cold switch is in the bottom position (Cold) it will dry run, operating only the tractor drive and the weaver.

5.1.J **STOP** – Stops the machine normally, making it go through the crater process. If it is pressed during startup or crater it will cause a quick stop. Pressing it two times quickly will cause this to happen. If it is held while the machine is idle it will cause the gas to purge.

5.1.K **Quick stop** – This will immediately turn off the welding arc and stop all the motors.

5.1.L **Steering** – Steers the torch left and right.

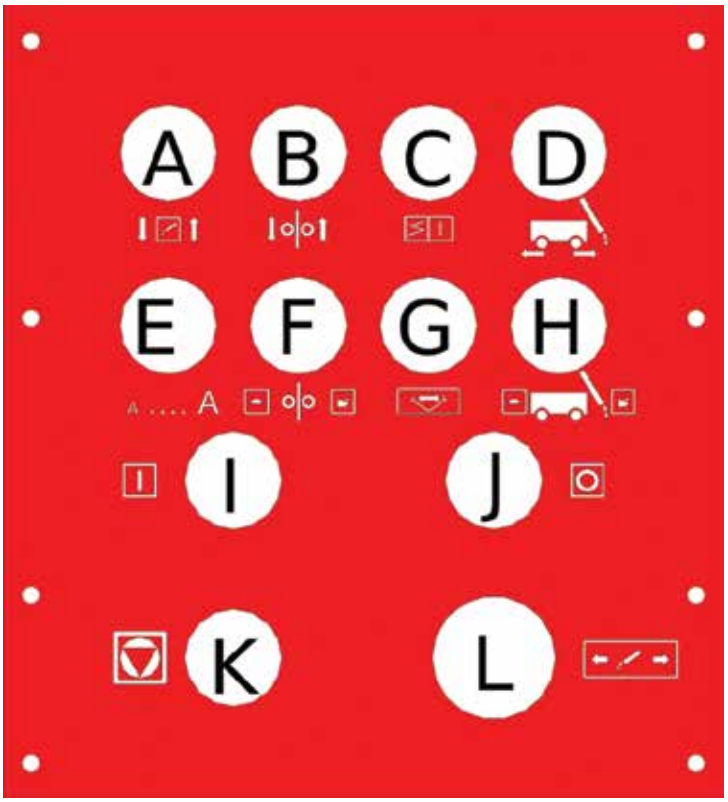


Figure 5.1

SECTION 5.0 PENDANT OPERATIONS, CONT'D.

5.2 Full Function Pendant – (*Figure 5.2)* The Full Function pendant is equipped with a small LCD screen that provides information to the operator such as the pass being run and the specific welding data being modified. The pendant is used to control the machine. It can also be used to make adjustments while the machine is idle or welding. It cannot make adjustments while the machine is starting up or stopping. The top four switches move the machine while it is idle. The lower eight switches will allow the user to adjust parameters, bound by the limits in the configuration of the pass. The first time an adjustment switch is pressed it will display the current value of that parameter on the display. Each press after that will adjust the value of the parameter, if the pass settings allow it. If an operator is using the limited pendant, they can still adjust parameters at the control box if the pass they are running allows it.

5.2.A Pass Select – Pressing this switch allows the operator to toggle through all of the passes within the selected folder.

5.2.B Height Jog – Activating this switch moves the height axis up and down while the machine is idle. If the Automatic Height Control is disabled it will allow you to adjust the height while welding. Pushing this switch toward the top of the pendant causes the height slide to move away from the work piece. Pushing this switch toward the bottom of the pendant causes the height slide to move toward the work piece.

5.2.C Wire Jog – Activating this switch jogs the welding wire up or down while idle. Pushing this switch toward the top of the pendant causes the welding wire to move away from the work piece. Pushing this switch toward the bottom of the pendant causes the welding wire to toward the work piece.

5.2.D Weave Jog – Activating this switch in either direction will cause the weaver to oscillate. Releasing it will make it center. (You can use this switch along with the Tractor Jog (See 5.1.D) switch to see how the motion will look without welding.)

5.2.E Tractor Jog – Activating this switch causes the tractor to travel forward or backward. Normally it will be setup to move faster in reverse. (See SECTION 7.0 Global Configuration) (The tractor will move forward at the welding speed for 5 seconds, then switch into a high speed mode.)

5.2.F Current – Adjusts the target current. Pushing this switch toward the top of the pendant causes the current value to increase. Pushing this switch toward the bottom of the pendant causes the current value to decrease. This will have no effect if the height control is disabled.

5.2.G Wire Feed Speed – Adjusts the wire feed speed. Pushing this switch toward the top of the pendant causes the Wire Feed Speed to increase. Pushing this switch toward the bottom of the pendant causes the Wire Feed Speed to decrease.

5.2.H Voltage – Adjusts the welding voltage. Pushing this switch toward the top of the pendant causes the voltage to increase. Pushing this switch toward the bottom of the pendant causes the voltage to decrease.

5.2.I Tractor Travel Speed – Adjusts the tractor travel speed. Pushing this switch toward the top of the pendant causes the tractor travel speed to increase. Pushing this switch toward the bottom of the pendant causes the tractor travel speed to decrease.

5.2.J Dwell Left – Adjusts the weave dwell time on the left side of the weave motion. Pushing this switch toward the top of the pendant causes the dwell time to increase. Pushing this switch toward the bottom of the pendant causes the dwell time to decrease.

5.2.K Dwell Right – Adjusts the weave dwell time on the right side of the weave motion. Pushing this switch toward the top of the pendant causes the dwell time to increase. Pushing this switch toward the bottom of the pendant causes the dwell time to decrease.

SECTION 5.0 PENDANT OPERATIONS, CONT'D.

5.2.L **Weave Width** – Adjusts the weave amplitude. Pushing this switch toward the top of the pendant causes the weave amplitude to increase. Pushing this switch toward the bottom of the pendant causes the weave amplitude to decrease.

5.2.M **Weave Speed** – Adjusts the weave motion speed. Pushing this switch toward the top of the pendant causes the weave motion speed to increase. Pushing this switch toward the bottom of the pendant causes the weave motion speed to decrease.

5.2.N **START** – Starts the welding process. All other switches must be released. If the Hot/Cold switch on the front of the control box is in the upper position (Hot) the machine will weld. If the Hot/Cold switch is in the bottom position (Cold) it will dry run, operating only the tractor drive and the weaver.

5.2.O **STOP** – Stops the machine normally, making it go through the crater process. If it is pressed during startup or crater it will cause a quick stop. Pressing it two times quickly will cause this to happen. If it is held while the machine is idle it will cause the gas to purge.

5.2.P **Quick stop** – This will immediately turn off the welding arc and stop all the motors.

5.2.Q **Steering** – Steers the torch left and right.

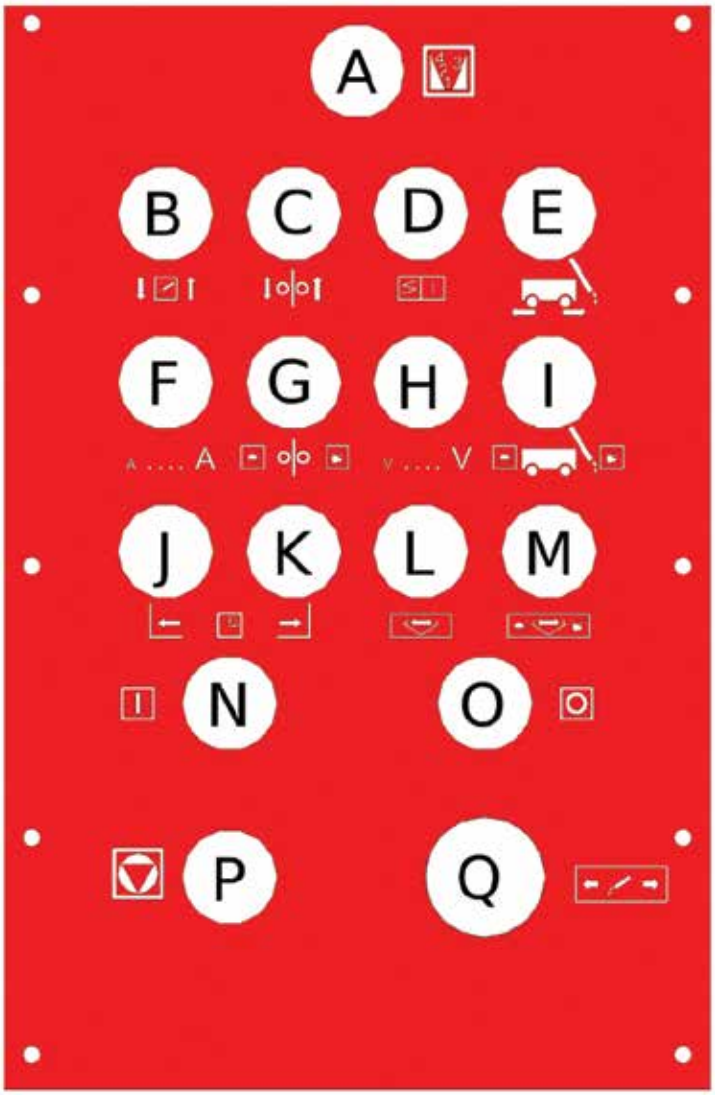


Figure 5.2

SECTION 6.0 WELDING OPERATION

Prior to welding, the operator can position the machine and make adjustments if the pass parameters allow it. The top row of switches is for positioning only. They do not have any function while the machine is welding. The operator should position the torch using the adjustment switches and steering. The operator can hold the oscillate switch to ensure it is in the proper place. If the programmed pass is properly set up, they should not have to make many adjustments.

The machine must be stationary with no switches being held down before welding can begin. The Live switch on the control box must be set to “Hot” or the machine will only dry run. When the start button is pressed, the buttons on the control box display will be disabled, preventing direction changes, height control settings, or pass selection. The adjustment controls on the pendant will also be disabled. Pressing stop before the startup procedure is complete will cause an emergency stop.

The machine will check that the motors are all running and ready and that water is flowing (if a water cooler is in use) before it will begin the welding startup procedures. It will pre-purge for the time specified in pass settings and check that there is proper gas flow. It will then turn on the welding contacts and run the wire in at its specified run in speed. It will continue at the run in speed until it detects an arc. If it does not detect any current in about half of a second, the machine will stop and display a notice in the status window.

When an arc is detected all of the startup parameters and timers will begin. All of the timers, such as the weave delay and startup time, are independent and can be configured to occur in any order. The machine is considered to be in the Welding state after the startup timer defined in the weld settings has finished, even if the machine is not weaving or moving. The user can make adjustments to the parameters while the machine is welding. It will continue welding until the Stop button is pressed.

When Stop is pressed, the weaver and main drive will both stop. The weaver will center itself. The wire speed, current, and voltage will all change to their Crater values. The machine will continue welding in place at these settings until the crater timer finishes. It will then stop the wire feeder and height axis, burn back for the specified time, turn off the arc, and raise the height axis a small distance to keep the wire from getting caught in the weld crater puddle if the machine is driven back to the bottom of the pipe. Welding is now complete and the machine is Idle again.

Arc Status Detection is a new feature in the Piper-Plus. The Piper-Plus knows exactly when the arc is struck, and if the arc is having problems. If the power source reports that the arc is lost or unstable for over 150ms, the Piper-Plus will stop the weld before it has a chance of causing defects. This can be caused by welding with incorrect parameters, open roots with a gap too large for automation, loose welding cables, broken sense leads, etc.

SECTION 7.0 GLOBAL CONFIGURATION

The global configuration screen contains settings for the calibration of the travel speed and options that affect the entire system. It allows you to set the language, administrator PIN number, default units, minimum gas flow, IP addresses, auto reverse, data logging and water cooler.

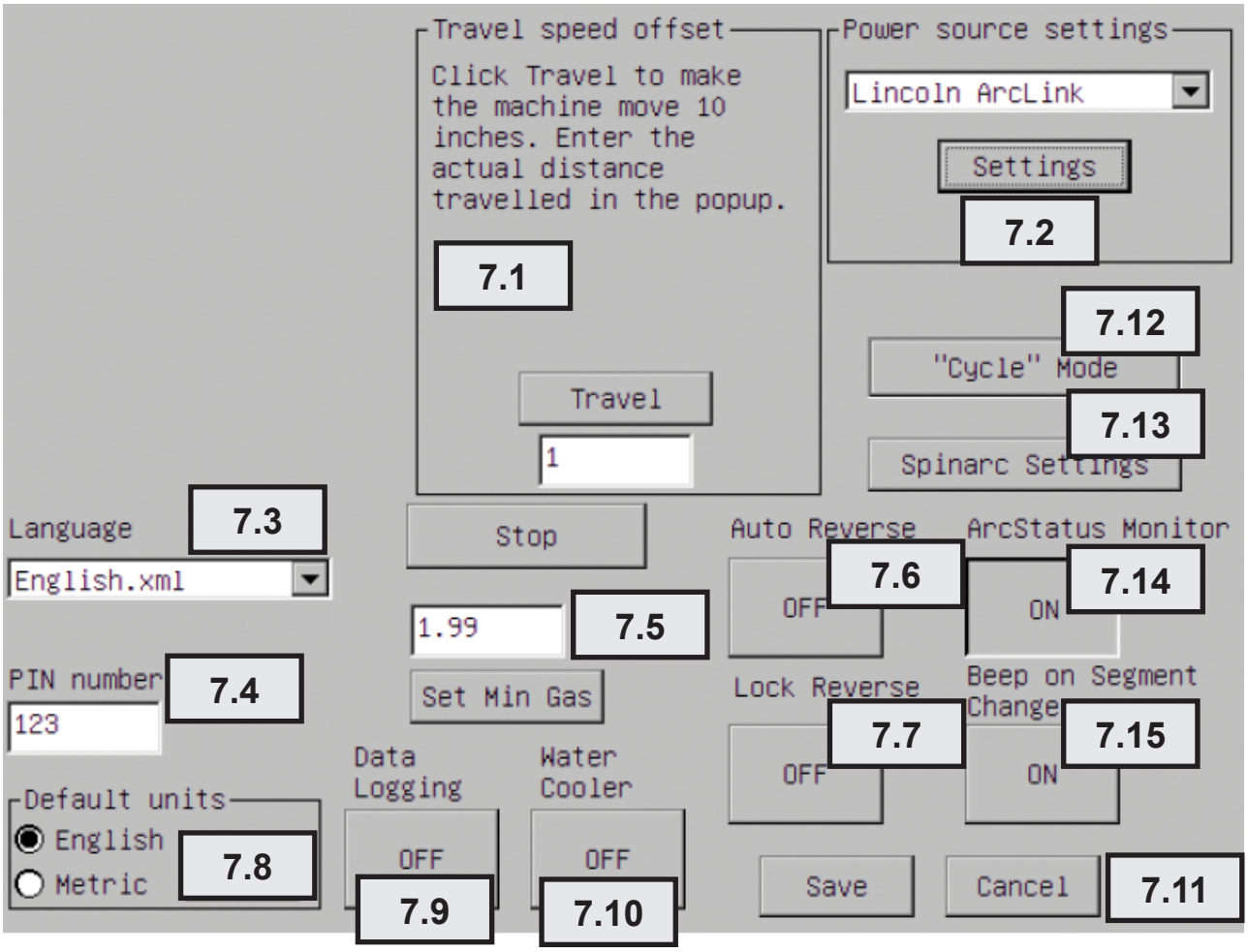
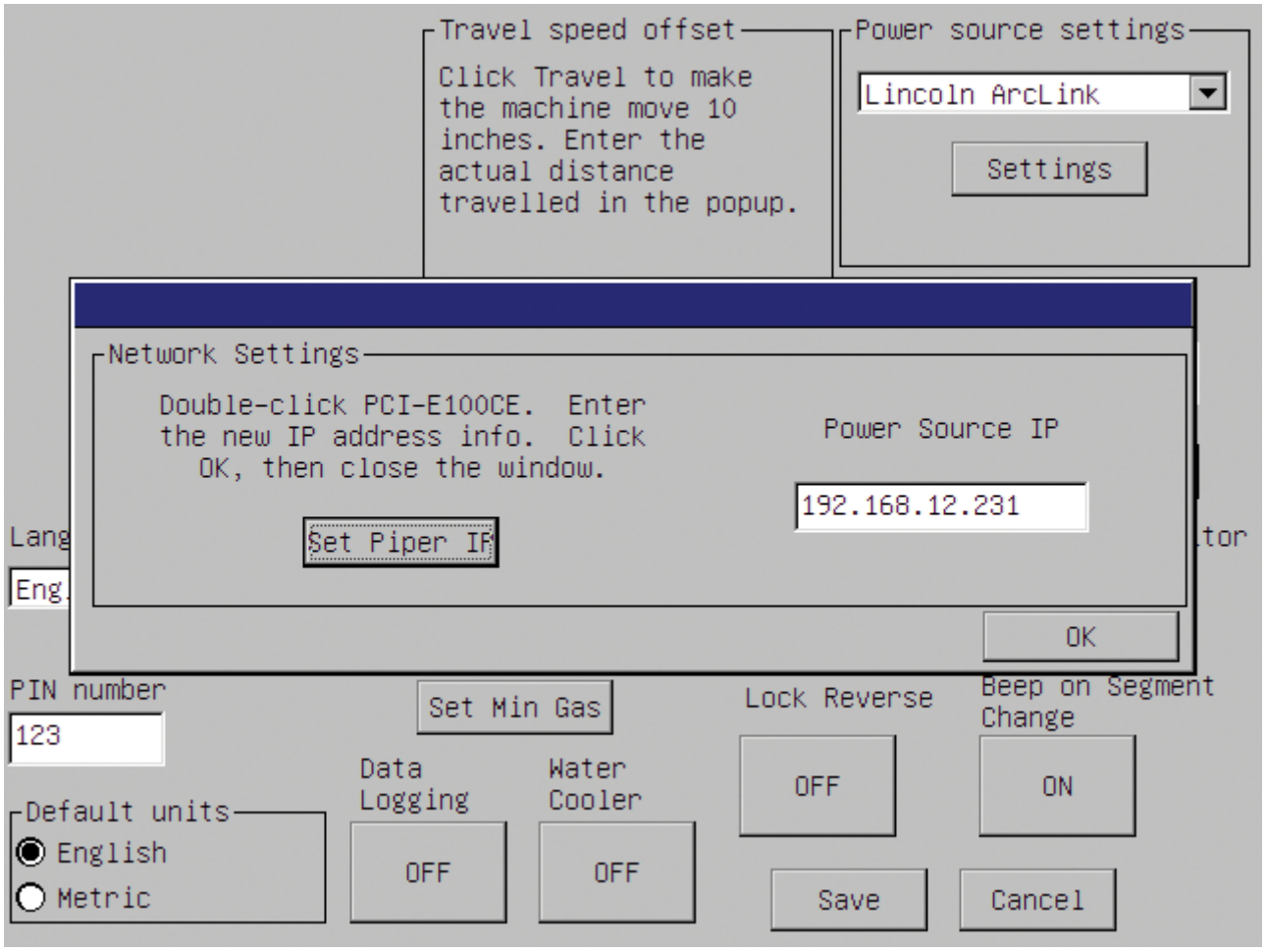


Figure 7.0

7.1 **Travel Speed Offset** – The travel speed offset should be set up before welding with the machine. This involves the drive moving a set distance. Follow the onscreen guides to calculate the offsets. Mark the initial position of the tractor on the pipe. Click Travel. Wait for the machine to stop moving. Enter the distance traveled (in inches) into the popup prompt. The stop button below this box will stop the drive if necessary. The calibration is always performed in inches.

7.2 **Power Source Settings** – Launches the Power Source Settings dialogue. See Section 8.0 - Networking for details.

SECTION 7.0 GLOBAL CONFIGURATION, CONT'D.



7.3 **Language** – The text displayed within each of the screens of the Piper Plus is based on standard .xml files. It is possible to modify these files so the screens display text in most standard script languages. Contact Bug-O Systems factory for details.

7.4 **PIN Number** – The PIN number can be a maximum of five digits. Only the numbers 0 - 9 are allowed. If you forget the PIN number, you will have to start the machine with a specially prepared USB stick that unlocks a special setup and programming menu and delete your global configuration settings. You will have to recalibrate the machine. ***Bug-O Systems recommends for users to make record of their PIN Number in a secure location.***

7.5 **Set Min Gas** – By setting the minimum acceptable gas flow, the machine can initiate a stop if the gas flow drops below this set value, thus preventing a weld that would be unsatisfactory due to insufficient gas flow. This value is not in any specific units. It is simply an analog voltage from the gas flow sensor. To set this value, adjust your gas flow regulator to the desired minimum acceptable value, and then click Set Min Gas. The gas will purge for 10 seconds, giving you time to adjust the regulator. It will then sample values for five seconds. It will average the values and display the minimum value. Set your regulator back to its proper value. If the gas flow drops below this minimum level, the machine will display an error three times and then stop. This function can be disabled by setting this value to 0.

SECTION 7.0 GLOBAL CONFIGURATION, CONT'D.

7.6 **Auto Reverse** – This function allows the system to run in reverse every time the operator enters the Run screen. If the machine is always going to be run in reverse, you can enable Auto Reverse so you don't have to rely on the operator to click Reverse on the running screen. See SECTION 4.8 for details on the Reverse function.

7.7 **Lock Reverse** – This function locks the Reverse button on the Run screen. With this function active, the operator cannot change the operating direction.

7.8 **Default Units** – This function sets the units that are used when parameter data is stored in the system. This can also be selected for each individual pass during creation of the pass.

7.9 **Data Logging** – Data logging can be turned on and off. Data logging is included with the Piper-Plus.

7.10 **Water Cooler** – For the Piper Plus, the Water Cooling option should be left off. Monitoring of water flow is handled by the Lincoln Electric Power Wave® S350 and AutoDrive® 19. If you are using a water cooled torch, the water cooler must be on and the sensor connected to the Lincoln Electric AutoDrive® 19 to operate the feeder. If water flow is not detected, it will not be possible to weld. If water flow is lost during a weld, the weld will stop.

7.11 **Save/Cancel** – Any changes made within the Global Configuration Screen will only be applied to the system if the Save button is pressed. If Cancel is selected, the screen will revert to the Main Screen but no data will be saved.

7.12 **Cycle Mode** – When in cycle mode, instead of starting a pass normally, the start button will begin a sequence of: reversing rapidly to starting position if not already there; simulating a start button press to begin the pass normally (including the effect of the hot/cold switch); stopping after traversing half the pipe; repeating this sequence until the stop or E-Stop buttons are pressed.

7.13 **SpinArc Settings** – for configuration of SpinArc torches. See SpinArc Addendum if you've purchased a SpinArc torch for use with your Piper Plus.

7.14 **Arc Status Monitor** – Enables/disables whether the Arc Status Detection stops the machine on arc loss as described in Section 6.0.

7.15 **Beep on Segment Change** – Enables/disables aural notification of tilt segment changes. See Tilt Addendum if you've purchased a tilt sensor license for use with your Piper Plus.

SECTION 8.0 NETWORKING

Important Safety Info: If you are going to network systems together, it is absolutely critical that the IP addresses and subnet masks are configured properly. Improper configuration could lead to a machine controlling the wrong power source, potentially resulting in injury or death. Bug-O cannot assist you in networking a pipeline. Bug-O Systems cannot tell you what networking equipment to purchase, how to configure it, or how to run a Production Monitoring server. Bug-O Systems cannot be held responsible for issues caused by networking equipment. Bug-O Systems can only support connecting the control box directly to the power source with the default addresses. It is highly recommended that you do not make any network changes while any system on the network is running. You must carefully assess the risks, benefits, and technical challenges of networking multiple machines together.

If you purchased a complete system from Bug-O, the power source's address will already be configured. If you did not purchase a complete system, you must configure the power source according to the manufacturer's instructions.

It is possible to change the control box's IP address and the address of the power source it is supposed to control on the Global Config screen. To change the target power source address, simply enter the new address. To change the control box's address, click Set Piper IP, double click PCI-E100CE1, and then enter the new IP Address and subnet mask. Click OK, and then close the window. It is highly recommended that you carefully label the machines with their IP addresses. There is a crossover network cable adapter located inside the control box. To connect the control box to a switch, your switch must be smart enough to detect a crossover cable. Alternatively you can use another crossover adapter to convert the cable back into a normal cable.

Passes are xml files that store all the parameters for a pass. They are stored inside folders. They can be placed in any folder or subfolder, but not in the root (the main folder).

SECTION 9.0 CREATING AND EDITING PASSES

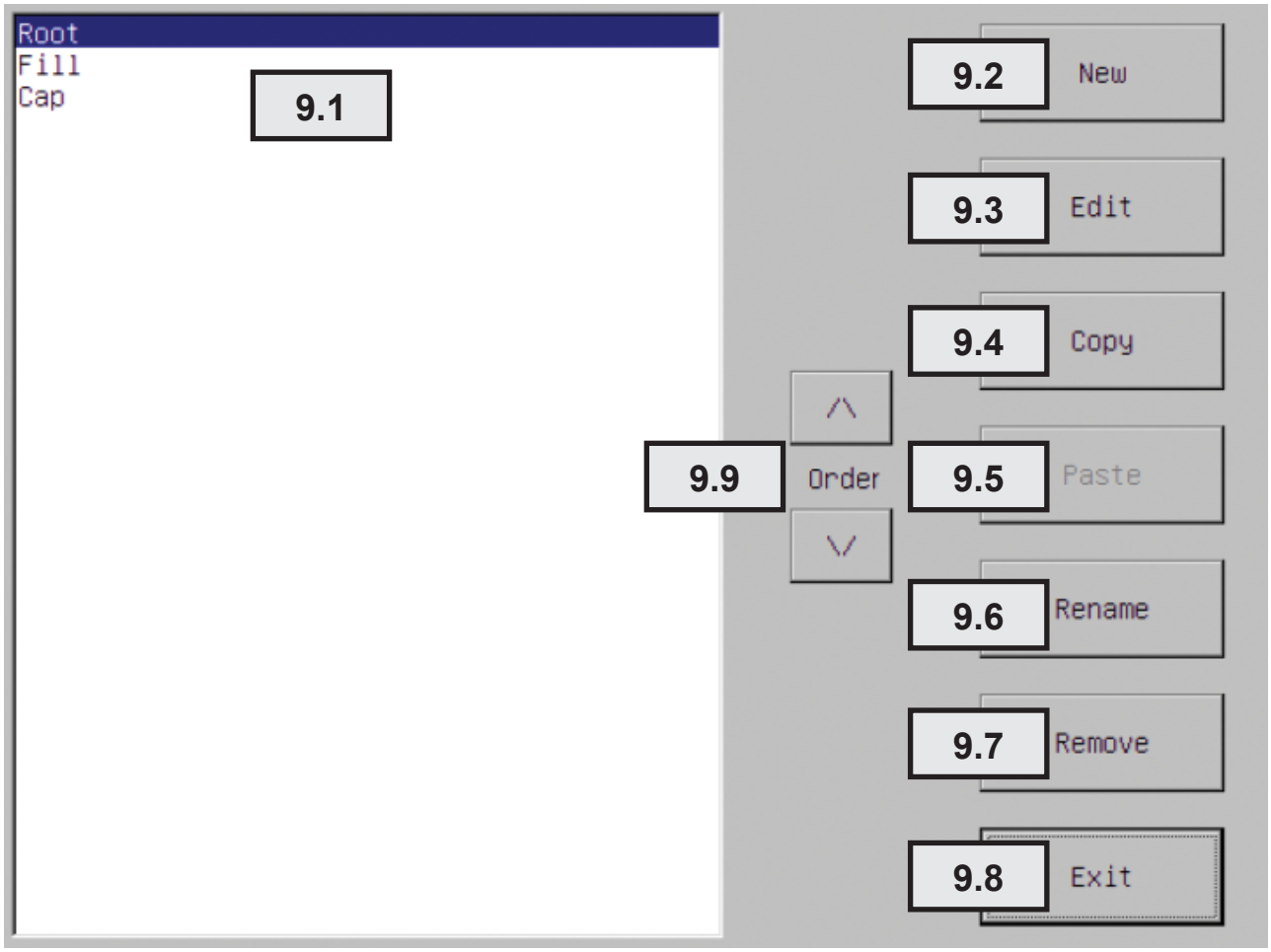


Figure 9.0

9.1 **Pass Display** – This area displays the passes that are within the folder that was selected.

9.2 **New** – This function allows the Administrator to create a new pass. When this button is pressed the screen will change to a screen similar to Figure 3.1.4. Enter the desired name for the new pass and press OK. (NOTE: It is recommended to put a number before the pass name, like “1 Root” to make the passes appear in the correct order.) The pass will be created with default parameters. The screen will then change to the Parameter Input Page. See SECTION 10.0.

9.3 **Edit** – This function allows the Administrator to modify data that is presently stored within a saved pass. Clicking on this button allows the operator to modify data stored within the folder highlighted in the Pass Display (See 9.1). The screen will then change to the Parameter Input Page. See SECTION 10.0.

9.4 **Copy** – This function allows the Administrator to copy a stored pass. Clicking this button places the highlighted pass into a temporary storage cache. This pass can then be pasted into other folders. The screen will not change.

SECTION 9.0 CREATING AND EDITING PASSES, CONT'D.

9.5 **Paste** – This function allows the Administrator to paste a pass that has been copied from this or another folder. A pass must first be copied before this function becomes active. See Section 9.4. If the copied pass has the same name as a pass that already exists within that folder, the operator will be given the option to rename the pasted file or to overwrite the existing file.

9.6 **Rename** – This function allows an already stored pass to be given a new name. When this button is pressed the screen will change to a screen similar to Figure 3.1.4. Enter the desired name for the renamed pass and press OK.

9.7 **Remove** – This function allows the Administrator to remove a pass that is no longer needed within the selected file folder.

9.8 **Exit** – Clicking on this button causes the screen to change back to the Main Screen. See SECTION 3.1.0.

9.9 **Order** – Use these arrows to change the order of the selected pass on the list.

SECTION 10.0 PARAMETER INPUT PAGES

SECTION 10.0 – PARAMETER INPUT PAGES

The Edit Screens allow the default parameters for all variables to be set and to configure the maximum, minimum, and the amount of adjustment per press of the associated switch on the Operator Pendant for the parameters the machine will use during normal operation. Operating units can be changed between English and Metric. The values entered are all real discrete values. These values are not percentages, values from potentiometers, or estimations. The drive speed must be calibrated in the Global Configuration (See SECTION 7.0) to account for different diameter pipes and bands.

The Administrator has the option to give the Operator a great deal of, or no control. Startup and shutdown parameters are not adjustable by the Operator. The Default value is the value that will be loaded initially. The "Max" value is the maximum, and the "Min" value is the minimum value the operator will have the ability to adjust the parameter to. The "Step" is the amount the parameter will be changed when the adjustment switch or button is pressed one time. **If you do not want the operator to be able to change a specific parameter, set the step to 0.**

The Edit Screens will help in entering values that are valid. If a value is entered that is invalid, the box will turn red and the range of allowed values will be displayed below it (See Figure 10.0). For minimum and maximum boxes, the range will be the machine's physical limits. For the actual values, the minimum and maximum will be values that are entered in corresponding minimum and maximum boxes. If a mistake is made and it is necessary to undo the changes that have been made, select the text box in which there is an error and press the red cancel button on the keypad. This will undo the last operation.

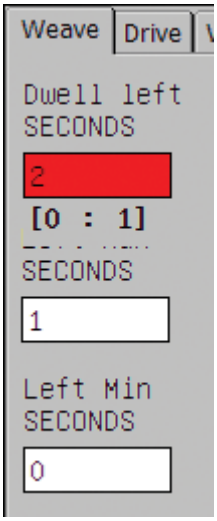


Figure 10.0

There are four pages, or tabs, of parameters that are relevant unless additional options are purchased. Weave, Travel, Search and Weld. Changing between these Tabs is accomplished by clicking on the tabs at the top of the screen. To move quickly between fields, press the left and right arrows on the keypad. Operations such as changing the units, saving, or canceling can be done on any page. Attempting to enter values that would be invalid cannot be saved such as attempting to set a minimum value that is greater than a maximum value. Other tabs will be explained in the addendum for the purchased option (Section 18 of this manual).

NOTE: In the description of functions below, each numbered explanation will describe the functions of the boxes shown in the vertical column beneath the numbered indicator. These boxes are all described as follows:

a. **Default (Top Row)** – In all cases, this is the default value that will be loaded for a given parameter. The units of measure are displayed for each box.

b. **Max (Second Row)** – This is the maximum value to which the Operator is allowed to adjust this particular parameter by the Administrator.

c. **Min (Third Row)** – This is the minimum value to which the Operator is allowed to adjust this particular parameter by the Administrator.

d. **Step (Bottom Row)** – This is the amount of change that will be applied to the given parameter each time the associated button or switch is operated.

SECTION 10.1 WEAVE TAB

The Weave tab contains parameters that will affect the weaver. The dwells, amplitude, speed, and delay can be set, along with the weave mode. The control system will not allow values to be entered that would be invalid, like a minimum that is greater than a maximum. If it is desired that the weaver be disabled, select the straight line mode. All weaving parameters will be ignored.

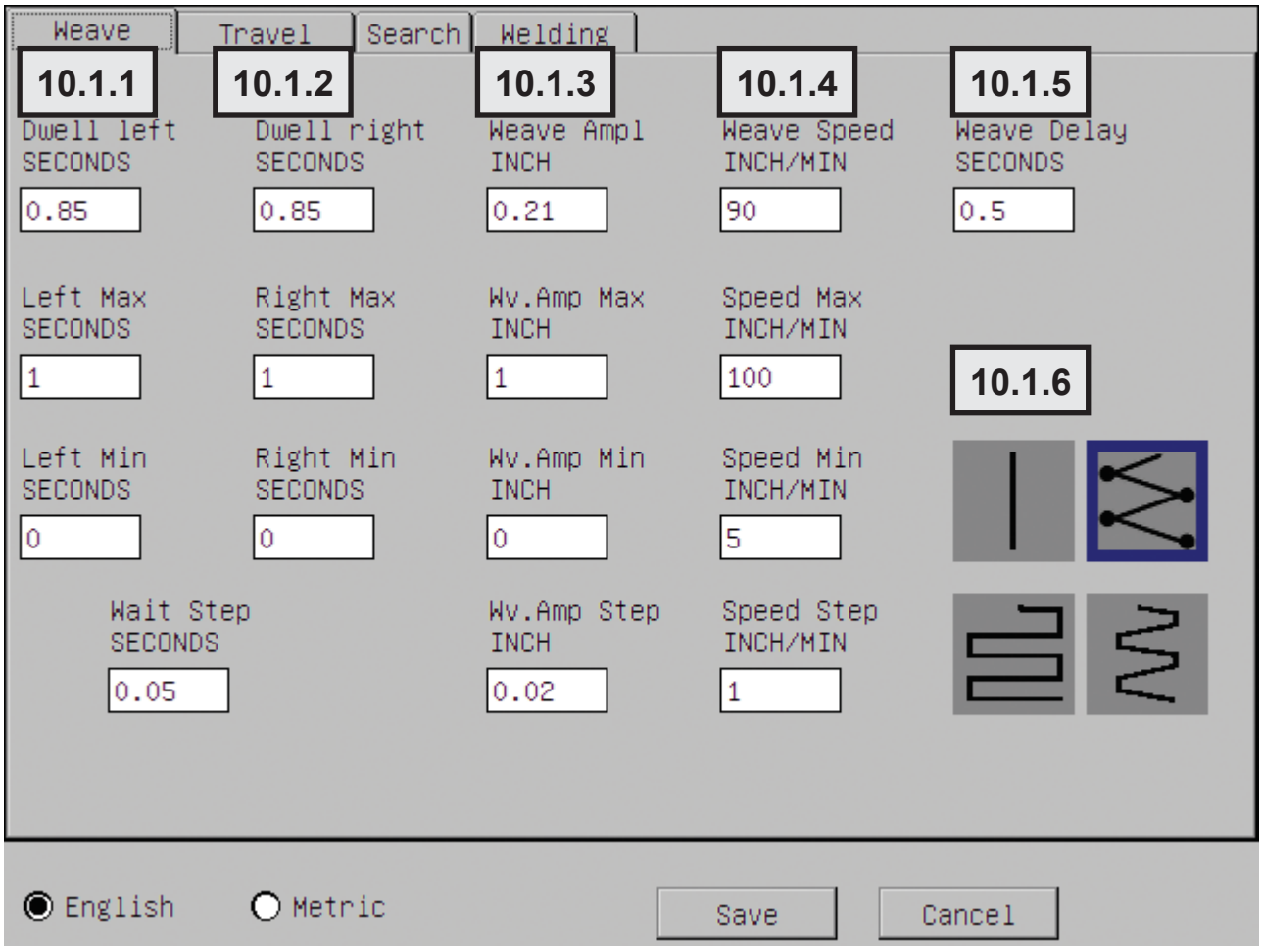


Figure 10.1

Note: The motion of the weaver does not consider the acceleration and deceleration time. This allows you to make a very fast and tight weave. If the acceleration and deceleration time was considered, the motion would appear to pause longer than expected. This is the same behavior across all machines. Numbers are still no match for the trained eye of a welding engineer and parameters must be tested before used.

10.1.1 Dwell Left – This column provides the default data for the weave dwell on the left side of the oscillation motion.

10.1.2 Dwell Right – This column provides the default data for the weave dwell on the right side of the oscillation motion.

10.1.3 Weave Amplitude – This column provides the default data for the width at which the weaver will move the welding gun from side to side during oscillation.

SECTION 10.1 WEAVE TAB, CONT'D.

10.1.4 Weave Speed – This column provides the default data for the speed at which the weaver will move the welding gun from side to side during oscillation.

10.1.5 Weave Delay – This value is the amount of time that the initiation of the weaving motion will be delayed from the moment the start button is pressed.

10.1.6 Weave Mode – This function allows the Administrator to select the weave motion with respect to tractor motion.

a. Straight Line – If the upper left button is selected, the machine is set to move in a straight line. No weaver motion will occur.

b. Stop on Dwells – If the upper right button is selected, the machine will pause all motion during the dwell.

c. Travel on Dwells – If the lower left button is selected, the forward travel will occur only during the dwells. The weaver arm does not move during the dwells in this mode.

d. Constant Motion – If the lower right button is selected, both the tractor and the weaver will continue to move during dwells. This constant motion mode of travel is the default.

SECTION 10.2 TRAVEL TAB

The Travel Tab will allow you to change the travel speed, delay, and reverse speed. The reverse speed can be set to a value much higher than the forward travel speed to allow the operator to back it into place quickly. The direction allows a pass to be created with vertical up or vertical down progression.

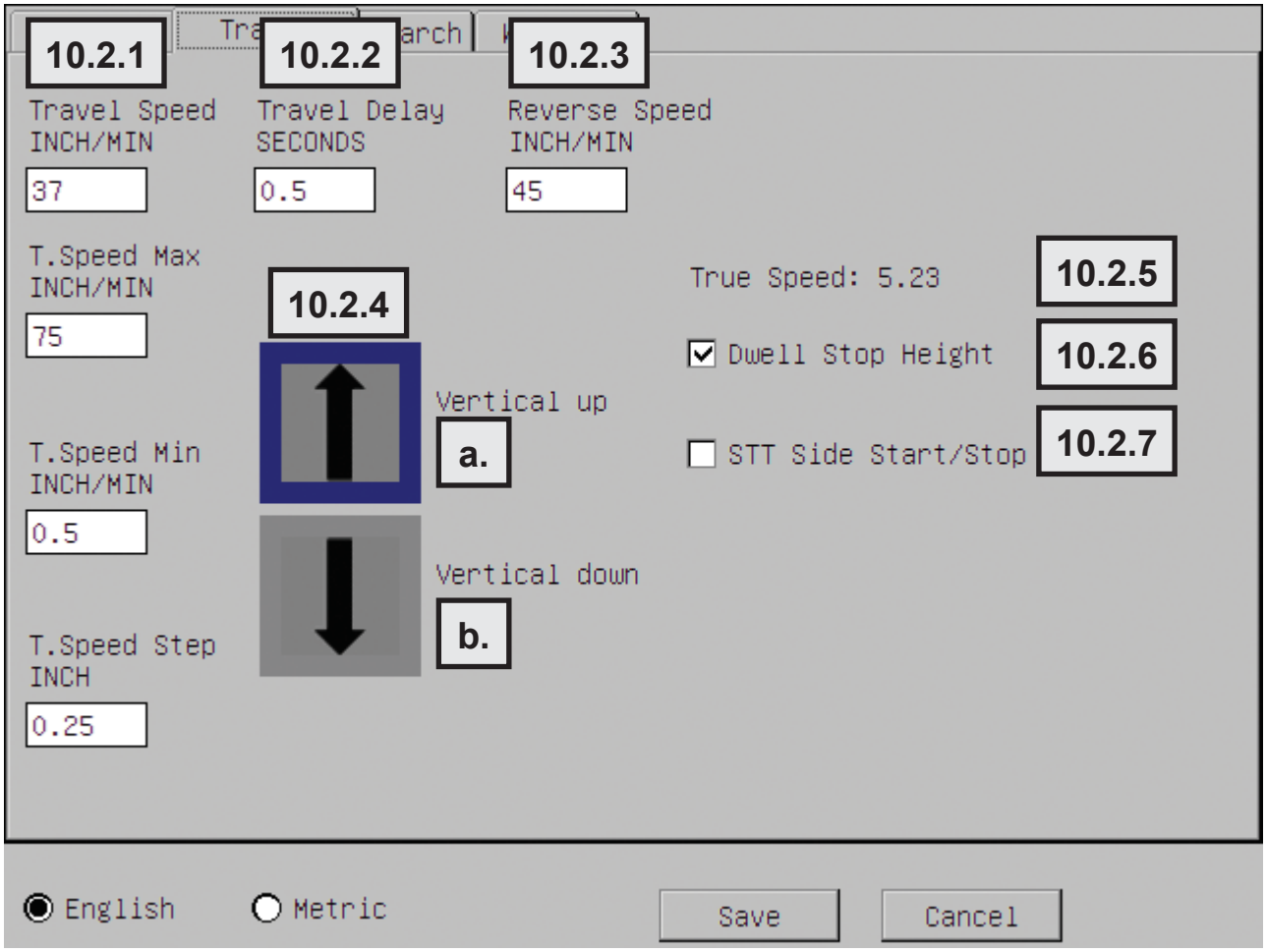


Figure 10.2

10.2.1 **Travel Speed** – This column provides the default data for the tractor travel speed. Travel Speed is the speed the motor will move the machine while it is allowed to move.

10.2.2 **Travel Delay** – This value is the amount of time that the initiation of the tractor travel motion will be delayed from the moment the start button is pressed.

10.2.3 **Reverse Speed** – This value is the tractor travel speed when the tractor is jogged in the reverse direction.

10.2.4 **Travel Direction** – This is the default direction of travel for the tractor.

a. **Vertical Up** – If this button is selected, upon pressing start, the tractor will proceed in an upward direction.

b. **Vertical Down** – If this button is selected, upon pressing start, the tractor will proceed in a downward direction.

SECTION 10.2 TRAVEL TAB, CONT'D.

10.2.5 True Speed – True Speed is the actual calculated speed of travel used for heat input calculations. It calculates the actual travel speed depending on the weave mode, using the weave speed, amplitude, dwells, and travel speed.

10.2.6 Dwell Stop Height – This function will ignore the Automatic Height Control during dwells. This improves performance with pulse waveforms and solid wire.

10.2.7 STT® Side Start/Stop – This function will cause the weaver to move to the side before striking the arc. It will not move if the procedure is set for Straight Line Mode.

SECTION 10.3 SEARCH TAB

The Search tab allows you to search through the available waveforms in the connected power source. Clicking search with the ignore boxes checked will list all the available waveforms. If you want to filter the search, uncheck the appropriate ignore box and choose a value from the drop down box. When you click on a new mode, the boxes and limits will automatically reconfigure themselves for the selected mode. A pop-up menu will let you choose whether you want the mode to be applied to welding, crater fill, or both.

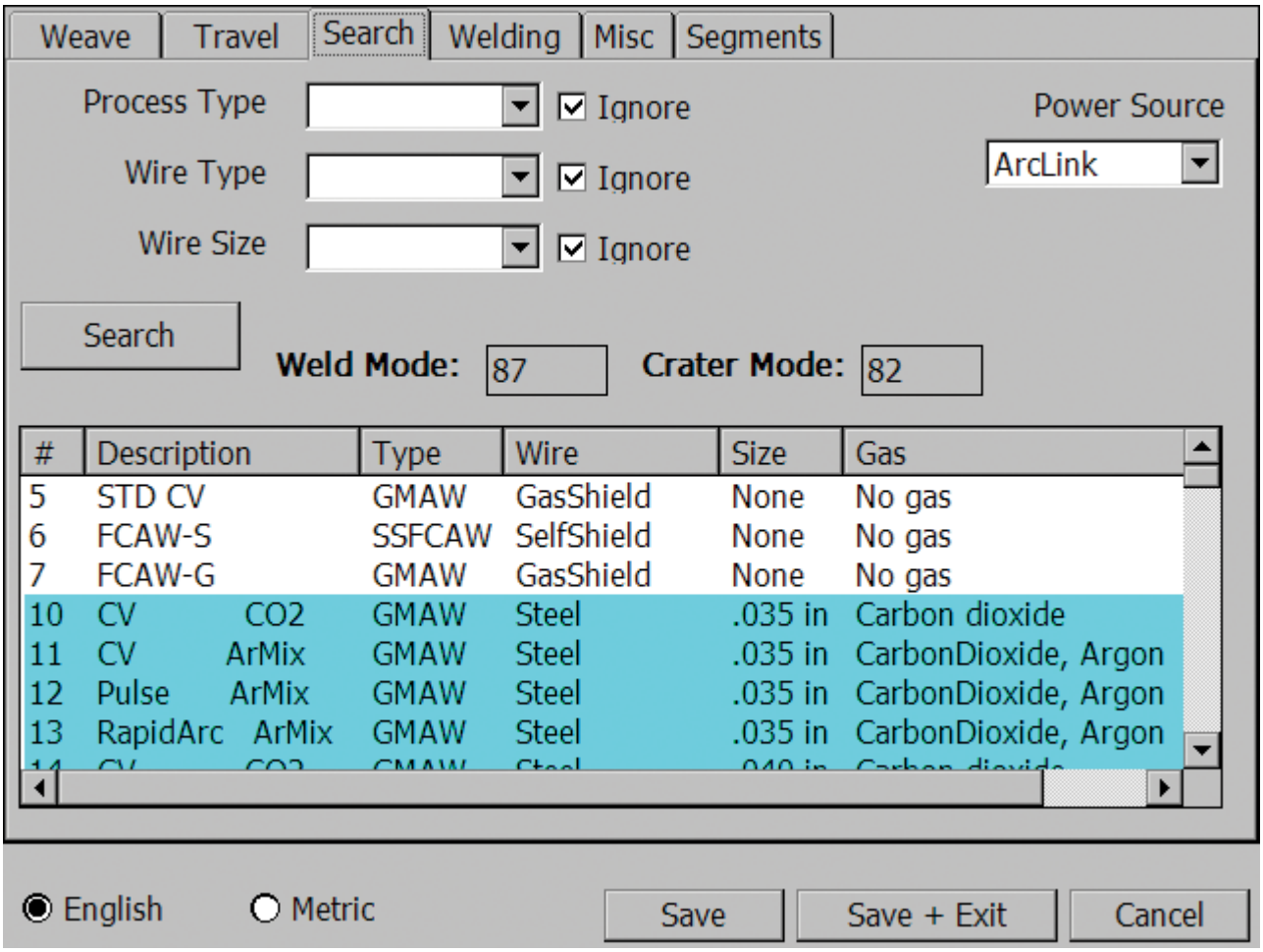


Figure 10.3

SECTION 10.4 WELDING TAB

The Welding tab contains the parameters for the power source and wire feeder. It also controls the time the machine will spend in pre-purge, start up, crater, and burn-back. The top group contains the run in settings. The next group contains the Startup settings. The next group contains the welding settings. The three groups under this contain the operator adjustment limits for the welding stage. The final group contains the crater.

Figure 10.4

10.4.1 **Run In** – These are the values used after the start button has been pressed but before the welding wire makes contact with the work piece and the arc is established.

10.4.2 **Start Up** – These values are used after the arc is struck for the time defined in Start Time. See SECTION 10.4.4.

10.4.3 **Welding** – These values are the parameters used during the standard weld portion of the operation. Values for the Default, Maximum and Minimum and Adjustment Step are defined. The welding phase is the normal welding done by the machine. The operator will be able to make changes during this phase of operation if the configuration allows. This phase ends when the stop button is pressed once.

SECTION 10.4 WELDING TAB, CONT'D.

10.4.4 Crater – These values are used after the stop button is pressed for the time defined in Crater Time. See SECTION 10.4.7. Crater mode has its own column labels since it may use a different welding mode.

10.4.5 Prepurge – This is the amount of time that the shielding gas solenoid will be open after the start button is pushed but before the welding wire makes contact with the work piece.

10.4.6 Start Time – This is the amount of time the Startup Parameters are active. This time begins after the welding wire makes contact with the work piece and an arc is established.

10.4.7 Crater Time – This is the amount of time the weld process will continue after the stop button has been pressed. During this time, the parameters defined in the Crater Weld default (See SECTION 10.4.4) will be active.

10.4.8 Burnback – This is the amount of time that voltage remains applied to the welding circuit in order to melt the welding wire a small amount. This eliminates the possibility of the welding wire being stuck into the crater of the weld puddle.

The available boxes and their limits are updated dynamically from the power source, if possible. The boxes that appear vary depending on the welding mode. The limits for each will be automatically configured. You can override this and set it as the application requires.

SECTION 11.0 AUTOMATIC HEIGHT CONTROL

If a new procedure is being developed, and there is no previous data available regarding the expected welding current, these steps should be followed.

11.1 Enter the Main Screen - Admin Function Active (See SECTION 3.1.0)

11.2 Configure a weld pass as closely to the expected values as possible. This data should be acquired from reliable industry product data. The values for the minimum, maximum range for the current should be set such that these values will allow a considerable range of adjustment. The startup and crater times should be set to very low values so that the Automatic Height control will not be given time to make erratic adjustments prior to the welding phase of operation.

11.3 Turn the Automatic Height Control (See SECTION 4.9) off and perform a weld, manually controlling the height axis to give a proper amount of contact tip to work distance..

11.4 While making the weld and with the height adjusted to an acceptable position as found in SECTION 11.3, observe the control box and record the current being displayed. (See SECTION 4.4) during the weld.

11.5 Stop the system.

11.6 Adjust the current using the Current Switch on the pendant (See SECTION 5.1.E or 5.2.F depending on the pendant being used.) so that the Current Value displayed on the Run screen (See SECTION 4.2) is close to the average current observed during the weld performed in 11.3 above.

11.7 Turn the Automatic Height Control on (See SECTION 4.9).

11.8 Perform another weld, making small adjustments to the current if necessary.

11.9 Save the pass. (See SECTION 4.10)

11.10 Edit the startup/crater current values so that they provide the required contact tip to work distance for the given wire feed speed.

SECTION 12.0 SETUP

**No set up needed for Piper steel rail (PSR) carriage.

1. Install Rail

The Piper-Plus is designed for use with Bent Rigid Rail (BRR) or Ring Rail. The exact outside diameter (OD) of the work piece, including coating, must be known when ordering rail. Minimum pipe OD is 16 inches (406 mm). Rail is custom bent for each OD and features adjustable feet to accommodate pipe ovality and deviations in coating thickness.

2. Secure Carriage on Rail

A. Select the correct pair of holes on each side of the carriage for the rail diameter being used (see chart at right). If the wheels are not attached to the correct set of holes, remove the wheel brackets and bolt them in selected holes. Tighten the bolts until the brackets are snug but still free to rotate.

B. Open the cam handle to separate the two halves of the split carriage. Loosen and turn the clutch knob counterclockwise to put the drive in the declutched position.

C. Place the carriage on the ring rail with the wheels in the rail grooves. Close the cam handle and move the carriage back and forth a few inches. The wheels on their mounting brackets will align themselves correctly with the rail grooves.

D. Verify that wheels are properly aligned, then tighten the wheel mounting bolts to lock them in position. Rotate the clutch knob clockwise to engage the drive pinion with the rack.

E. Verify that pinion is properly engaged in rack. The correct wheel position will provide a minimum of 50% engagement between the drive pinion and the gear rack.

Carriage Wheel Hole Set	Rail ID		Pipe OD	
	in	mm	in	mm
A	20 - 25	500 - 635	9 - 21	230 - 530
B	23 - 35	585 - 890	12 - 31	300 - 790
C	30 - 44	760 - 1120	18 - 40	455 - 1015
D	41 - 60	1040 - 1525	29 - 54	735 - 1375
E	75 - 174	1905 - 4420	64 - 170	1625 - 4320
F	flat rail		flat work	

Note: Chart values are for reference only

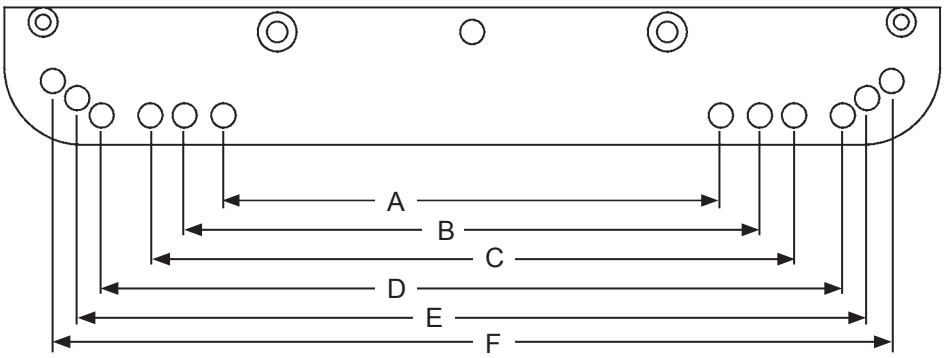


Figure 12.1

CARRIAGE WHEEL ADJUSTMENT

The wheels along one side of the carriage have stainless steel shim washers **(A)** underneath. These wheels are adjustable. Readjust these wheels (if necessary) by rotating the hex bolt **(B)** with a 1/2" wrench.

Grasp the sides of the carriage. The wheels are too loose if it is possible to move the carriage from side to side or up and down. Use a finger to keep one of the adjustable wheels from rotating as the carriage is manually pushed along the track. The wheels are adjusted too tight if firm finger pressure is not enough to prevent wheel rotation. Repeat the process for the other adjustable wheel.

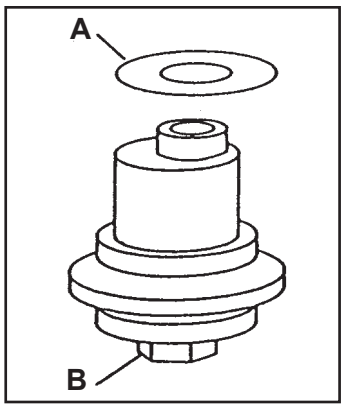


Figure 12.2

SECTION 13.0 TRACTOR DRAWINGS / PWS-4000 PWS BASE ASSEMBLY / EXPLODED VIEW

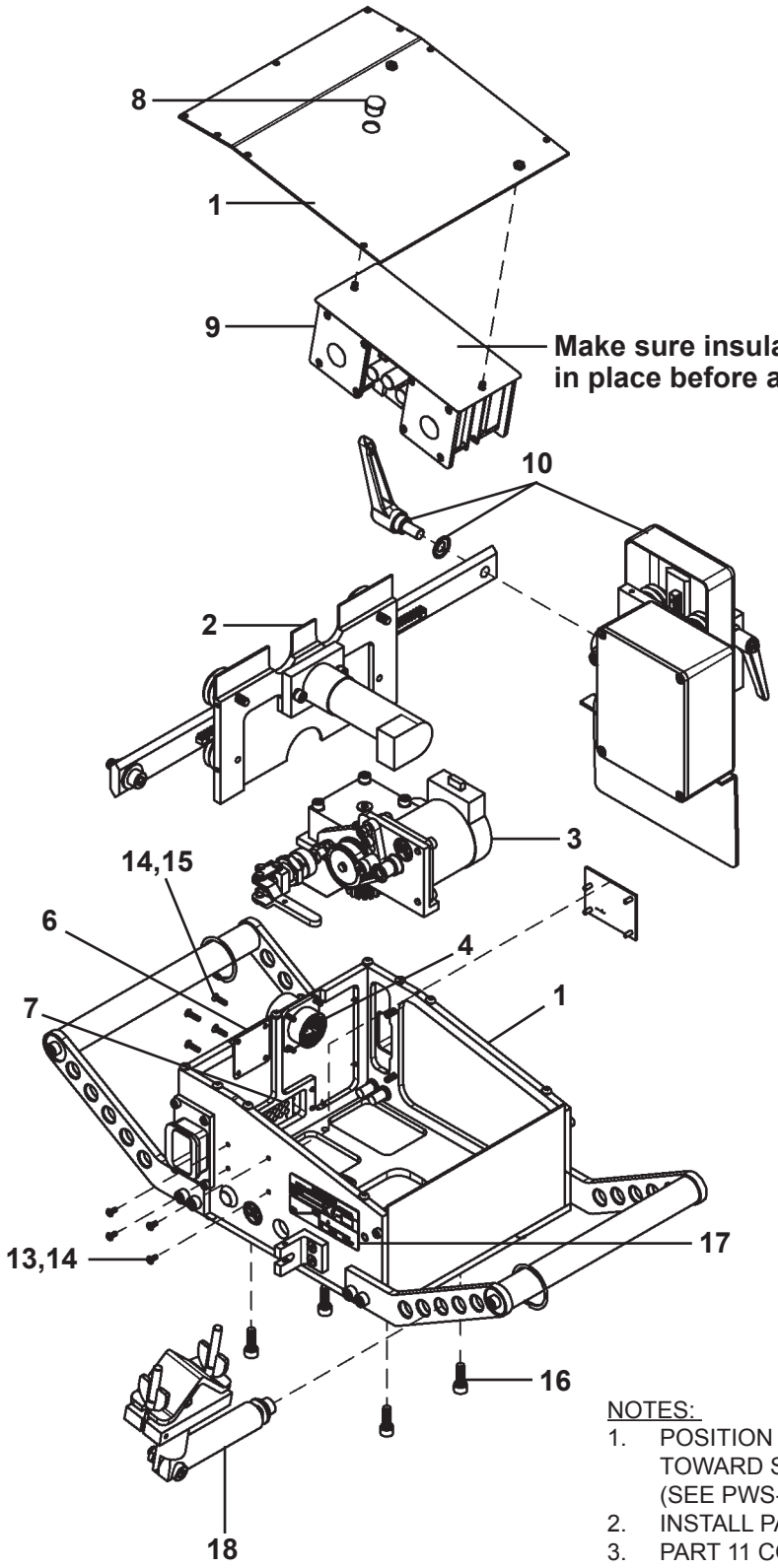


Figure 13.0

NOTES:

1. POSITION PART 4 WITH KEY FACING TOWARD SIDE OF TRACTOR (SEE PWS-4000-WD)
2. INSTALL PART 7 BEFORE PART 2
3. PART 11 CONNECTS TO PARTS 4 & 10
4. USE CABLE TIES TO ATTACH PART 5 TO SLEEVE RETENTION BRACKETS ON PART 1

SECTION 13.0 TRACTOR DRAWINGS / PWS-4000 PWS BASE ASSEMBLY / PARTS LIST

ITEM	QTY	PART NO.	DESCRIPTION
1	1	PWS-4010	Tractor Frame Assembly
2	1	PWS-1020	Weaver Assembly
3	1	PWS-1030	Main Drive Assembly
4	1	PWS-1075	Height Axis Wiring Harness
*	2	PWS-1084	Weaver Arm Sleeve
6	1	PWS-1128	Panel Connector Cover
7	1	PWS-1087	Bug Control Wiring Harness
8	1	MUG-1589	Hole Plug Button
9	1	PWS-4120	Bug Motor Drivers Assembly
10	1	PWS-1200	Height Control Assembly
*	1	PWS-1495-1.3	16" Motor Control Cable
*	2	TIE-4002	Black Nylon Cable Tie
13	4	MET-0141-SS	Pan Hd Phil Scr M3 x 6
14	8	MET-1340-SS	M3 Hex Nut
15	4	MET-0944-SS	FLT Hd Soc Scr M3 x 12
16	4	MET-0578-SS	Soc Hd Cap Scr M6 x 18
17	1	BUG-1338	Nameplate
18	1	PWS-4465	Adjustable Cable Anchor

* Not Shown

SECTION 13.0 TRACTOR DRAWINGS / PWS-4010 TRACTOR FRAME ASSEMBLY / EXPLODED VIEW / PARTS LIST

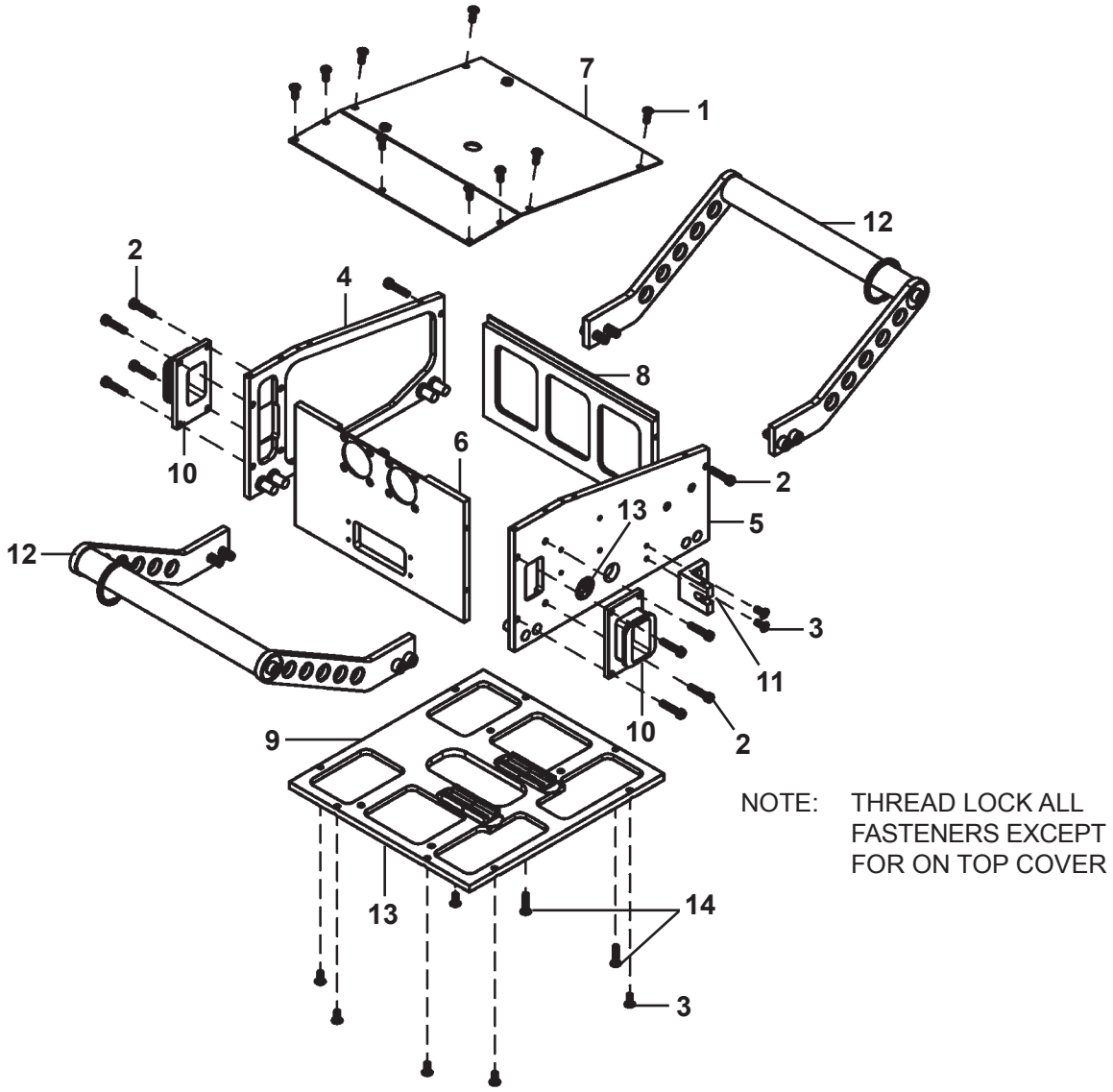


Figure 13.1

ITEM	QTY	PART NO.	DESCRIPTION
1	9	MET-1253-SS	Button HD Soc Scr M4 x 10
2	10	MET-0559-SS	Soc Hd Cap Scr M4 x 20
3	10	MET-0953-SS	Flt Hd Soc Scr M4 x 10
4	1	PWS-1012	Left Side Plate Assembly
5	1	PWS-1013	Right Side Plate Assembly
6	1	PWS-1014	End Plate
7	1	PWS-1015	Sheet Metal Cover
8	1	PWS-1017	Insulator Panel
9	1	PWS-1019	Bed Plate Assembly
10	2	PWS-1095	Sleeve Retention Bracket
11	1	PWS-1125	Clutch Handle Catch Assembly
12	2	PWS-1127	Rear Handle Assembly
13	2	PWS-1196	Pinch Point Label, 1"
14	2	MET-0958-SS	Flt Hd Soc Scr M4 x 18

SECTION 13.0 TRACTOR DRAWINGS / PWS-1020 WEAVER ASSEMBLY / EXPLODED VIEW / PARTS LIST

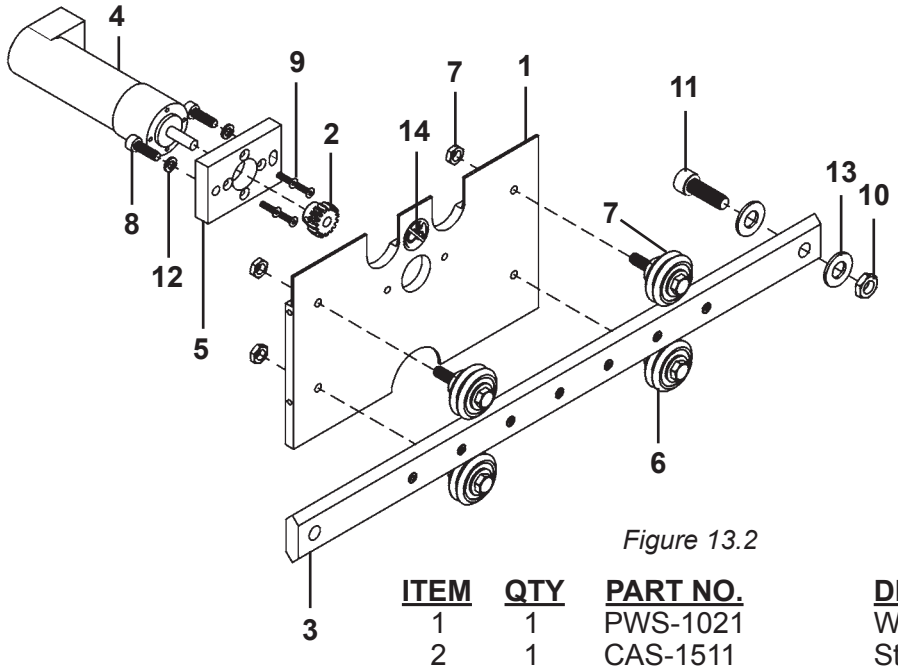
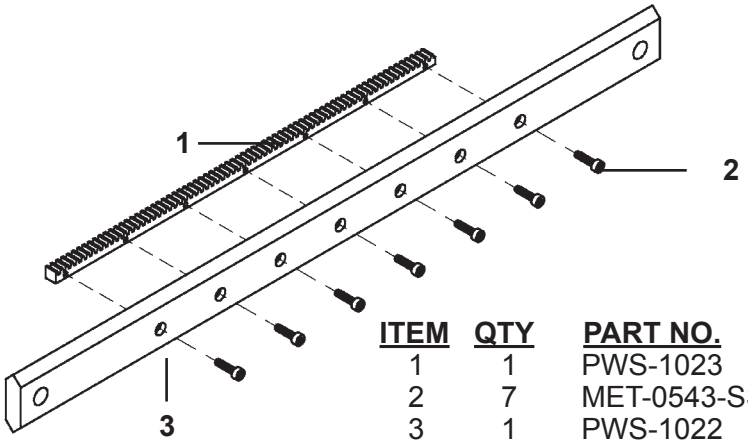


Figure 13.2

NOTE: THREAD LOCK PARTS 6 & 7 TO PART 1

ITEM	QTY	PART NO.	DESCRIPTION
1	1	PWS-1021	Weaver Mounting Plate
2	1	CAS-1511	Steel Pinion
3	1	PWS-1025	16" Weaver Arm Assembly
4	1	PWS-1159	Weaver Motor
5	1	PWS-1027	Weaver Motor Mounting Block
6	2	PWS-1197	Fixed Wheel & Leg Assy
7	2	PWS-1198	Adjustable Wheel & Leg Assy
8	2	MET-0567-SS	Soc Hd Cap Scr M5 x 16
9	4	MET-0944-SS	Flt Hd Soc Scr M3 x 12
10	1	MET-1380-SS	M8 Hex Nut
11	1	MET-2582-SS	Soc Hd Cap Scr M8 x 25
12	2	WAS-0232	#10 Split Lock Washer
13	2	WAS-0260	3/8 Washer
14	1	PWS-1196	Pinch Point Label, 1"

PWS-1025 WEAVER ARM / EXPLODED VIEW / PARTS LIST



NOTE: THREAD LOCK ALL MET-0543-SS

ITEM	QTY	PART NO.	DESCRIPTION
1	1	PWS-1023	Gear Rack
2	7	MET-0543-SS	Soc Hd Cap Screw M3 x 10
3	1	PWS-1022	16" Weaver Arm

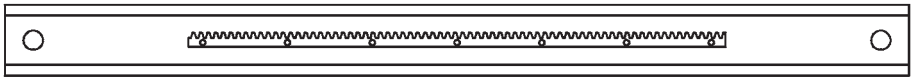


Figure 13.3

SECTION 13.0 TRACTOR DRAWINGS / PWS-1030 MAIN DRIVE ASSEMBLY / EXPLODED VIEW

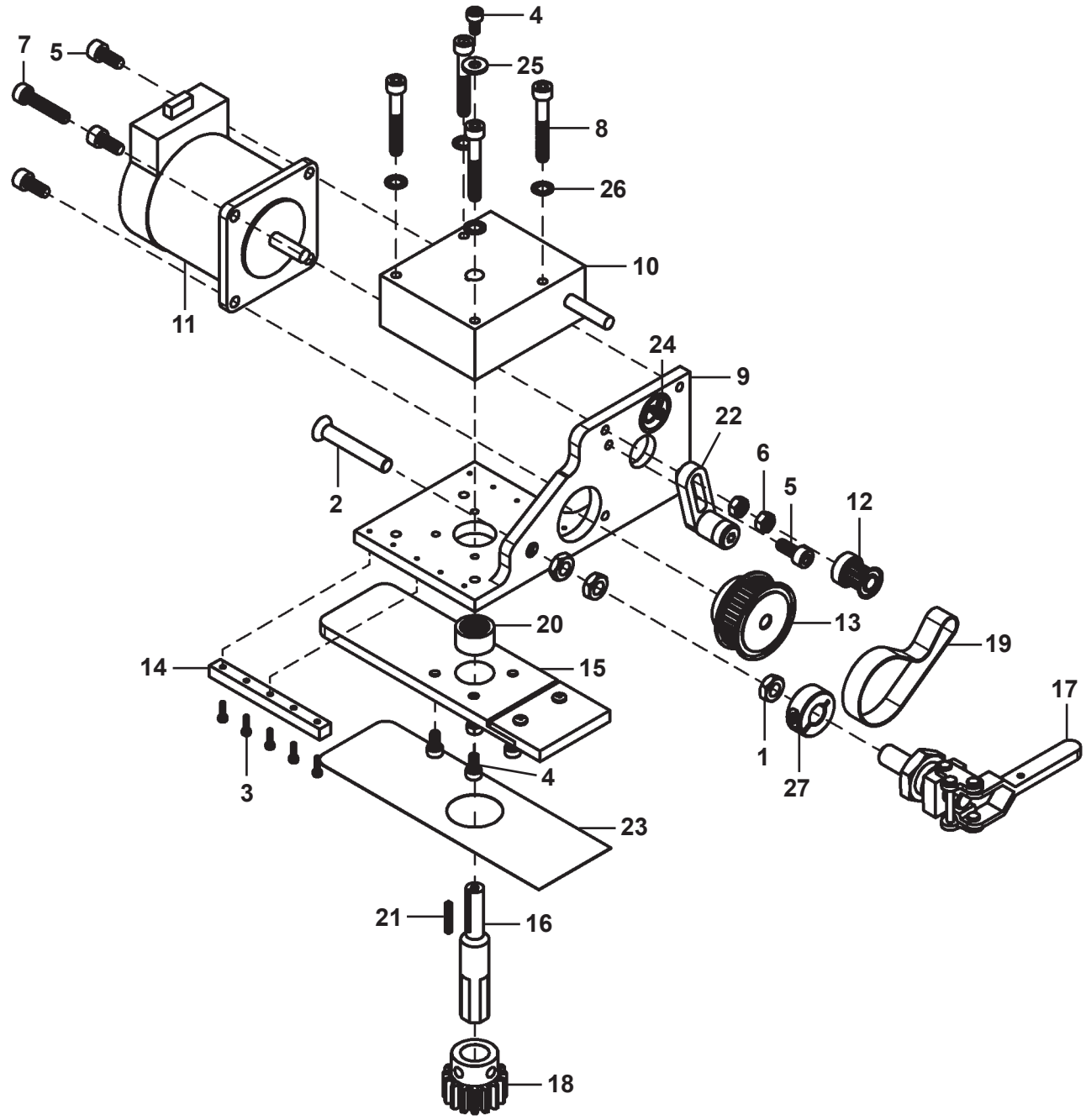
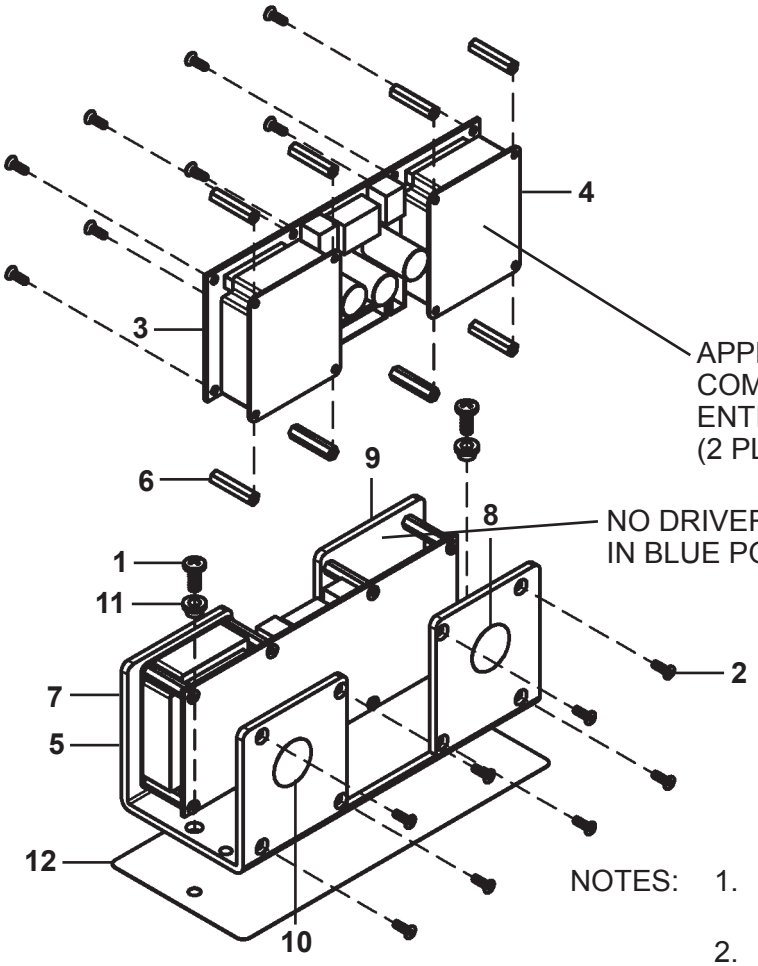


Figure 13.4

SECTION 13.0 TRACTOR DRAWINGS / PWS-1030 MAIN DRIVE ASSEMBLY / PARTS LIST

ITEM	QTY	PART NO.	DESCRIPTION
1	3	FAS-1350	Hex Jam Nut 1/4-20
2	1	FAS-2953-FT	Flt Hd Soc Scr 1/4-20 x 1 1/2Full Thd
3	10	MET-0522-SS	Soc Hd Cap Scr M2 x 8
4	5	MET-0552-SS	Soc Hd Cap Scr M4 x 8
5	4	MET-0564-SS	Soc Hd Cap Scr M5 x 12
6	2	MET-1360-SS	M5 Hex Nut
7	1	MET-2562-SS	Soc Hd Cap Scr M5 x 25
8	4	MET-2564-SS	Soc Hd Cap Scr M5 x 35 Partial Thr
9	1	PWS-1031	Drive Assembly Bracket
10	1	PWS-1032	Modified Gearbox
11	1	PWS-1081	Drive Motor w/ Wiring Harness
12	1	PWS-1034	Driving Timing Pulley Assembly
13	1	PWS-1035	Alum Timing Pulley, 36 Teeth
14	2	PWS-1037	Slider Guide Rail
15	1	PWS-1175	Pillow Block Assembly
16	1	PWS-1039	Output Shaft
17	1	PWS-1040	Panel Mount Clamping Lever
18	1	PWS-1041	Modified Drive Pinion
19	1	PWS-1043	Htd Timing Belt, 9mm Wide
20	1	PWS-1044	Needle Bng, 11/16 OD, 1/2 ID
21	1	PWS-1046	2mm Square Key .75" Lg
22	1	PWS-1048	Tensioner Assembly
23	1	PWS-1176	Slot Cover
24	1	PWS-1196	Pinch Point Label, 1"
25	1	WAS-0220	#8 SAE Flat
26	4	WAS-0231	#10 Internal Star Lockwasher
27	1	BUG-9012	Locking Collar

SECTION 13.0 TRACTOR DRAWINGS / PWS-4120 BUG MOTOR DRIVERS ASSEMBLY / EXPLODED VIEW / PARTS LIST



NOTES:
1. MOTOR DRIVERS SHOWN ASSEMBLED ON PART 3
2. CNN-5079 CLIPS TO BE ADDED UPON ASSEMBLY IN MACHINE

Figure 13.5

ITEM	QTY	PART NO.	DESCRIPTION
1	2	MET-0153-SS	Pan Hd Phil Scr M4 x 10
2	32	MET-0932-SS	Flt Hd Soc Scr M2.5 x 8
3	2	PCB-1067	Ampcard Motherboard
4	3	PCB-1220	5A Bldc Motor Driver Card
5	1	PWS-1121	Ampcard Heatsink / Mount
6	16	STOF-5002	M2.5 Hex Standoff F/F 20mm Lg
7	1	PWS-1191	3/4" Circle Sticker - Red
8	1	PWS-1192	3/4" Circle Sticker - Yellow
9	1	PWS-1193	3/4" Circle Sticker - Light Blue
10	1	PWS-1194	3/4" Circle Sticker - Green
11	2	WAS-5599	M4 x 3 Shoulder Washer Nylon
12	1	PWS-1123	Heat Sink Isolator
*	3	CNN-5079	Long Retainer Clip

* Not Shown

SECTION 13.0 TRACTOR DRAWINGS / PWS-1200 HEIGHT CONTROL ASSEMBLY / PARTS LIST / EXPLODED VIEW

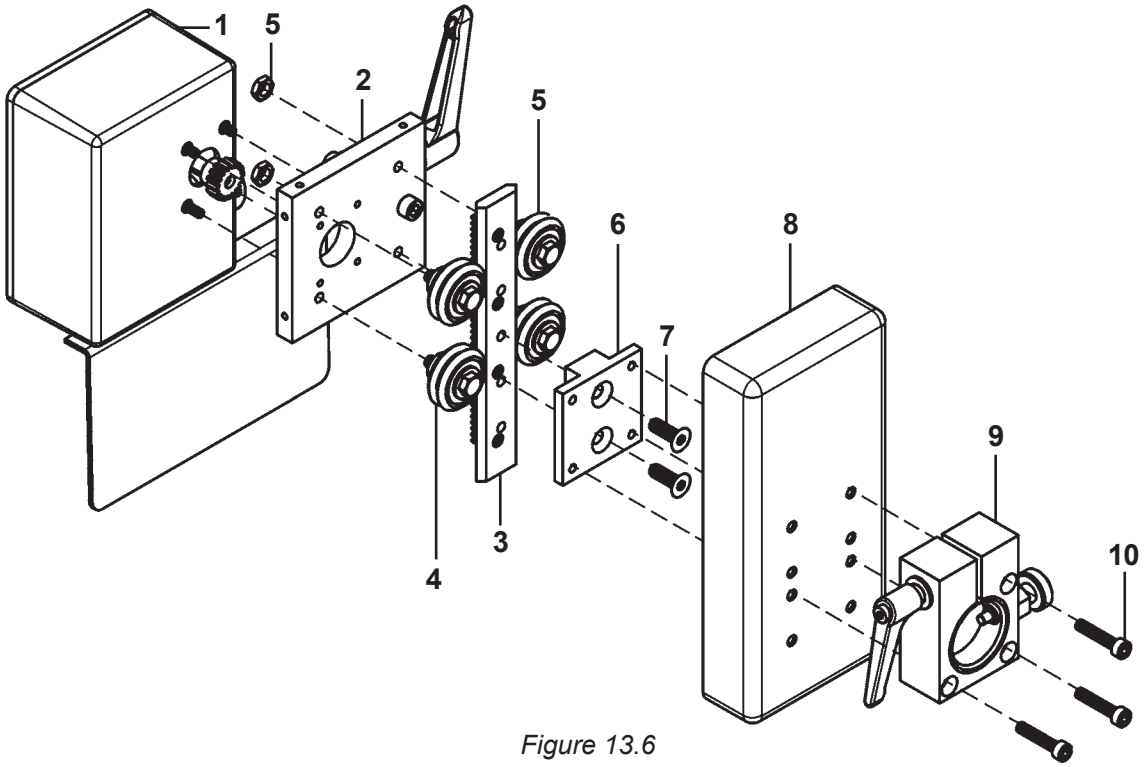


Figure 13.6

ITEM	QTY	PART NO.	DESCRIPTION
1	1	PWS-1160	Height Control Motor Assembly
2	1	PWS-1170	Height Control Mount Assembly
3	1	PWS-1065	Height Control Arm Assembly
4	2	PWS-1028	Fixed Wheel & Leg Assembly
5	2	PWS-1198	Adj Wheel & Leg Assembly
6	1	PWS-1073	Torch Mount Spacer
7	2	MET-0978-SS	Flt Hd Soc Scr M6 x 18
8	1	PWS-1201	Height Control Arm Cover
9	1	PWS-1079	Torch Mounting Assembly
10	3	MET-2562-SS	Soc Hd Cap Scr M5 x 25

For PWS-1495-XX motor control cable, see page 103.

SECTION 13.0 TRACTOR DRAWINGS / PWS-1079 TORCH MOUNTING ASSEMBLY / PARTS LIST / EXPLODED VIEW

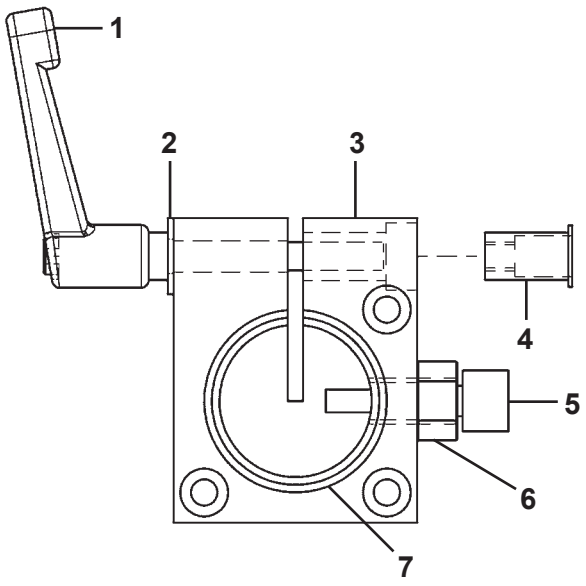


Figure 13.7

ITEM	QTY	PART NO.	DESCRIPTION
1	1	PWS-1077	M6 x 45 Adj Lever, SS, Black
2	1	WAS-0240	1/4 SAE Flat
3	1	PWS-1071	Insulator Block
4	1	PWS-1078	Rivet Nut M6 Threaded Insert
5	1	ARR-1106	Latch Pin
6	1	FAS-1390	Hex Nut 3/8-16
7	1	PWS-1072	Torch Mounting Collar

SECTION 13.0 TRACTOR DRAWINGS / PWS-1170 HEIGHT CONTROL MOUNT ASSEMBLY / PARTS LIST / EXPLODED VIEW

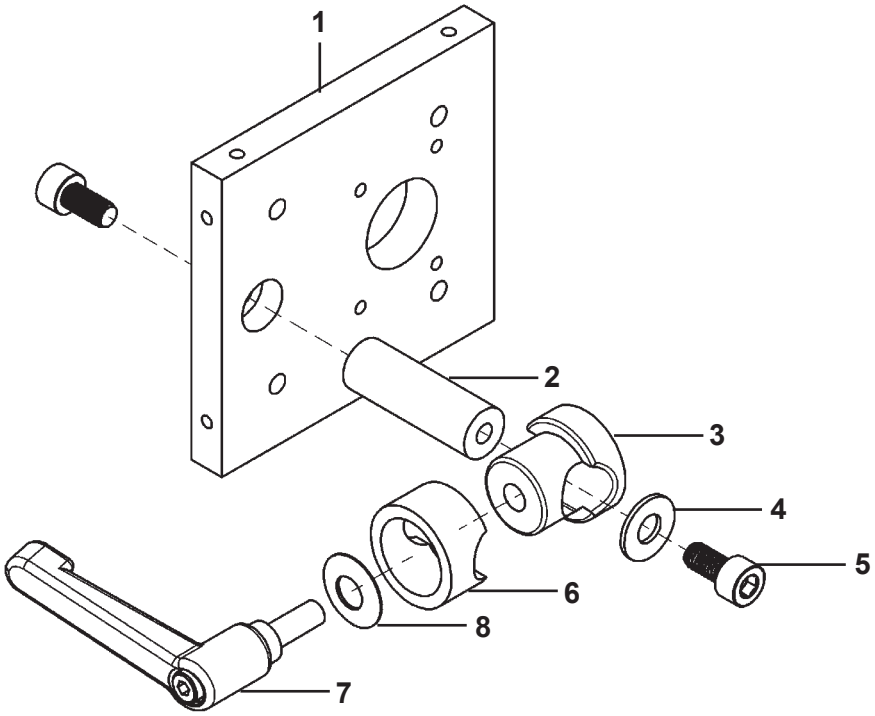


Figure 13.8

ITEM	QTY	PART NO.	DESCRIPTION
1	1	PWS-1169	Mounting Plate
2	1	PWS-1068	Knurled Rod
3	1	PWS-1067	Angle Adjuster Hub
4	1	WAS-0240	1/4 SAE Flat
5	2	MET-0574-SS	Soc Hd Cap Screw M6 x 12
6	1	PWS-1066	Angle Adjuster Spacer
7	1	PWS-1083	M8 x 16 Adj. Lever
8	1	BUG-1988	Belleville Washer

SECTION 13.0 TRACTOR DRAWINGS / PWS-1160 HEIGHT CONTROL MOTOR & GEARBOX ASSEMBLY / EXPLODED VIEW

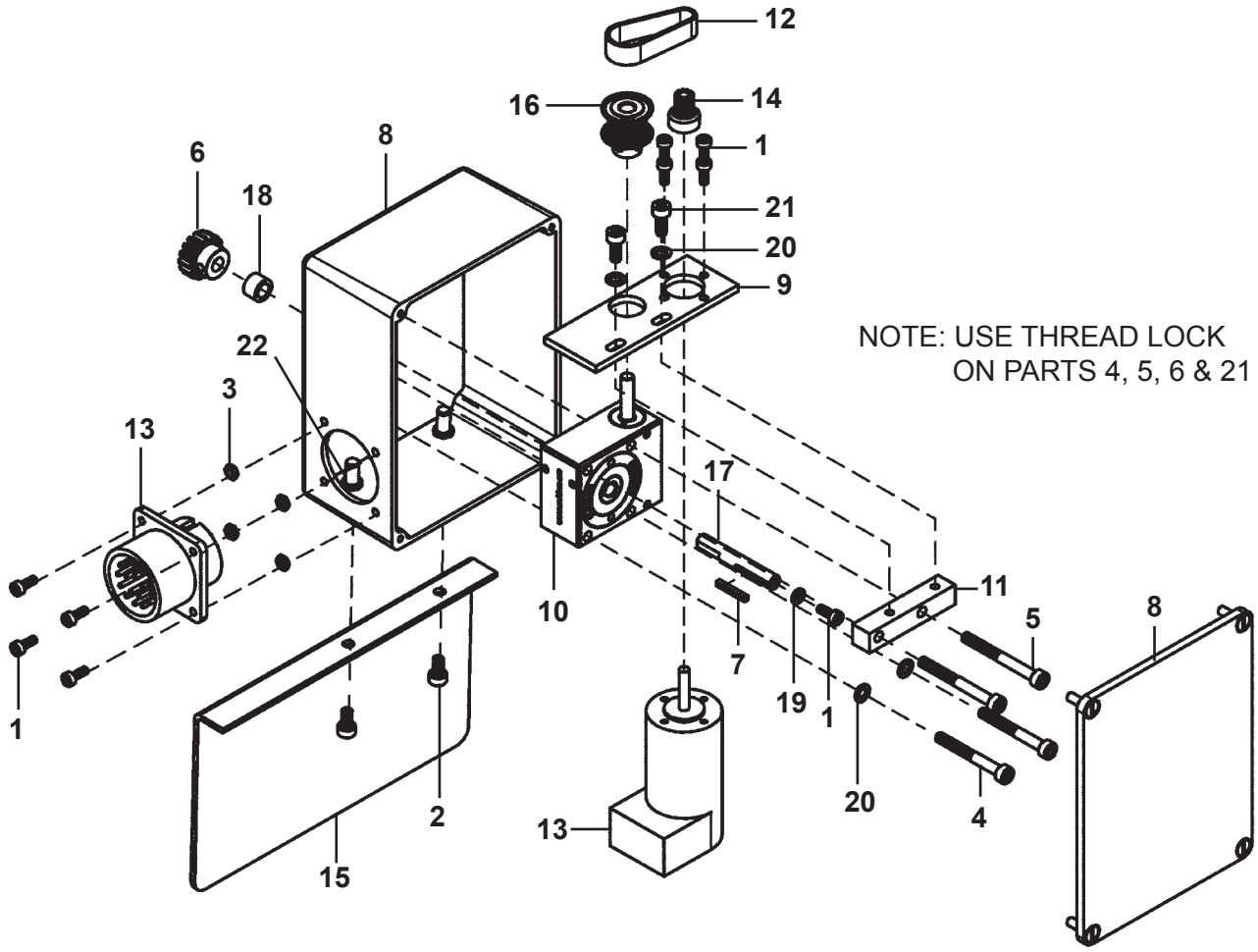


Figure 13.9

SECTION 13.0 TRACTOR DRAWINGS / PWS-1160 HEIGHT CONTROL MOTOR & GEARBOX ASSEMBLY / PARTS LIST

ITEM	QTY	PART NO.	DESCRIPTION
1	9	MET-0542-SS	Soc Hd Cap Scr M3 x 8
2	2	MET-0552-SS	Soc Hd Cap Scr M4 x 8
3	4	MET-1340-SS	M3 Hex Nut
4	2	MET-2554-SS	Soc Hd Cap M4 x 35 Partial Thr
5	2	MET-2555-SS	Soc Hd Cap M4 x 40 Partial Thr
6	1	PWS-1024-ST	Steel Pinion Assembly
7	1	PWS-1046	2mm Square key .75" Lg
8	1	PWS-1051	Height Motor Cover Assy. Includes Box, Lid and Screens
9	1	PWS-1053	Height Motor Mount Plate
10	1	PWS-1055	Height Control Gearbox
11	1	PWS-1056	Spacer Block
12	1	PWS-1057	3/8" Wide MXL Timing Belt
13	1	PWS-1058	Height Motor Assembly Includes Motor and Panel Connector
14	1	PWS-1059	Modified Motor Pulley
15	1	PWS-1060	Spatter Shield
16	1	PWS-1061	Modified Gearbox Pulley
17	1	PWS-1074	Output Shaft
18	1	PWS-1161	Pinion Spacer
19	1	WAS-0202	#4 Washer, .25" OD Stainless
20	4	WAS-5551-SS	M4 Lock Washer
21	2	WAS-0553-SS	Soc Hd Cap Scr M4 x 10
22	2	SCF-1021	Self-Clenching Blind Fastener

SECTION 14.0 PENDANTS / PWS-0200 FULL FUNCTION PENDANT / EXPLODED VIEW

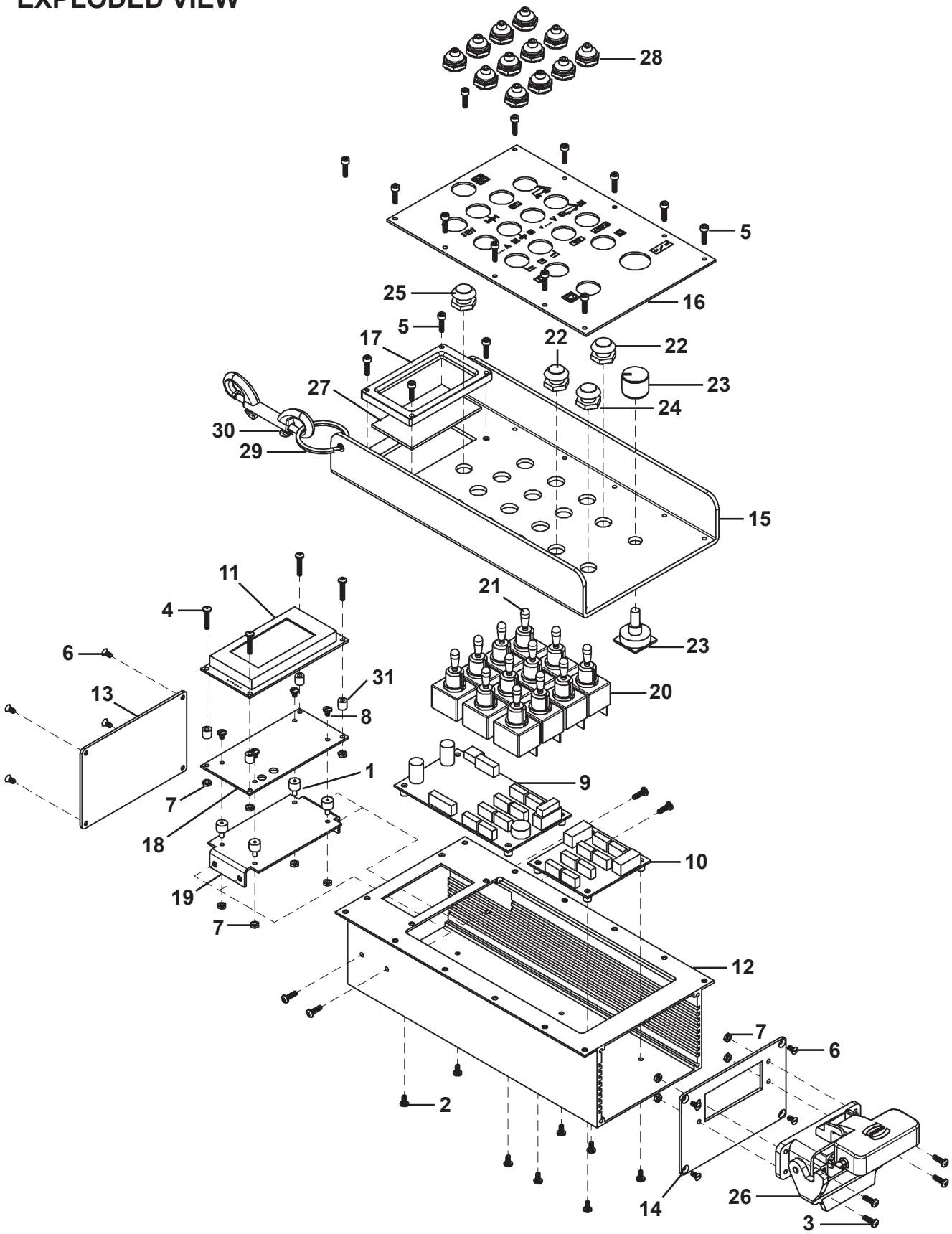


Figure 14.0

SECTION 14.0 PENDANTS / PWS-0200 FULL FUNCTION PENDANT / PARTS LIST

ITEM	QTY	PART NO.	DESCRIPTION
1	4	HDW-1008	Isolation Mount 3M M/F
2	8	MET-0141-SS	Pan Hd Phil Scr M3 x 6
3	8	MET-0143-SS	Pan Hd Phil M3 x 10
4	4	MET-0147-SS	Pan Hd Phil M3 x 16
5	16	MET-0543-SS	Soc Hd Cap Scr M3 x 10
6	8	MET-1043	Flt Hd Phil Scr M3 x 10
7	12	MET-1340-SS	M3 Hex Nut
8	4	MET-A0144-SS	Pan Hd Slot Scr M3 x 4
9	1	PCB-1202	Pendant Control Board
10	1	PCB-1203	Switch Interface Board
11	1	PCB-1205	Display Module
12	1	PWS-0221	Large Pendant Body
13	1	PWS-0223	Pendant End Plate
14	1	PWS-0224	Pendant End Plate w/Hole
15	1	PWS-0226	Pendant Lid
16	1	PWS-0228	Legend Plate
17	1	PWS-0231	Pendant Bezel
18	1	PWS-0232	Display Mount Assembly
19	1	PWS-0233	Display Bracket Assembly
20	11	PWS-0238	Mom-Off-Mom Toggle
21	1	PWS-0239	On-Off-On Toggle
22	1	PWS-0240	Grn+Blk Pushbuttons
23	1	PWS-0241	Encoder w/ Harness & Knob
24	1	PWS-0242	Red Push Button
25	1	PWS-0243	Switch, Yel w/Harness
26	1	PWS-0244	Pendant Wiring Harness
27	1	PWS-0247	Lens
28	12	PWS-0249	Boot, Half Toggle 15/32
39	1	PWS-1088	Split Ring, 1.48" OD 1.264" ID
30	1	PWS-1089	Dbl End Slide Bolt Snap
31	4	STOF-0345	1/4" x 1/4" Round Nylon Spacer
*	1	LIT-PWS-0200-CARD	Large Pendant Wiring Diagram

* Not Shown

SECTION 14.0 PENDANTS / PWS-0200 FULL FUNCTION PENDANT / WIRING DIAGRAM

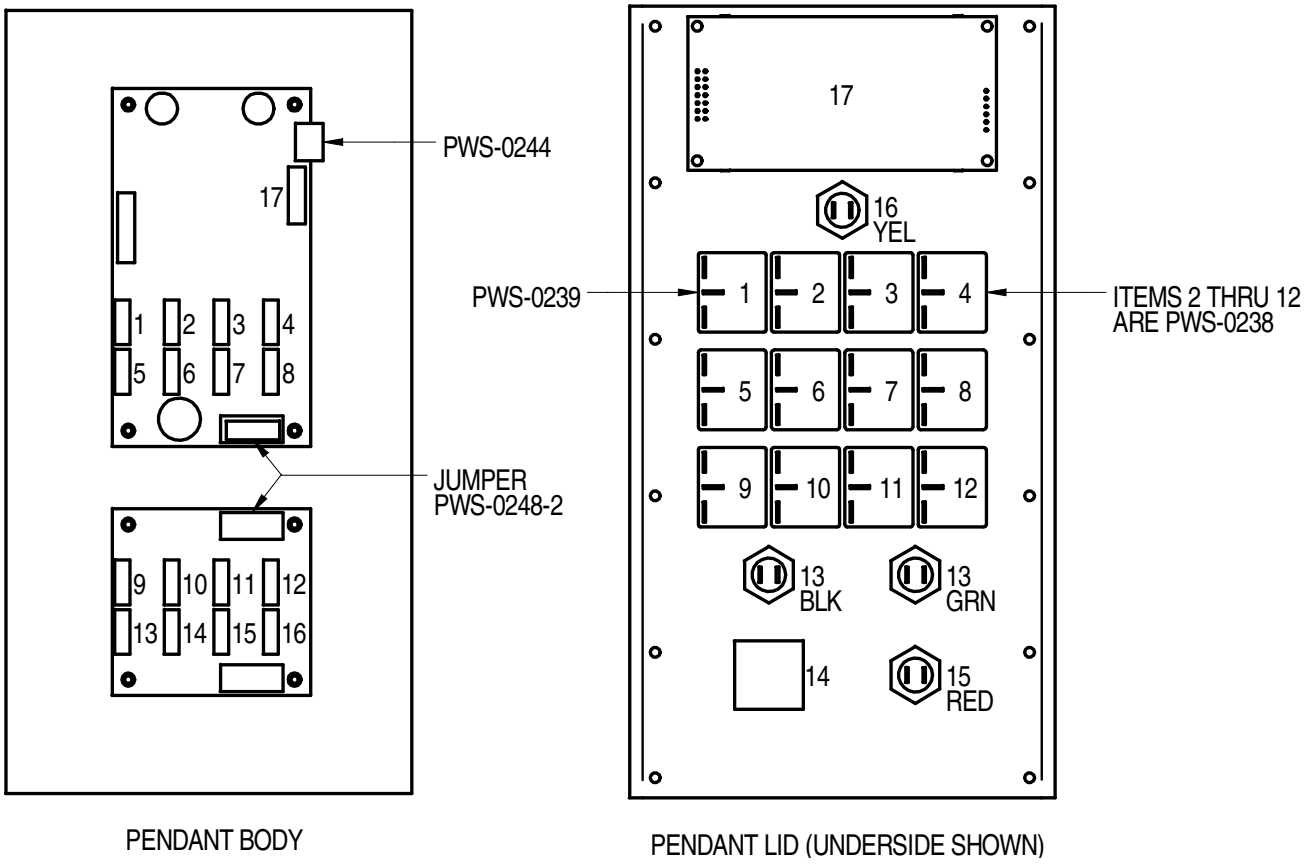


Figure 14.1

SECTION 14.0 PENDANTS / PWS-0201 LIMITED FUNCTION PENDANT / WIRING DIAGRAM

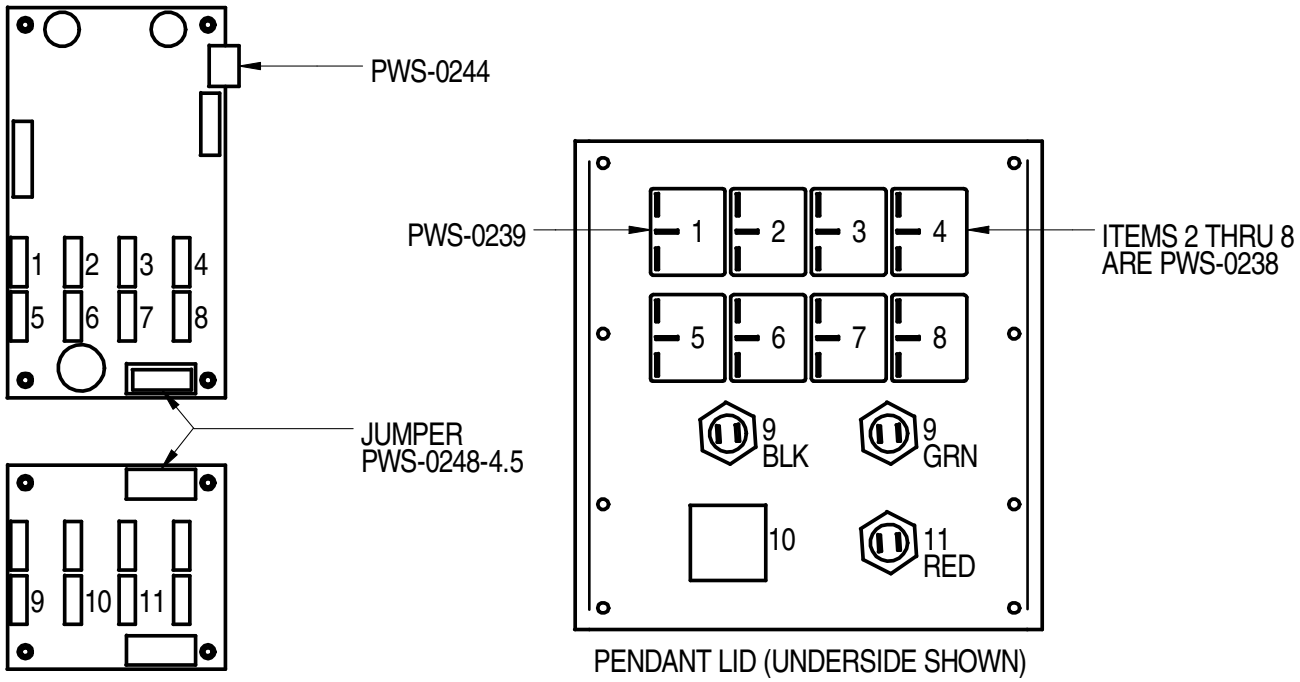


Figure 14.2

SECTION 14.0 PENDANTS / PWS-0201 LIMITED FUNCTION PENDANT / EXPLODED VIEW

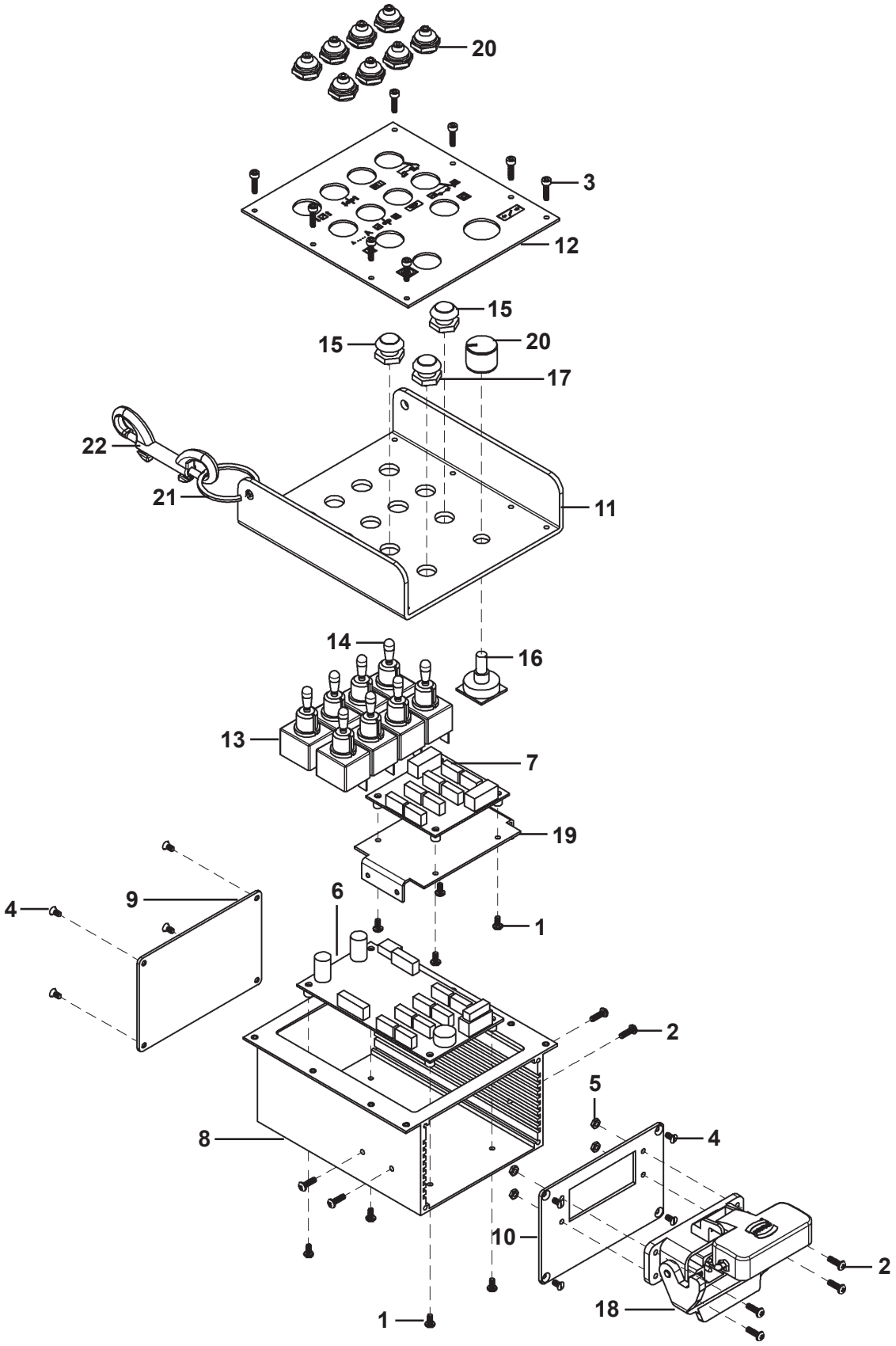


Figure 14.3

SECTION 14.0 PENDANTS / PWS-0201 LIMITED FUNCTION PENDANT / PARTS LIST

ITEM	QTY	PART NO.	DESCRIPTION
1	8	MET-0141-SS	Pan Hd Phil Scr M3 x 6
2	8	MET-0143-SS	Pan Hd Phil M3 x 10
3	8	MET-0543-SS	Soc Hd Cap Scr M3 x 10
4	8	MET-1043	Flt Hd Phil Scr M3 x 10
5	4	MET-1340-SS	M3 Hex Nut
6	1	PCB-1202	Pendant Control Board
7	1	PCB-1203	Switch Interface Board
8	1	PWS-0222	Small Pendant Body
9	1	PWS-0223	Pendant End Plate
10	1	PWS-0224	Pendant End Plate w/Hole
11	1	PWS-0227	Small Pendant Lid
12	1	PWS-0229	Small Legend Plate
13	7	PWS-0238	Mom-Off-Mom Toggle
14	1	PWS-0239	On-Off-On Toggle
15	1	PWS-0240	Grn+Blk Push Buttons
16	1	PWS-0241	Encoder w/Harness & Knob
17	1	PWS-0242	Red Pushbutton
18	1	PWS-0244	Pendant Wiring Harness
19	1	PWS-0245	Switch Interface Bracket Assy
20	8	PWS-0249	Boot Half Toggle 15/32
21	1	PWS-1088	Split Ring, 1.48" OD 1.264" ID
22	1	PWS-1089	Dbl End Slide Bolt Snap
*	1	LIT-PWS-0201-CARD	Small Pendant Wiring Diagram

* Not Shown

SECTION 15.0 CONTROL BOX / PWS-0100/3100 CONTROL BOX / EXPLODED VIEW / PARTS LIST

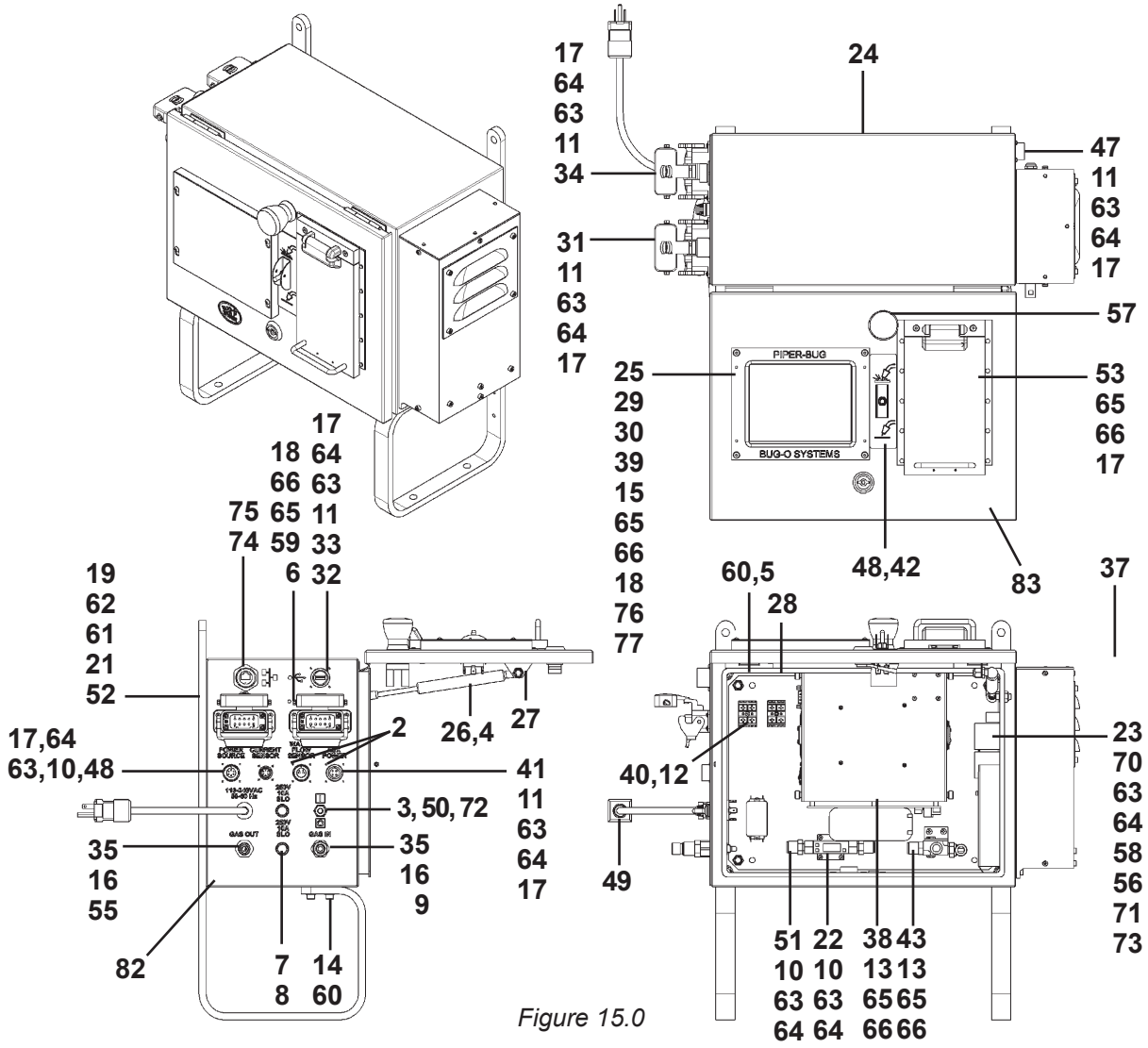


Figure 15.0

ITEM	QTY	PART NO.	DESCRIPTION
1	1	100-0427, 100-0429	CE Nameplate, Electric Shock Sticker
2	2	BUG-9628	Cap & Chain Assembly
3	1	PWS-0255	Boot Half Toggle M12 x 1
4	2	FAS-1372	Hex Nut 1/2-20 x 5/16 Nylok
5	2	FAS-1350	Hex Jam Nut 1/4-20
6	1	PWS-0259	Ground Bar Assembly
7	2	FHO-0188	Fuse Holder, Panel Mount
8	2	FUS-0110	10A Fuse Slo-Blo 250V
9	1	HDW-1007	1/4" NPT Male to B-Size Female
10	22	MET-0141-SS	Pan Hd Phil Scr M3 x 6
11	32	MET-0143-SS	Pan Hd Phil M3 x 10
12	2	MET-0148-SS	Pan Hd Slotted Scr M3 x 20
13	8	MET-0153-SS	Pan Hd Phil M4 x 10
14	4	MET-0578-SS	Soc Hd Cap Scr M6 x 18
15	4	MET-0959-SS	Flt Hd Soc Scr M4 x 20
16	2	WAS-0341-SS	7/8" Spring Lock Washer
17	32	MET-1340-SS	M3 Hex Nut
18	20	MET-1350-SS	M3 Hex Nut (Stainless Steel)
19	4	MET-1380-SS	M6 Hex Nut

NOTE:
PWS-0100 & PWS-0100/3100 are physically the same part with software changes.

SECTION 15.0 CONTROL BOX / PWS-0100/3100 CONTROL BOX / PARTS LIST CONT'D.

ITEM	QTY	PART NO.	DESCRIPTION
20	4	MET-2143-SS	Pan Hd Phil M3 x 30
21	4	MET-2983-SS	Flt Hd Soc Scr M8 x 30
22	1	PCB-1200	Breakout Board
23	1	PCB-1210	24V DC Supply 110/220
24	1	PWS-0101	Control Box Enclosure
25	1	PWS-0256	Control Box Bezel
26	1	PWS-0104	Lid Support Cylinder
27	1	PWS-0105	Lid Support Bracket
28	1	PWS-0106	Control Box Backer Plate
29	1	PWS-0108	Rubber Edge Trim, 1/8" Gap
30	1	PWS-0109	Glass for Display
31	1	PWS-0110	Tractor Panel Harting Assembly
32	1	PWS-0111	Conn USB-A Rcpt-Rcpt Sq Flange
33	1	PWS-0112	USB Dust Cap
34	1	PWS-0115	Pendant Panel Harting Assembly
35	2	PWS-1446	3/8" Female NPT Bulkhead Fitting
*	2'	PWS-0119	Black Polyurethane Tubing
37	1	PWS-0120	Control Box Heat Sink Assembly
38	1	PWS-0130	PC104 Computer Box Assembly
39	1	PWS-0140	LCD Display Assembly
40	2	PWS-0147	2 Pos Terminal Block
41	1	PWS-3148	Water Cooler Control Harness
42	1	PWS-0149	Switch Guard
43	1	PWS-0150	Solenoid Valve Assembly
*	1	PWS-0157	Main 24V DC Supply Harness
*	1	PWS-0158	Deluxe USB Type A-B Cable, 5M
*	1	PWS-0159	Premium USB Type A-A Cable 1M
47	1	PWS-0160	Heat Sink Interconnect Harness
48	1	PWS-0163	Main Wiring Harness
49	1	PWS-0164	120VAC Power Cord
50	1	PWS-0166	Incoming Power Wiring Harness
51	1	PWS-0170	Gas Flow Sensor Assembly
52	2	PWS-0179	Control Box Mount Bracket
53	1	PWS-0190	Keypad & Mouse Assembly
*	1	PWS-0191	USB Can Interface
55	1	PWS-1438	Green Female Gas Coupling
56	6	STOF-5003	Standoff Hex M3 Thr Nylon 10mm
57	1	SWT-FNC2	E-Stop 2 N.C. Contacts
*	4	TIE-5001	Ribbon Cable Mounting Clip
59	2	MET-2152-SS	Pan Hd Phil Scr M4 x 25
60	7	WAS-0242	1/4" External Star Lock Washer
61	4	WAS-0260	3/8 Washer
62	4	WAS-0262	3/8 Split Lock Washer
63	48	WAS-5540-SS	M3 Flat Washer Stainless Steel
64	48	WAS-5541-SS	M3 Lock Washer Stainless Steel
65	24	WAS-5550-SS	M4 Flat Washer Stainless Steel
66	26	WAS-5551-SS	M4 Lock Washer Stainless Steel
*	9.5"	WRE-5162	16 AWG Black, 1000V, PVC
*	2"	WRE-5163	16 AWG Red, 1000V, PVC
*	2"	WRE-5608	16 AWG Dark Blue, 1000V PVC
70	6	MET-0541-SS	Soc Hd Cap Scr M3 x 6
71	5	PWS-0196	Insulating Boot-Black
72	2"	SRK-2006	2" Dia x 6" Black Heat Shrink
73	6	MET-1041-SS	Flt Hd Slot Scr M3 x 6
74	1	PWS-1472	Cat. 5E Crossover Cable, 350 Mhz
75	1	CNN-5029	Conn RJ45 Rcpt w/ Cover
*	1	PWS-0260-BOX	Ground Wire Assembly, Ground to Box
*	1	PWS-0260-LID	Ground Wire Assembly, Ground to Lid
76	2	PWS-0268	Disposable Display Cover
77	4	MET-1253-SS	Button HD Socket M4x10
82	1	PWS-0600	Piper Box I/O Legend Plate
83	1	PWS-0601	Piper Box Hot/Cold Legend Plate
84	1	100-0434	Filter Wiring Harness
*	1	100-0435	E-Stop Wiring Harness

* Not Shown

SECTION 15.0 CONTROL BOX / PWS-0130 PC104 COMPUTER BOX ASSEMBLY / EXPLODED VIEW

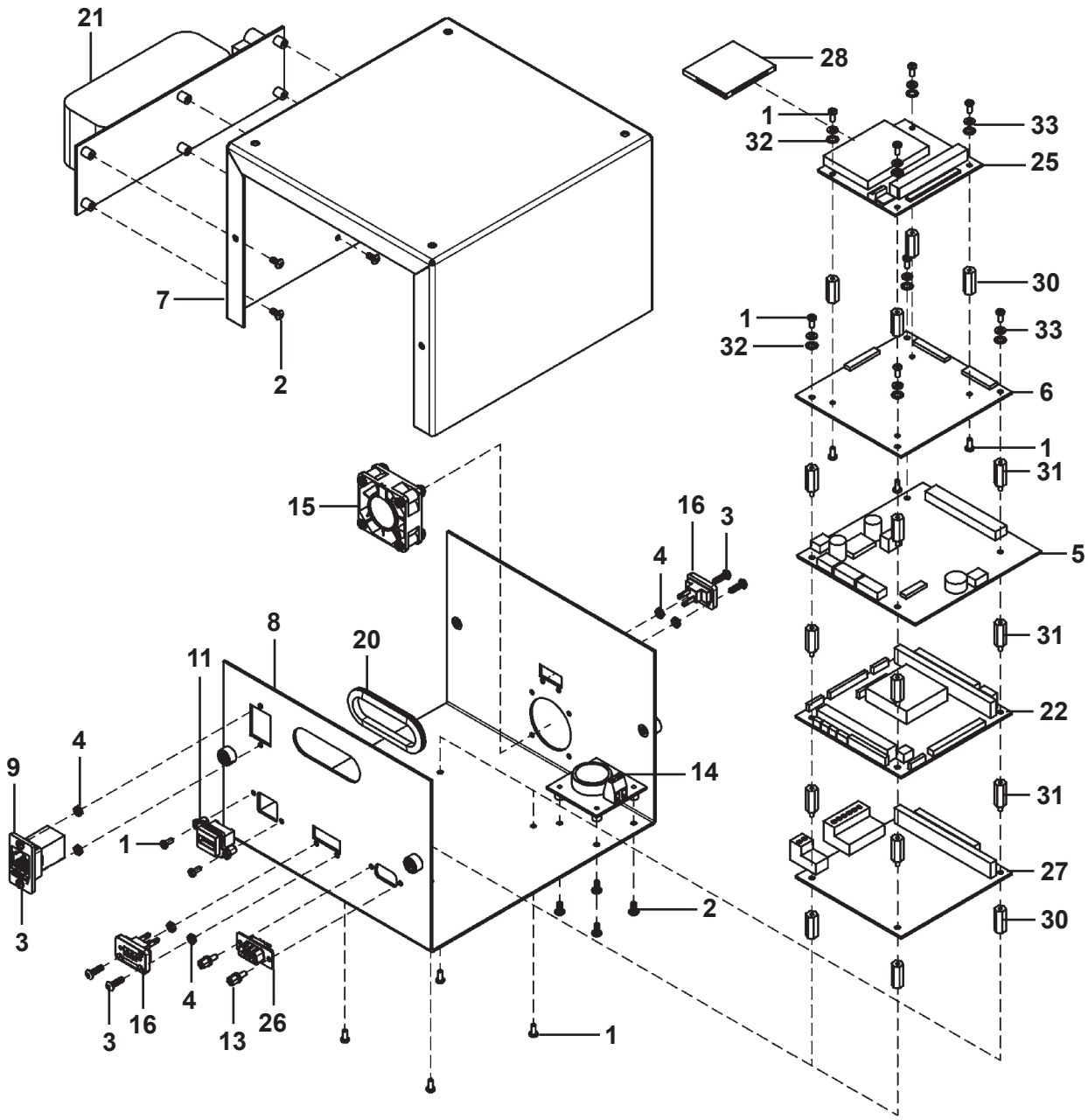


Figure 15.1

SECTION 15.0 CONTROL BOX / PWS-0130 PC104 COMPUTER BOX ASSEMBLY / PARTS LIST

ITEM	QTY	PART NO.	DESCRIPTION
1	18	FAS-0102	Pan Hd Scr 4-40 x 1/4
2	10	MET-0141-SS	Pan Hd Phil Scr M3 x 6
3	6	MET-0143-SS	Pan Hd Phil Scr M3 x 10
4	6	MET-1340-SS	M3 Hex Nut
5	1	PCB-1201	Control Board
6	1	PCB-1204	Video Driver Board
7	1	PWS-0131	Computer Box Assembly
8	1	PWS-0132	Computer Box Cover
9	1	PWS-0133	Modular Coupler
*	1	PWS-0137	Network Cable
11	1	PWS-0138	USB Wiring Harness
13	2	PWS-0144	4-40 Female Screwlock
14	1	PWS-0146	Lithium Battery Assembly
15	1	PWS-0155	Cooling Fan Assembly
16	1	PWS-0161	Can Wiring Harness
17	1	PWS-0167	Video Control Cable
*	1	PWS-0168	Backlight Driver Cable
*	1	PWS-0169	Breakout Control Cable
20	5"	PWS-0174	Grommet Edging
21	1	PWS-0176	UPS Assembly
22	1	PWS-0181	PC104 CPU Board
*	1	PWS-0182	Cable Flat Flex 40 Pos.
*	1	PWS-0183	44 Pin IDE Cable for CPU Board
25	1	PWS-0184	Compact Flash IDE Adapter
26	1	PWS-0186	RS232 DB9 Port and Cable
27	1	PWS-0189	PC104 Power Supply 50 Watt
28	1	PWS-0194	Compact Flash Card 512 MB
*	1	PWS-0196	Windows CE 6 COA
30	8	STOF-P206	3/16" Hex 4-40 Thr. Standoff x 5/8"
31	12	STOF-U206	Standoff M/F Hex 4-40, 3/16" OD x 5/8"
32	8	WAS-0201	#4 Internal Star Lockwasher
33	8	WAS-0202	#4 Washer .250 OD Stainless

* Not Shown

SECTION 15.0 CONTROL BOX / PWS-0120 CONTROL BOX HEAT SINK ASSEMBLY / EXPLODED VIEW / PARTS LIST

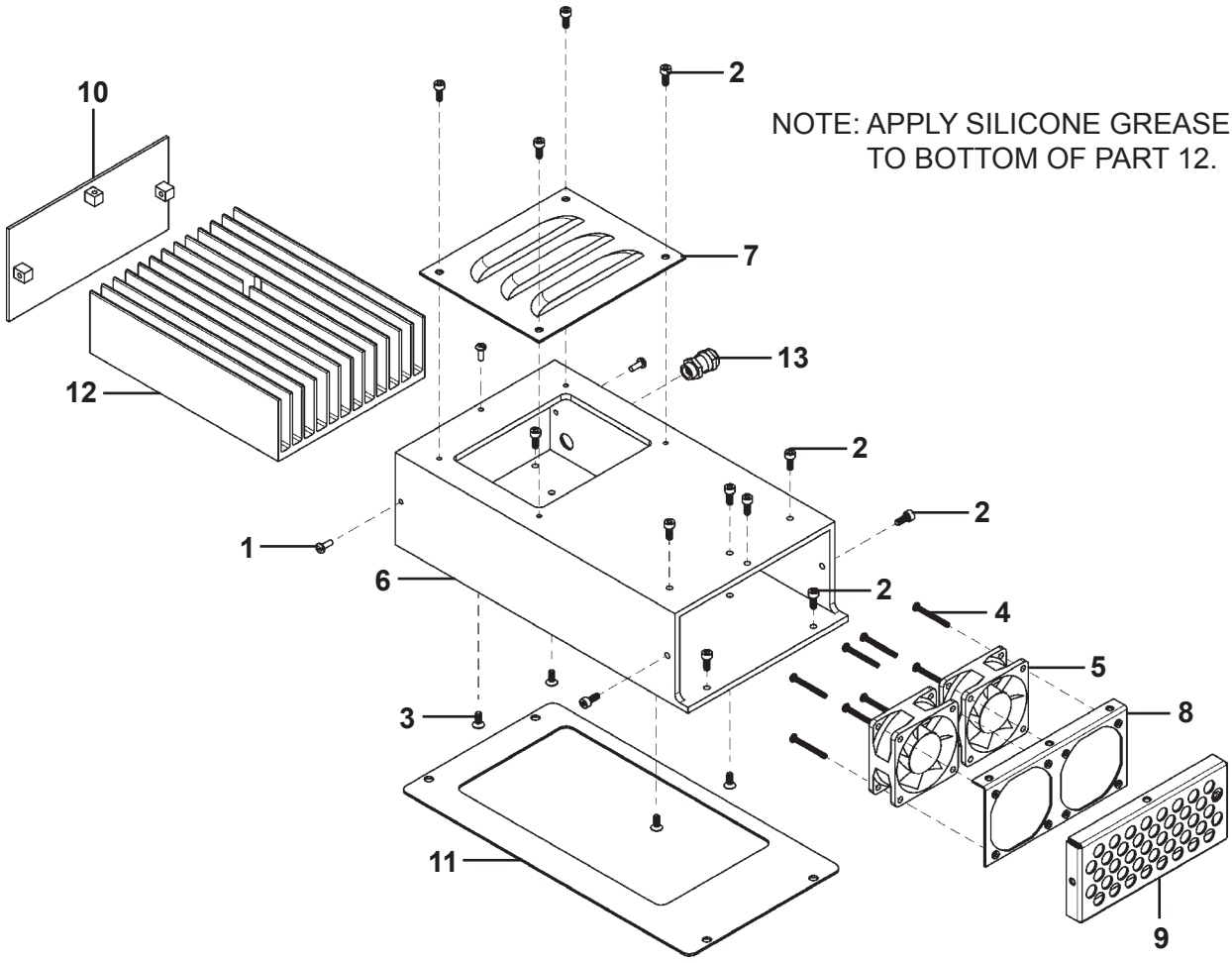


Figure 15.2

ITEM	QTY	PART NO.	DESCRIPTION
1	3	FAS-0114	6-32 x 3/8" Pan Hd Black
2	14	MET-0553-SS	Soc Hd Cap Scr M4 x 10
3	4	MET-0953-SS	Flt Hd Soc Scr M4 x 10
4	8	MET-2143-SS	Pan Hd Phil M3 x 30
5	2	PWS-0113	24V DC Waterproof Fan
6	1	PWS-0121-M1	Heat Sink Enclosure
7	1	PWS-0122	Louver Plate
8	1	PWS-0123	Fan Mounting Bracket Assembly
9	1	PWS-0124	Fan Guard Assembly
10	1	PWS-0126	End Plate Assembly
11	1	PWS-0127	Gasket, .062" Thick Sil Blk
12	1	PWS-0129	Heat Sink Assembly
13	1	PWS-0165	Heat Sink Wiring Harness

SECTION 15.0 CONTROL BOX / PWS-0150 SOLENOID VALVE ASSEMBLY / EXPLODED VIEW / PARTS LIST

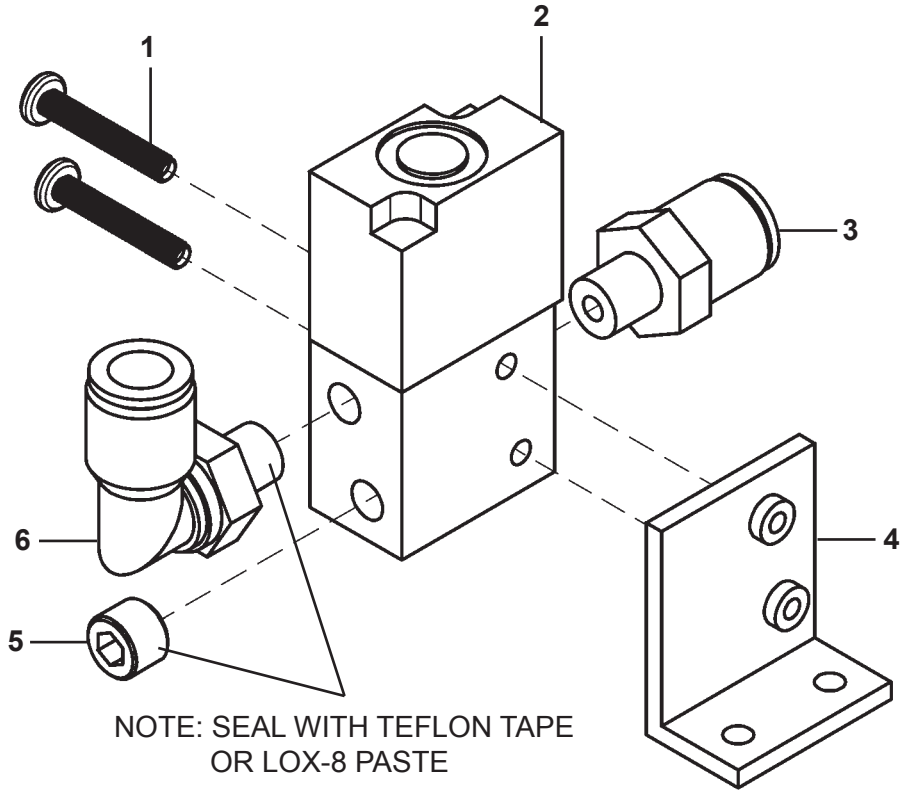
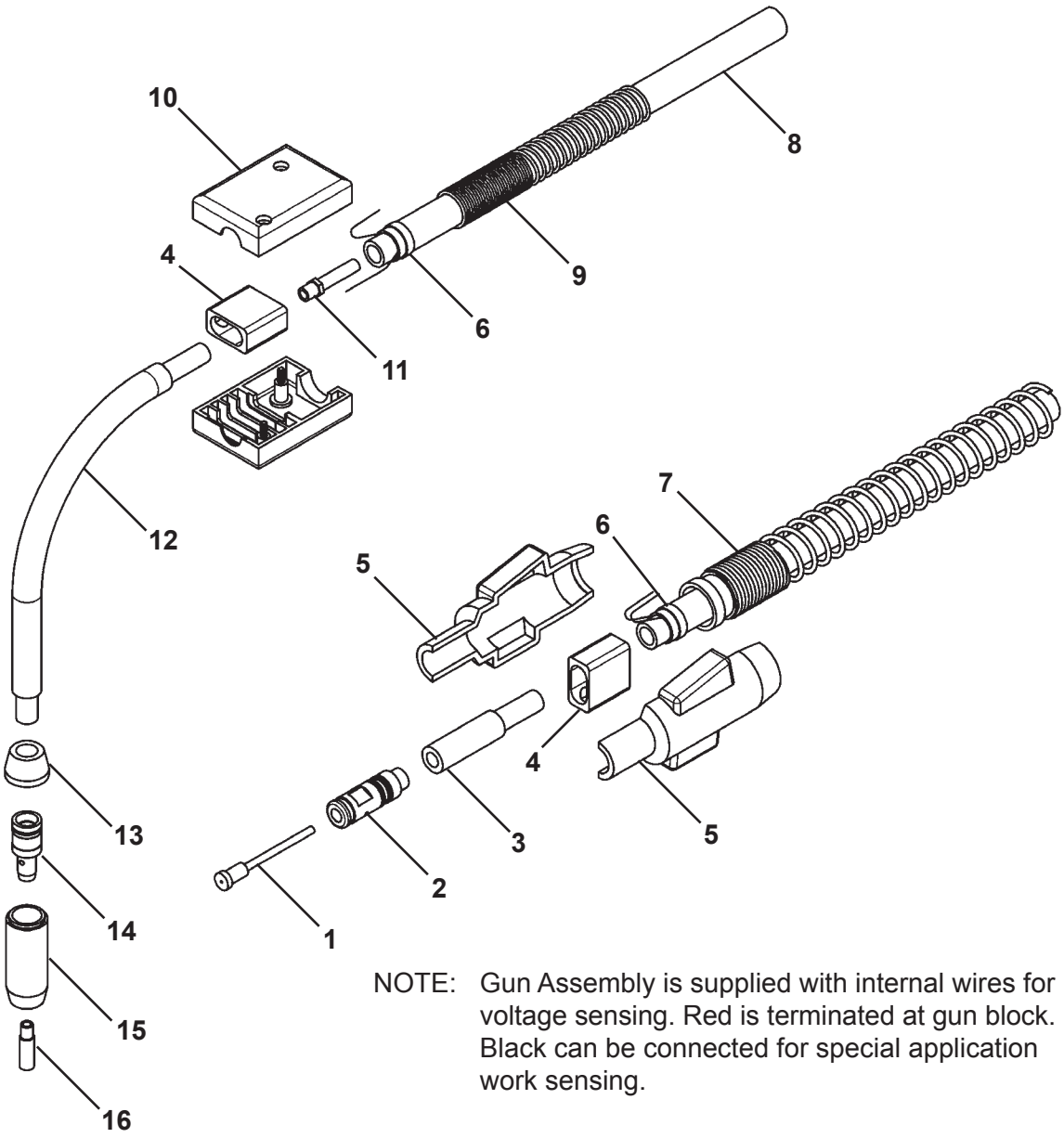


Figure 15.3

ITEM	QTY	PART NO.	DESCRIPTION
1	2	MET-2152-SS	Pan Hd Phil Screw M4 x 25
2	1	PWS-0151	Solenoid Valve
3	1	PWS-0153	Push to Connect Fitting
4	1	PWS-0152	Solenoid Bracket Assembly
5	1	CWO-4134	1/8 NPTF Countersunk Hex Plug
6	1	PWS-0154	90 Deg Push to Connect Fitting 3/8 Dia.

SECTION 16.0 ACCESSORIES / PWS-4400-15-25 GUN & CABLE ASSEMBLY / EXPLODED VIEW



NOTE: Gun Assembly is supplied with internal wires for voltage sensing. Red is terminated at gun block. Black can be connected for special application work sensing.

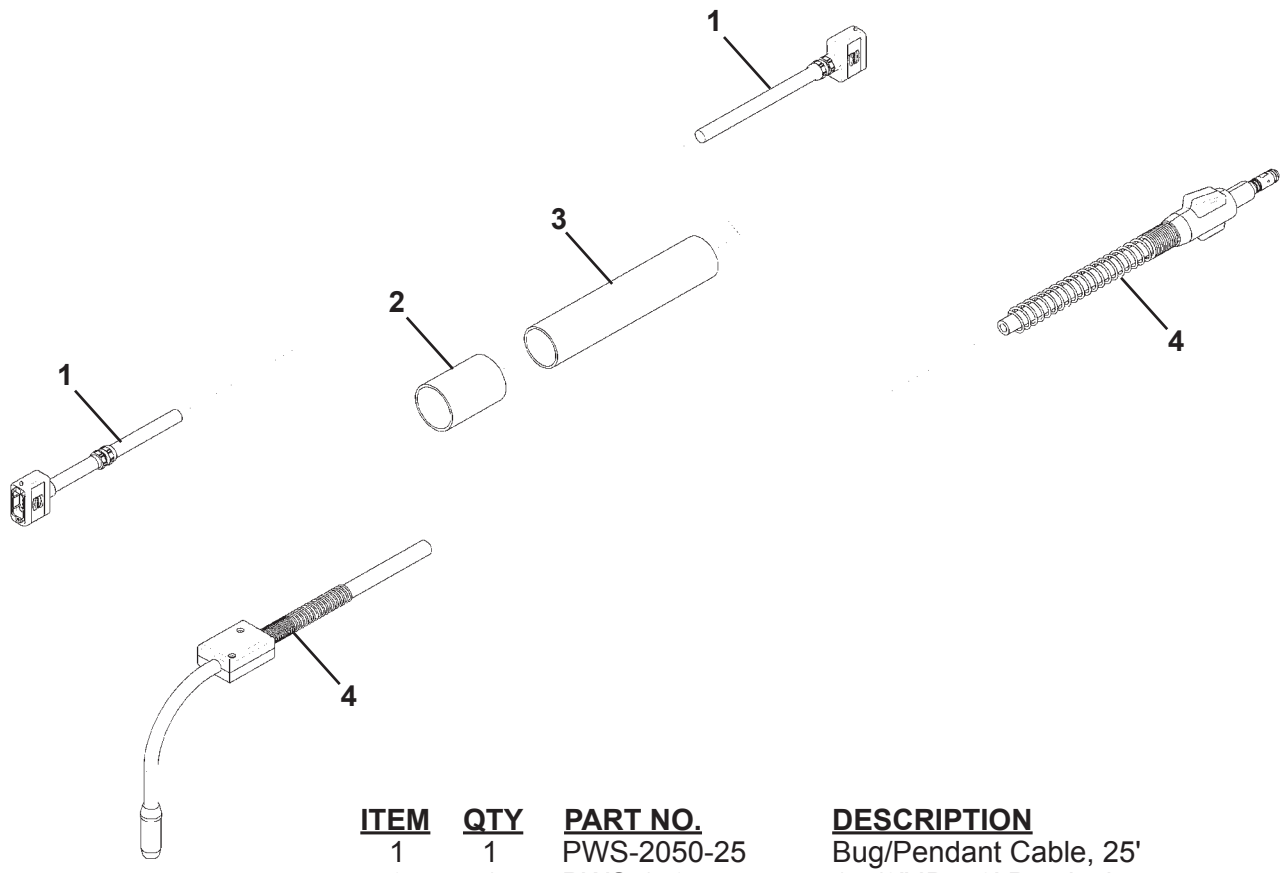
Figure 16.0

SECTION 16.0 ACCESSORIES / PWS-4400-AC-15-25 GUN & CABLE ASSEMBLY / PARTS LIST

ITEM	QTY	PART NO.	DESCRIPTION
1	1	PWS-4405	Coil Liner, .035" .045" Dia. Wire, 15'
*	1	PWS-4406	Coil Liner, 1/16" Dia. Wire, 15'
2	1	PWS-4407	Wire Feeder Connector
*	1	PWS-1432	Set Screw, 8-32
*	1	PWS-4408	O-Ring
3	1	PWS-4409	STD Connector Plug
*	1	STW-3045	Nipple
4	2	PWS-4410	Connector Block Assy
5	1	PWS-4411	Housing, Feeder End
*	2	PWS-4411-SCR	Screws for Housing
6	2	PWS-4412	Spring Clamp
7	1	PWS-4413	Protector Spring, Feeder End
8	1	PWS-4414	500 Amp Mig Cable
9	1	PWS-4415	Protector Spring, Gun End
10	1	PWS-4416	Housing, Gun End
*	2	PWS-4416-SCR	Screws for Housing
11	1	PWS-4417	Nipple, 3/8-24 Thread
12	1	PWS-4418	Goose Neck
*	1	PWS-4418-WC	Goose Neck, Water Cooled
13	1	PWS-4419	H.D. Shock Washer
14	1	PWS-4449	Gas Diffuser
*	1	PWS-1432	Set Screw, 8-32
*	1	PWS-4442	O-Ring
*	1	PWS-4443	Spring
15	1	PWS-4446	H.D. Nozzle, 13mm
	1	PWS-4447	H.D. Nozzle, 16mm
	1	PWS-4448	H.D. Nozzle, 19mm
	1	PWS-4447-WC	H.D. Nozzle, 16mm, Water Cooled
16	1	PWS-4436-__	Contact Tip, Flush Standard
	1	PWS-4437-__	Contact Tip, Flush Tapered
	1	PWS-4438-__	Contact Tip, Recessed Standard
	1	PWS-4439-__	Contact Tip, Recessed Tapered

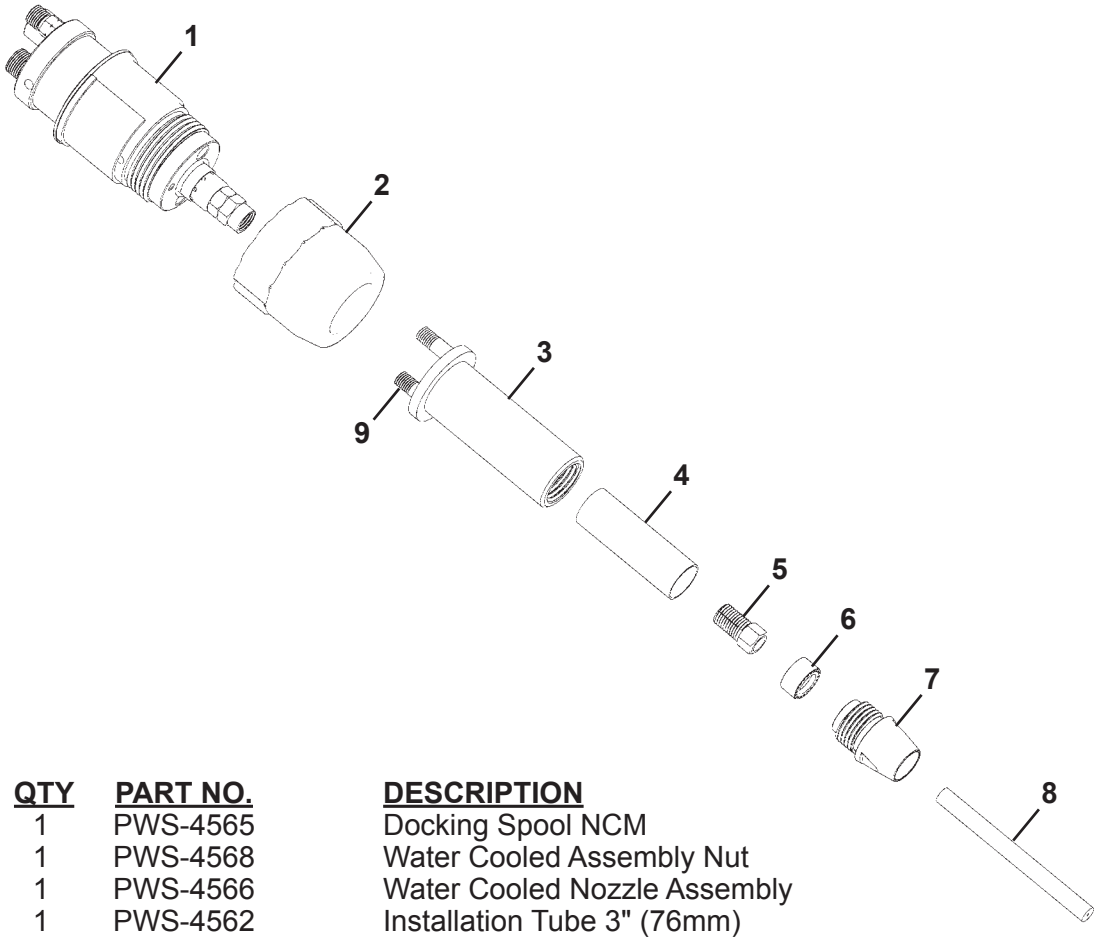
* Not Shown

SECTION 16.0 ACCESSORIES / PWS-4499-AC-15-25 GUN & CABLE ASSEMBLY / EXPLODED VIEW



ITEM	QTY	PART NO.	DESCRIPTION
1	1	PWS-2050-25	Bug/Pendant Cable, 25'
2	1	PWS-1494	1-5/8" ID x 8' Pyrojacket
3	1	PWS-1496-P	1-1/2" ID Flexgard VCO Sleeve
4	1	PWS-4400-15	500 AMP Special Gun & Cable

SECTION 16.0 ACCESSORIES / PWS-4550 DF WATER COOLED WELDING GUN ASSEMBLY / EXPLODED VIEW / PARTS LIST



ITEM	QTY	PART NO.	DESCRIPTION
1	1	PWS-4565	Docking Spool NCM
2	1	PWS-4568	Water Cooled Assembly Nut
3	1	PWS-4566	Water Cooled Nozzle Assembly
4	1	PWS-4562	Installation Tube 3" (76mm)
5	1	PWS-4558	Collet Nut 8mm Slip In Tip
6	1	PWS-4561	Spatter Disc
7	1	PWS-4554	Gas Nozzle 16mm ID
		PWS-4556	Gas Nozzle 11mm ID Tapered
8	1	PWS-4555	Current Tip 1.1mm
		PWS-4557	Current Tip 1.1mm
9	1	PWS-4563	Transfer Fittings
*	1	PWS-4559	Liner 1.1mm-1.6mm 15ft.
*	1	PWS-4567	Liner Casing 15ft.
*	1	PWS-4564	Nozzle Thread Chaser Tap

SECTION 16.0 ACCESSORIES / PWS-4450 TORCH HOLDER ASSEMBLY / EXPLODED VIEW / PARTS LIST

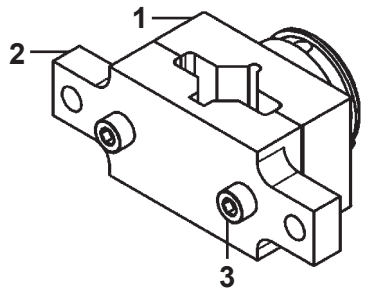


Figure 17.1

ITEM	QTY	PART NO.	DESCRIPTION
1	1	PWS-4451	Torch Holder Block
2	1	PWS-4452	Clamp Block Half
3	2	MET-2564-SS	Soc Hd Cap M5x35 Partial Thr

PWS-4455 SENSING LEAD ASSEMBLY / EXPLODED VIEW / PARTS LIST

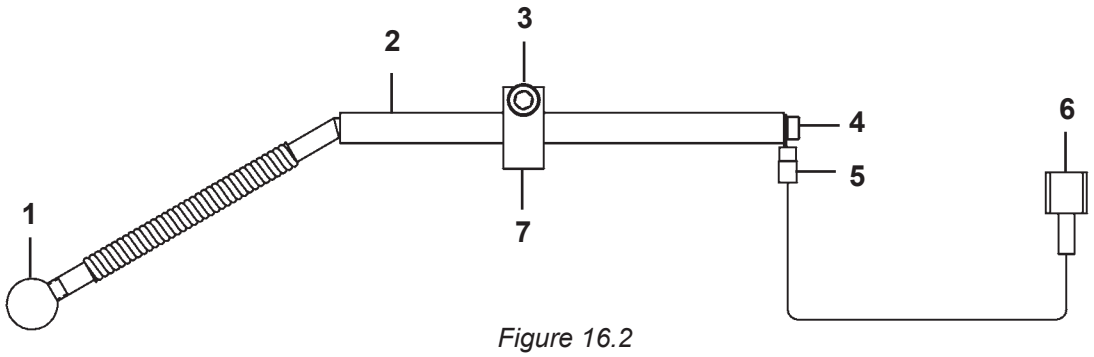


Figure 16.2

ITEM	QTY	PART NO.	DESCRIPTION
1	1	PWS-4457-.625	Sensing Lead Ball, .625 Dia.
2	1	PWS-4456	Sensing Lead
3	1	MET-2573-SS	Soc Hd Cap Scr M6 x 30
4	1	MET-0552-SS	Soc Hd Cap Scr M4 x 8
5	1	TERM WTE 0312	#8 Ring Blue
6	1	TERM 5093	1/4 QD Male Blue Full
7	1	PWS-4453	Sensing Lead Clamp

SECTION 16.0 ACCESSORIES / PWS-5960 PIPER BRR CARRIAGE / EXPLODED VIEW / PARTS LIST

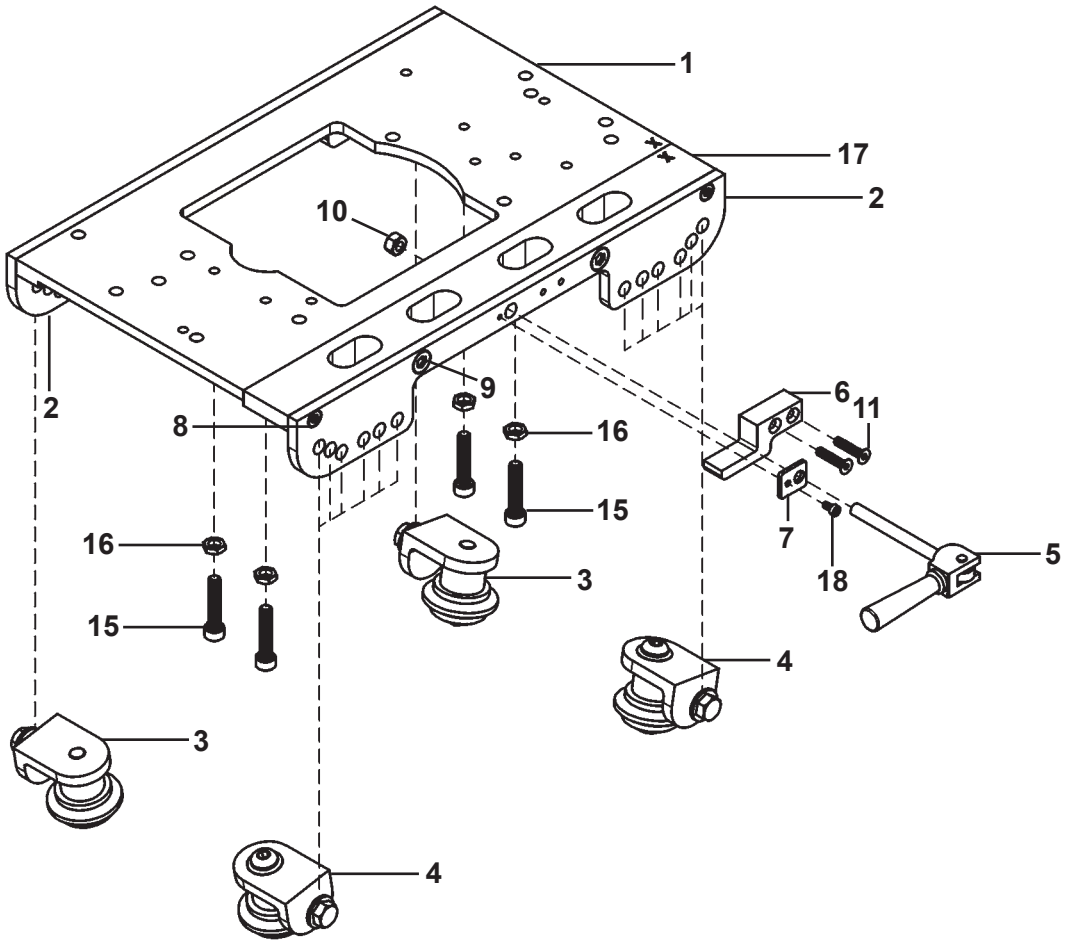


Figure 16.3

ITEM	QTY	PART NO.	DESCRIPTION
1	1	PWS-5961	Carriage Left Plate
2	2	PWS-5964	Carriage Side Plate
3	2	BUG-5918	Fixed Angle Leg w/ Wheel
4	2	BUG-5920	Adjustable Angle Leg w/ Wheel
5	1	BUG-5967	Cam Handle Assembly
6	1	BUG-5962	Cam Stop Block
7	1	PWS-5966	Cam Handle Washer
8	4	FAS-0935	Screw, Flat Head Socket, 10 - 24 x 1/2
9	4	FAS-0957	Screw, Flat Head Socket, 1/4 - 20 x 3/4
10	1	FAS-1353	Rev Two-Way Lock Nut 1/4 - 20
11	2	MET-0958-SS	Flt Hd Soc Scr M4 x 18
*	1	BUG-1979	Label
*	2	BUG-5911	Spring
*	2	BUG-5912	Dowel Pin 18/8, Stainless
15	4	MET-2573-SS	Soc Hd Cap Scr M6 x 30
16	4	MET-1370-SS	M6 Hex Nut
17	1	PWS-5962	Carriage Right Plate
18	1	MET-0541-SS	Soc Hd Cap Scr M3 x 6

* Not Shown

SECTION 16.0 ACCESSORIES / BRR-3250-_ BENT RIGID RAIL / BRR-3255 RIGID RAIL FOOT ASSEMBLY / EXPLODED VIEW / PARTS LIST

BRR-3250-_

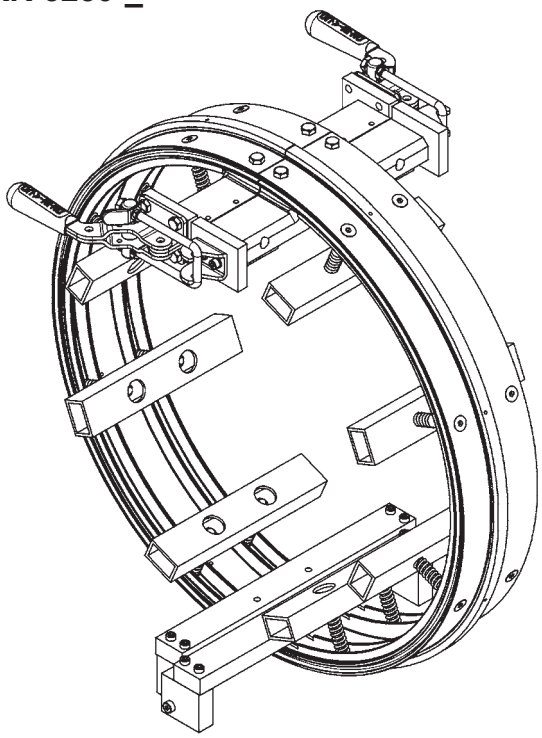


Figure 16.4

BRR-3255 BRR FOOT ASSEMBLY

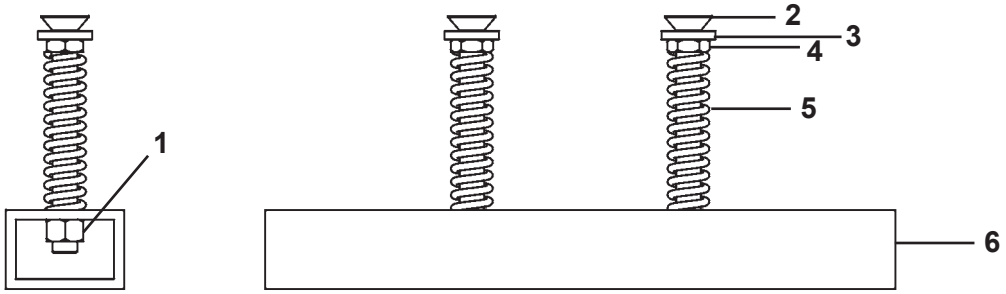
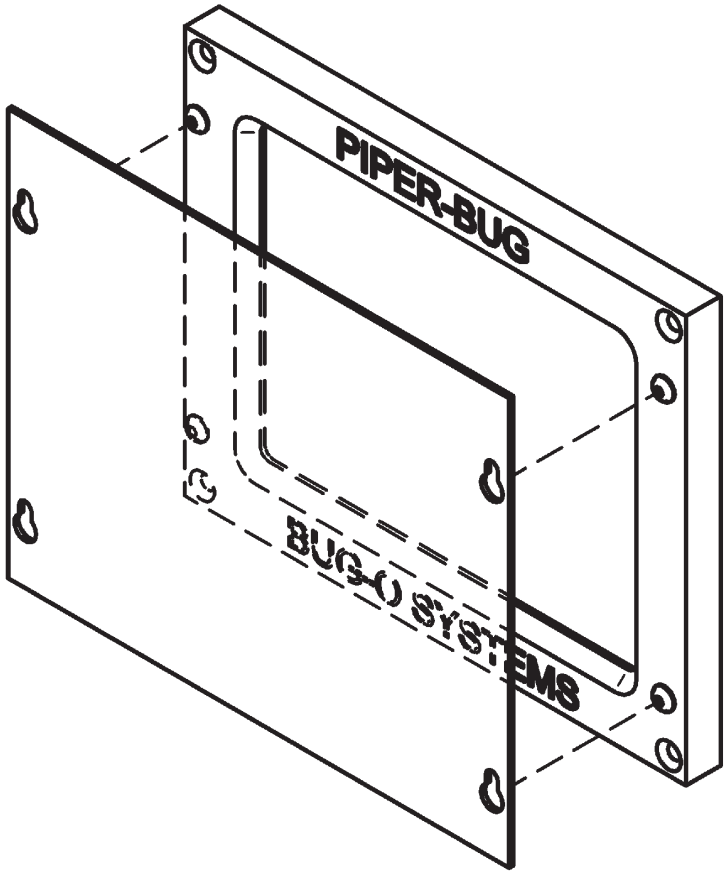


Figure 16.5

ITEM	QTY	PART NO.	DESCRIPTION
1	2	FAS-1374	Hex Nut 5/16-18 Hx Lock Nut Reversible
2	2	FAS-2978	Flt Hd Soc Scr 5/16-18 x 3
3	2	BRR-3253	Spacer
4	2	FAS-1371	Hex Jam Nut 5/16-18
5	2	BRR-3256	Chrome Silicon Steel Die Spring
6	1	BRR-3254	Foot

SECTION 16.0 ACCESSORIES / PWS-0268 PIPER DISPOSABLE DISPLAY COVER



PIPER DISPLAY SCREEN COVER

- Heat and flame resistant Display Screen cover
- This protective screen cover is located on the face of the bezel that surrounds the Display Screen on the Control Box.
- This cover is provided to protect the Display Screen from welding spatter, sparks, and material created during grinding of the work piece.
- It is recommended that this screen be replaced any time the Display Screen cannot be easily observed from within the work environment.
- This cover can be replaced by loosening the 4 locating screws and lifting the screen so the heads of the screws can pass through the enlarged portion of the "keyhole" shaped mounting holes.

SECTION 16.0 ACCESSORIES / PSR-1000 CARRIAGE / EXPLODED VIEW / PARTS LIST

PSR-1000

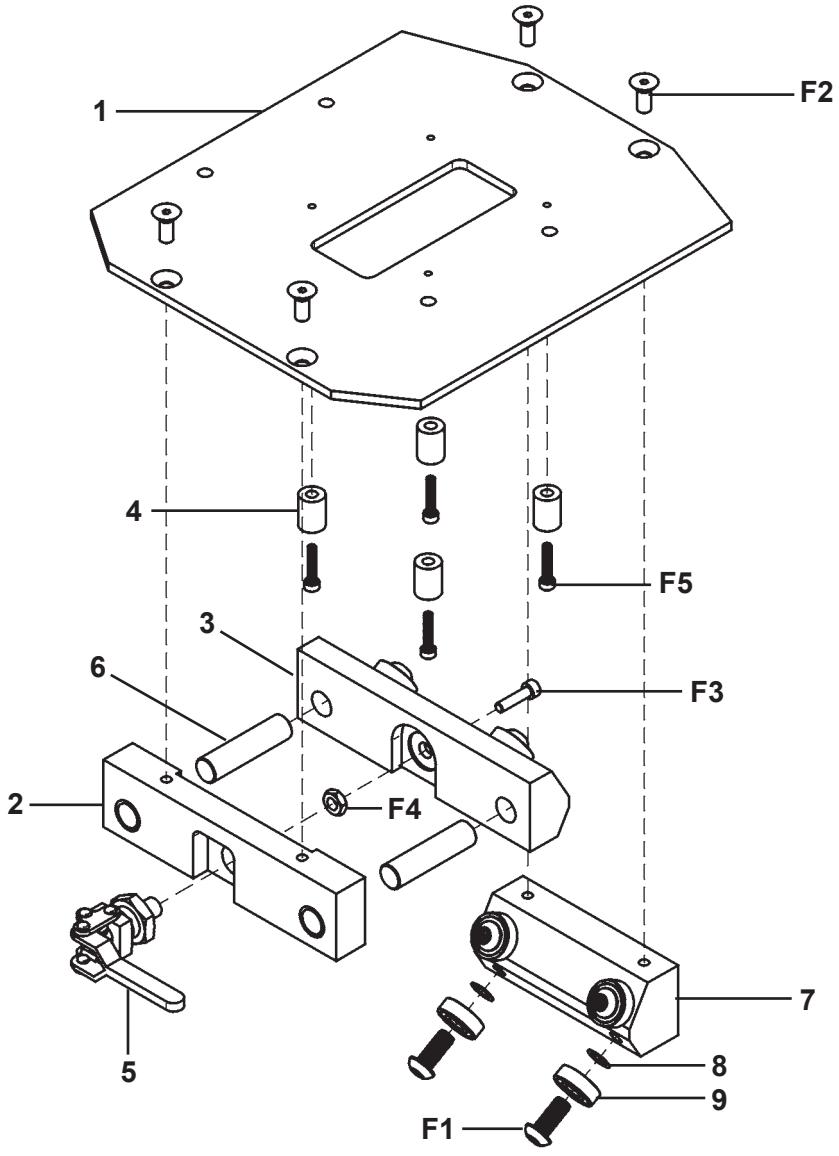


Figure 16.6

ITEM	QTY	PART NO.	DESCRIPTION
1	1	PSR-1001	Carriage Top Plate
2	1	PSR-1002	Bearing Block
3	1	PSR-1003	Adj. Wheel Mounting Block
4	4	PSR-1004	Rail Standoff Spacer
5	1	PSR-1005	Clutch Handle
6	2	FMD-1083	Dowel Pin 1/2" x 2" Lg
7	1	FMD-1068	Fixed Wheel Mounting Block
8	8	CON-1029	Washer 5/16 x .015
9	8	BUG-2012	Bearing
F1	8	FAS-1287	Button Hd Soc Scr 5/16-24 x 3/4
F2	4	FAS-0956	Flt Hd Soc Scr 1/4-20 x 5/8
F3	1	FAS-0557-SS	Soc Hd Cap 1/4-20 x 3/4
F4	1	FAS-1350	Hex Jam Nut 1/4-20
F5	4	MET-0559-SS	Soc Hd Cap M4 x 20

SECTION 16.0 ACCESSORIES / PSR-2000 RAIL / EXPLODED VIEW / PARTS LIST

PSR-2000

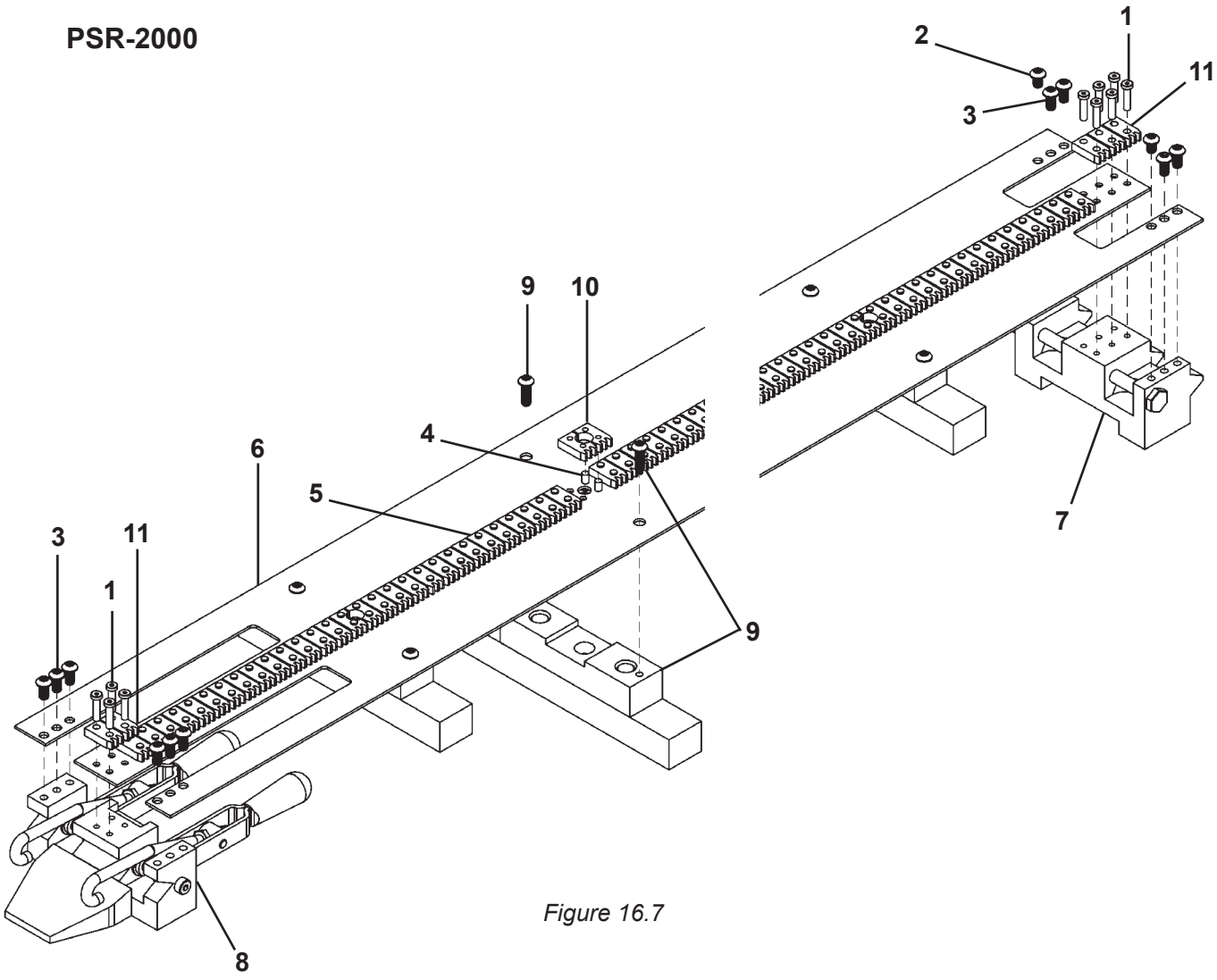


Figure 16.7

ITEM	QTY	PART NO.	DESCRIPTION
1	10	FAS-0548	Soc HD Cap 10-32 x 3/4
2	2	FAS-1264-SS	But HD Soc Scr 1/4-28 x 3/8" *(Shoulder Bolt Clearance)*
3	10	FAS-1265-SS	But HD Soc Scr 1/4-28 x 1/2"
4	**	FAS-1444	Phil Pan HD Scr 10-32 x 3/8 Zinc
5	**	FMD-1052	Rack Section, 3 Teeth
6	1	PSR-2001-XX-P	Piper-Flex Band for 40" O.D.
7	1	PSR-2005-CATCH	PSR Steel Rail Latch, Catch
8	1	PSR-2005-HOOK	Piper Steel Rail, Hook Side
9	**	PSR-2020	PSR Adj. Foot Assembly
10	**	PSR-2019	PSR Adj. Foot Rack Section
11	5	PSR-2021	PSR Latch Rack Section

** Quantity Varies

SECTION 16.0 ACCESSORIES / PWS-1300-_ PWS PIPE GROUND ASSEMBLY / EXPLODED VIEW / PARTS LIST

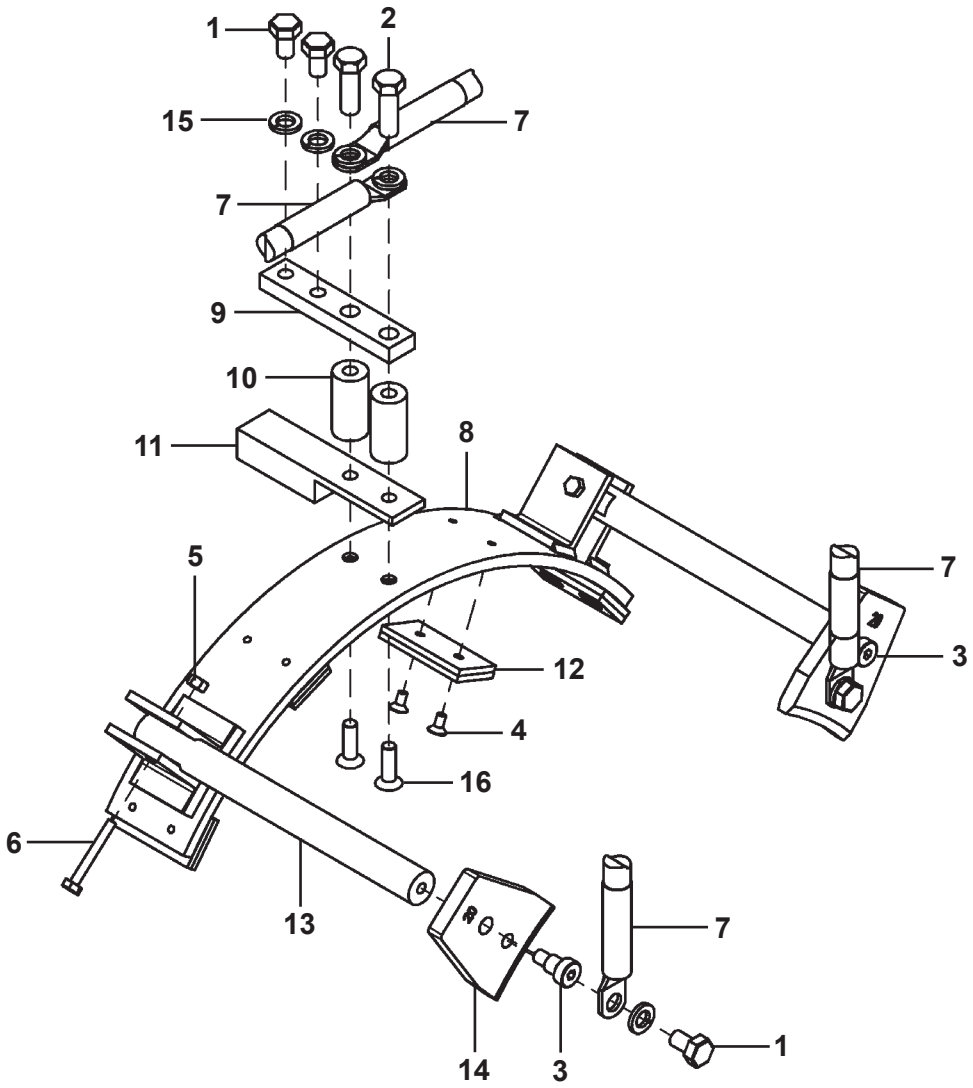


Figure 16.8

ITEM	QTY	PART NO.	DESCRIPTION
1	4	FAS-0307	Hex Hd Cap Scr 1/2-13 x 3/4"
2	2	FAS-0308	Hex Hd Cap Scr 1/2-13 x 1 1/2"
3	2	FAS-0695	Soc Hd Shr 1/2 x 1/2 x 3/8-16
4	8	FAS-0955	Flt Hd Soc Scr 1/4-20 x 1/2"
5	2	FAS-1374	5/16-18 Hex Lock Nut Reversible
6	2	FAS-2375	Hex Hd Cap Scr 5/16-18 x 2"
7	2	PWS-1305-XX	Cable Assembly
8	1	PWS-1310-XX	Band Weldment
9	1	PWS-1311	Cable Block
10	2	PWS-1312	Insulator Standoff
11	1	PWS-1313	Stabilizer Block
12	4	PWS-1317	Rubberized Foot
13	2	PWS-1321	Point Arm
14	2	PWS-1327-XX	Grounding Foot
15	6	WAS-0281	1/2" Split Lockwasher
16	2	FAS-0995	Flt Hd Soc Scr 3/8-16 x 2"

SECTION 16.0 ACCESSORIES / PWS-4600 WIRE KITS

PART NO.	QTY	PART NO.	DESCRIPTION
PWS-4600-1.2V13FT			**1.2MM SOLID WIRE, 13 MM NOZZLE, FLUSH-TAPERED TIP**
	5	PWS-4449	GAS DIFFUSER
	5	PWS-4443	SPRING
	5	PWS-4442	O-RING
	5	PWS-1432	SET SCREW FOR GAS DIFFUSER (SPARE)
	50	PWS-4436-1.2	0.045" FLUSH-STANDARD CONTACT TIP
	5	PWS-4446	1/2" I.D. NOZZLE
	1	CWO-8039	15' COIL LINER FOR 0.035"-0.045" WIRE
	1	PWS-4431-1.2	1.2MM (0.045") V DRIVE ROLL (SET)
PWS-4600-1.2K13FT			**1.2MM CORED WIRE, 13 MM NOZZLE, FLUSH-TAPERED TIP**
	5	PWS-4449	GAS DIFFUSER
	5	PWS-4443	SPRING
	5	PWS-4442	O-RING
	5	PWS-1432	SET SCREW FOR GAS DIFFUSER (SPARE)
	50	PWS-4437-1.2	0.045" FLUSH-TAPERED CONTACT TIP
	5	PWS-4446	1/2" I.D. NOZZLE
	1	CWO-8039	15' COIL LINER FOR 0.035"-0.045" WIRE
	1	PWS-4432-1.2	1.2MM (0.045") V KNURLED DRIVE ROLL (SET)
PWS-4600-1.2V16FT			**1.2MM SOLID WIRE, 16 MM NOZZLE, FLUSH-TAPERED TIP**
	5	PWS-4449	GAS DIFFUSER
	5	PWS-4443	SPRING
	5	PWS-4442	O-RING
	5	PWS-1432	SET SCREW FOR GAS DIFFUSER (SPARE)
	50	PWS-4437-1.2	0.045" FLUSH-TAPERED CONTACT TIP
	5	PWS-4447	5/8" I.D. NOZZLE
	1	CWO-8039	15' COIL LINER FOR 0.035"-0.045" WIRE
	1	PWS-4431-1.2	1.2MM (0.045") V DRIVE ROLL (SET)
PWS-4600-1.2K16FT			**1.2MM CORED WIRE, 16 MM NOZZLE, FLUSH-TAPERED TIP**
	5	PWS-4449	GAS DIFFUSER
	5	PWS-4443	SPRING
	5	PWS-4442	O-RING
	5	PWS-1432	SET SCREW FOR GAS DIFFUSER (SPARE)
	50	PWS-4437-1.2	0.045" FLUSH-TAPERED CONTACT TIP
	5	PWS-4447	5/8" I.D. NOZZLE
	1	CWO-8039	15' COIL LINER FOR 0.035"-0.045" WIRE
	1	PWS-4432-1.2	1.2MM (0.045") V KNURLED DRIVE ROLL (SET)
PWS-4600-1.2V19FT			**1.2MM SOLID WIRE, 19 MM NOZZLE, FLUSH-TAPERED TIP**
	5	PWS-4449	GAS DIFFUSER
	5	PWS-4443	SPRING
	5	PWS-4442	O-RING
	5	PWS-1432	SET SCREW FOR GAS DIFFUSER (SPARE)
	50	PWS-4437-1.2	0.045" FLUSH-TAPERED CONTACT TIP
	5	PWS-4448	3/4" I.D. NOZZLE
	1	CWO-8039	15' COIL LINER FOR 0.035"-0.045" WIRE
	1	PWS-4431-1.2	1.2MM (0.045") V DRIVE ROLL (SET)
PWS-4600-1.2K19FT			**1.2MM CORED WIRE, 19 MM NOZZLE, FLUSH-TAPERED TIP**
	5	PWS-4449	GAS DIFFUSER
	5	PWS-4443	SPRING
	5	PWS-4442	O-RING
	5	PWS-1432	SET SCREW FOR GAS DIFFUSER (SPARE)
	50	PWS-4437-1.2	0.045" FLUSH-TAPERED CONTACT TIP
	5	PWS-4448	3/4" I.D. NOZZLE
	1	CWO-8039	15' COIL LINER FOR 0.035"-0.045" WIRE
	1	PWS-4432-1.2	1.2MM (0.045") V KNURLED DRIVE ROLL (SET)

SECTION 16.0 ACCESSORIES / PWS-4600 WIRE KITS, CONT'D.

PART NO.	QTY	PART NO.	DESCRIPTION
PWS-4600-1.2V13RS			**1.2MM SOLID WIRE, 13 MM NOZZLE, RECESSED-STANDARD TIP**
	5	PWS-4449	GAS DIFFUSER
	5	PWS-4443	SPRING
	5	PWS-4442	O-RING
	5	PWS-1432	SET SCREW FOR GAS DIFFUSER (SPARE)
	50	PWS-4438-1.2	0.045" RECESSED-STANDARD CONTACT TIP
	5	PWS-4446	1/2" I.D. NOZZLE
	1	CWO-8039	15' COIL LINER FOR 0.035"-0.045" WIRE
	1	PWS-4431-1.2	1.2MM (0.045") V DRIVE ROLL (SET)
PWS-4600-1.2K13RS			**1.2MM CORED WIRE, 13 MM NOZZLE, RECESSED-STANDARD TIP**
	5	PWS-4449	GAS DIFFUSER
	5	PWS-4443	SPRING
	5	PWS-4442	O-RING
	5	PWS-1432	SET SCREW FOR GAS DIFFUSER (SPARE)
	50	PWS-4438-1.2	0.045" RECESSED-STANDARD CONTACT TIP
	5	PWS-4446	1/2" I.D. NOZZLE
	1	CWO-8039	15' COIL LINER FOR 0.035"-0.045" WIRE
	1	PWS-4432-1.2	1.2MM (0.045") V KNURLED DRIVE ROLL (SET)
PWS-4600-1.2V16RS			**1.2MM SOLID WIRE, 16MM NOZZLE, RECESSED-STANDARD TIP**
	5	PWS-4449	GAS DIFFUSER
	5	PWS-4443	SPRING
	5	PWS-4442	O-RING
	5	PWS-1432	SET SCREW FOR GAS DIFFUSER (SPARE)
	50	PWS-4438-1.2	0.045" RECESSED-STANDARD CONTACT TIP
	5	PWS-4447	5/8" I.D. NOZZLE
	1	CWO-8039	15' COIL LINER FOR 0.035"-0.045" WIRE
	1	PWS-4431-1.2	1.2MM (0.045") V DRIVE ROLL (SET)
PWS-4600-1.2K16RS			**1.2MM CORED WIRE, 16MM NOZZLE, RECESSED-STANDARD TIP**
	5	PWS-4449	GAS DIFFUSER
	5	PWS-4443	SPRING
	5	PWS-4442	O-RING
	5	PWS-1432	SET SCREW FOR GAS DIFFUSER (SPARE)
	50	PWS-4438-1.2	0.045" RECESSED-STANDARD CONTACT TIP
	5	PWS-4447	5/8" I.D. NOZZLE
	1	CWO-8039	15' COIL LINER FOR 0.035"-0.045" WIRE
	1	PWS-4432-1.2	1.2MM (0.045") V KNURLED DRIVE ROLL (SET)
PWS-4600-1.2V19RS			**1.2MM SOLID WIRE, 19MM NOZZLE, RECESSED-STANDARD TIP**
	5	PWS-4449	GAS DIFFUSER
	5	PWS-4443	SPRING
	5	PWS-4442	O-RING
	5	PWS-1432	SET SCREW FOR GAS DIFFUSER (SPARE)
	50	PWS-4438-1.2	0.045" RECESSED-STANDARD CONTACT TIP
	5	PWS-4448	3/4" I.D. NOZZLE
	1	CWO-8039	15' COIL LINER FOR 0.035"-0.045" WIRE
	1	PWS-4431-1.2	1.2MM (0.045") V DRIVE ROLL (SET)
PWS-4600-1.2K19RS			**1.2MM CORED WIRE, 19MM NOZZLE, RECESSED-STANDARD TIP**
	5	PWS-4449	GAS DIFFUSER
	5	PWS-4443	SPRING
	5	PWS-4442	O-RING
	5	PWS-1432	SET SCREW FOR GAS DIFFUSER (SPARE)
	50	PWS-4438-1.2	0.045" RECESSED-STANDARD CONTACT TIP
	5	PWS-4448	3/4" I.D. NOZZLE
	1	CWO-8039	15' COIL LINER FOR 0.035"-0.045" WIRE
	1	PWS-4432-1.2	1.2MM (0.045") V KNURLED DRIVE ROLL (SET)

SECTION 16.0 ACCESSORIES / PWS-4600 WIRE KITS, CONT'D.

PART NO.	QTY	PART NO.	DESCRIPTION
PWS-4600-1.2V13FS			**1.2MM SOLID WIRE, 13 MM NOZZLE, FLUSH-STANDARD TIP**
	5	PWS-4449	GAS DIFFUSER
	5	PWS-4443	SPRING
	5	PWS-4442	O-RING
	5	PWS-1432	SET SCREW FOR GAS DIFFUSER (SPARE)
	50	PWS-4436-1.2	0.045" FLUSH-STANDARD CONTACT TIP
	5	PWS-4446	1/2" I.D. NOZZLE
	1	CWO-8039	15' COIL LINER FOR 0.035"-0.045" WIRE
	1	PWS-4431-1.2	1.2MM (0.045") V DRIVE ROLL (SET)
PWS-4600-1.2K13FS			**1.2MM CORED WIRE, 13 MM NOZZLE, FLUSH-STANDARD TIP**
	5	PWS-4449	GAS DIFFUSER
	5	PWS-4443	SPRING
	5	PWS-4442	O-RING
	5	PWS-1432	SET SCREW FOR GAS DIFFUSER (SPARE)
	50	PWS-4436-1.2	0.045" FLUSH-STANDARD CONTACT TIP
	5	PWS-4446	1/2" I.D. NOZZLE
	1	CWO-8039	15' COIL LINER FOR 0.035"-0.045" WIRE
	1	PWS-4432-1.2	1.2MM (0.045") V KNURLED DRIVE ROLL (SET)
PWS-4600-1.2V16FS			**1.2MM SOLID WIRE, 16MM NOZZLE, FLUSH-STANDARD TIP**
	5	PWS-4449	GAS DIFFUSER
	5	PWS-4443	SPRING
	5	PWS-4442	O-RING
	5	PWS-1432	SET SCREW FOR GAS DIFFUSER (SPARE)
	50	PWS-4436-1.2	0.045" FLUSH-STANDARD CONTACT TIP
	5	PWS-4447	5/8" I.D. NOZZLE
	1	CWO-8039	15' COIL LINER FOR 0.035"-0.045" WIRE
	1	PWS-4431-1.2	1.2MM (0.045") V DRIVE ROLL (SET)
PWS-4600-1.2K16FS			**1.2MM CORED WIRE, 16MM NOZZLE, FLUSH-STANDARD TIP**
	5	PWS-4449	GAS DIFFUSER
	5	PWS-4443	SPRING
	5	PWS-4442	O-RING
	5	PWS-1432	SET SCREW FOR GAS DIFFUSER (SPARE)
	50	PWS-4436-1.2	0.045" FLUSH-STANDARD CONTACT TIP
	5	PWS-4447	5/8" I.D. NOZZLE
	1	CWO-8039	15' COIL LINER FOR 0.035"-0.045" WIRE
	1	PWS-4432-1.2	1.2MM (0.045") V KNURLED DRIVE ROLL (SET)
PWS-4600-1.2V19FS			**1.2MM SOLID WIRE, 19MM NOZZLE, FLUSH-STANDARD TIP**
	5	PWS-4449	GAS DIFFUSER
	5	PWS-4443	SPRING
	5	PWS-4442	O-RING
	5	PWS-1432	SET SCREW FOR GAS DIFFUSER (SPARE)
	50	PWS-4436-1.2	0.045" FLUSH-STANDARD CONTACT TIP
	5	PWS-4448	3/4" I.D. NOZZLE
	1	CWO-8039	15' COIL LINER FOR 0.035"-0.045" WIRE
	1	PWS-4431-1.2	1.2MM (0.045") V DRIVE ROLL (SET)
PWS-4600-1.2K19FS			**1.2MM CORED WIRE, 19MM NOZZLE, FLUSH-STANDARD TIP**
	5	PWS-4449	GAS DIFFUSER
	5	PWS-4443	SPRING
	5	PWS-4442	O-RING
	5	PWS-1432	SET SCREW FOR GAS DIFFUSER (SPARE)
	50	PWS-4436-1.2	0.045" FLUSH-STANDARD CONTACT TIP
	5	PWS-4448	3/4" I.D. NOZZLE
	1	CWO-8039	15' COIL LINER FOR 0.035"-0.045" WIRE
	1	PWS-4432-1.2	1.2MM (0.045") V KNURLED DRIVE ROLL (SET)

SECTION 16.0 ACCESSORIES / PWS-4600 WIRE KITS, CONT'D.

PART NO.	QTY	PART NO.	DESCRIPTION
PWS-4600-1.2V13RT			**1.2MM SOLID WIRE, 13 MM NOZZLE, RECESSED-TAPERED TIP**
	5	PWS-4449	GAS DIFFUSER
	5	PWS-4443	SPRING
	5	PWS-4442	O-RING
	5	PWS-1432	SET SCREW FOR GAS DIFFUSER (SPARE)
	50	PWS-4439-1.2	0.045" RECESSED-TAPERED CONTACT TIP
	5	PWS-4446	1/2" I.D. NOZZLE
	1	CWO-8039	15' COIL LINER FOR 0.035"-0.045" WIRE
	1	PWS-4431-1.2	1.2MM (0.045") V DRIVE ROLL (SET)
PWS-4600-1.2K13RT			**1.2MM CORED WIRE, 13 MM NOZZLE, RECESSED-TAPERED TIP**
	5	PWS-4449	GAS DIFFUSER
	5	PWS-4443	SPRING
	5	PWS-4442	O-RING
	5	PWS-1432	SET SCREW FOR GAS DIFFUSER (SPARE)
	50	PWS-4439-1.2	0.045" RECESSED-TAPERED CONTACT TIP
	5	PWS-4446	1/2" I.D. NOZZLE
	1	CWO-8039	15' COIL LINER FOR 0.035"-0.045" WIRE
	1	PWS-4432-1.2	1.2MM (0.045") V KNURLED DRIVE ROLL (SET)
PWS-4600-1.2V16RT			**1.2MM SOLID WIRE, 16MM NOZZLE, RECESSED-TAPERED TIP**
	5	PWS-4449	GAS DIFFUSER
	5	PWS-4443	SPRING
	5	PWS-4442	O-RING
	5	PWS-1432	SET SCREW FOR GAS DIFFUSER (SPARE)
	50	PWS-4439-1.2	0.045" RECESSED-TAPERED CONTACT TIP
	5	PWS-4447	5/8" I.D. NOZZLE
	1	CWO-8039	15' COIL LINER FOR 0.035"-0.045" WIRE
	1	PWS-4431-1.2	1.2MM (0.045") V DRIVE ROLL (SET)
PWS-4600-1.2K16RT			**1.2MM CORED WIRE, 16MM NOZZLE, RECESSED-TAPERED TIP**
	5	PWS-4449	GAS DIFFUSER
	5	PWS-4443	SPRING
	5	PWS-4442	O-RING
	5	PWS-1432	SET SCREW FOR GAS DIFFUSER (SPARE)
	50	PWS-4439-1.2	0.045" RECESSED-TAPERED CONTACT TIP
	5	PWS-4447	5/8" I.D. NOZZLE
	1	CWO-8039	15' COIL LINER FOR 0.035"-0.045" WIRE
	1	PWS-4432-1.2	1.2MM (0.045") V KNURLED DRIVE ROLL (SET)
PWS-4600-1.2V19RT			**1.2MM SOLID WIRE, 19MM NOZZLE, RECESSED-TAPERED TIP**
	5	PWS-4449	GAS DIFFUSER
	5	PWS-4443	SPRING
	5	PWS-4442	O-RING
	5	PWS-1432	SET SCREW FOR GAS DIFFUSER (SPARE)
	50	PWS-4439-1.2	0.045" RECESSED-TAPERED CONTACT TIP
	5	PWS-4448	3/4" I.D. NOZZLE
	1	CWO-8039	15' COIL LINER FOR 0.035"-0.045" WIRE
	1	PWS-4431-1.2	1.2MM (0.045") V DRIVE ROLL (SET)
PWS-4600-1.2K19RT			**1.2MM CORED WIRE, 19MM NOZZLE, RECESSED-TAPERED TIP**
	5	PWS-4449	GAS DIFFUSER
	5	PWS-4443	SPRING
	5	PWS-4442	O-RING
	5	PWS-1432	SET SCREW FOR GAS DIFFUSER (SPARE)
	50	PWS-4439-1.2	0.045" RECESSED-TAPERED CONTACT TIP
	5	PWS-4448	3/4" I.D. NOZZLE
	1	CWO-8039	15' COIL LINER FOR 0.035"-0.045" WIRE
	1	PWS-4432-1.2	1.2MM (0.045") V KNURLED DRIVE ROLL (SET)

****PLEASE CONTACT FACTORY FOR OTHER WIRE DIAMETERS.**

SECTION 17.0 WIRING DIAGRAMS / TRACTOR

PWS-1000

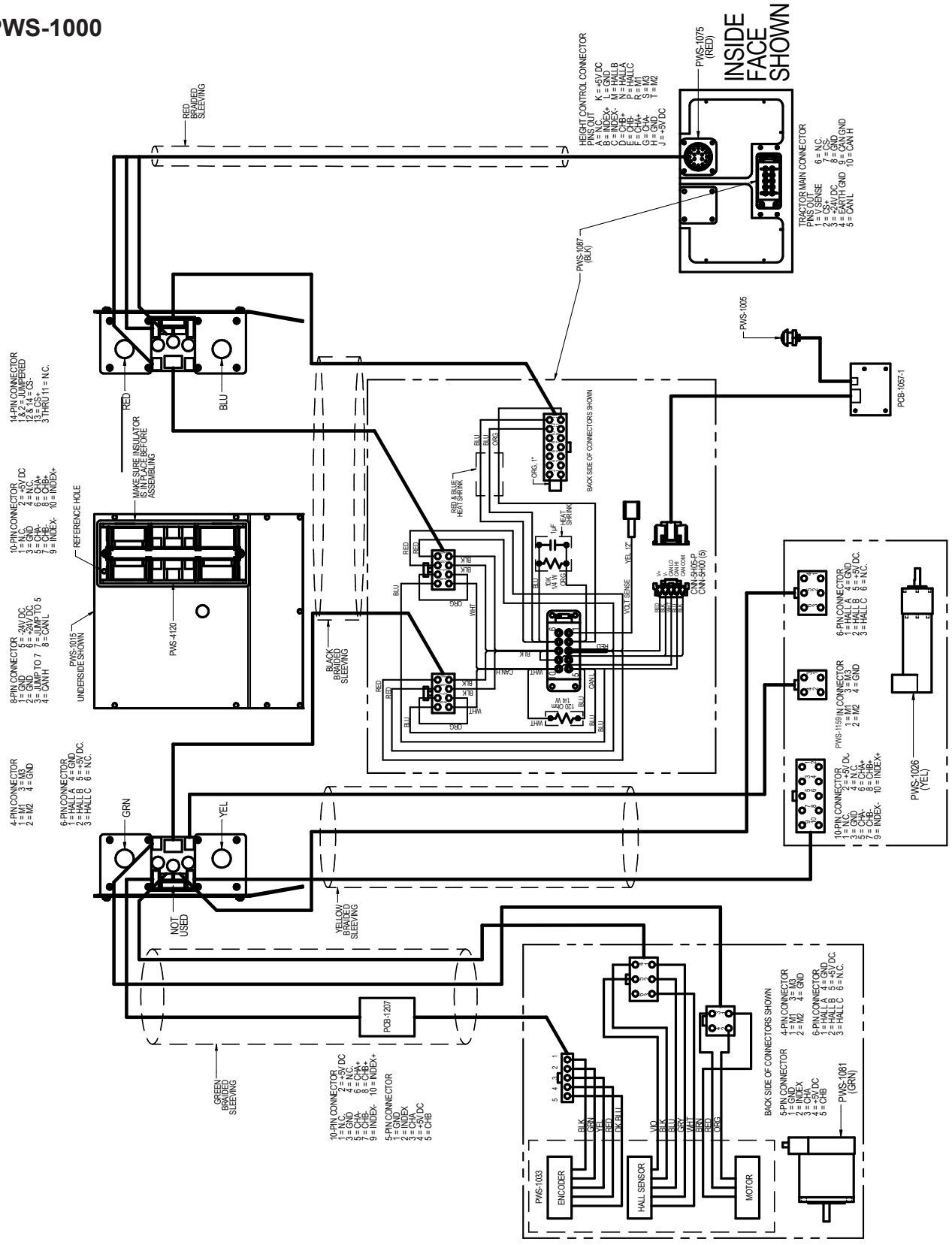


Figure 17.0

SECTION 17.0 WIRING DIAGRAMS / TRACTOR / MOTOR

PWS-1058

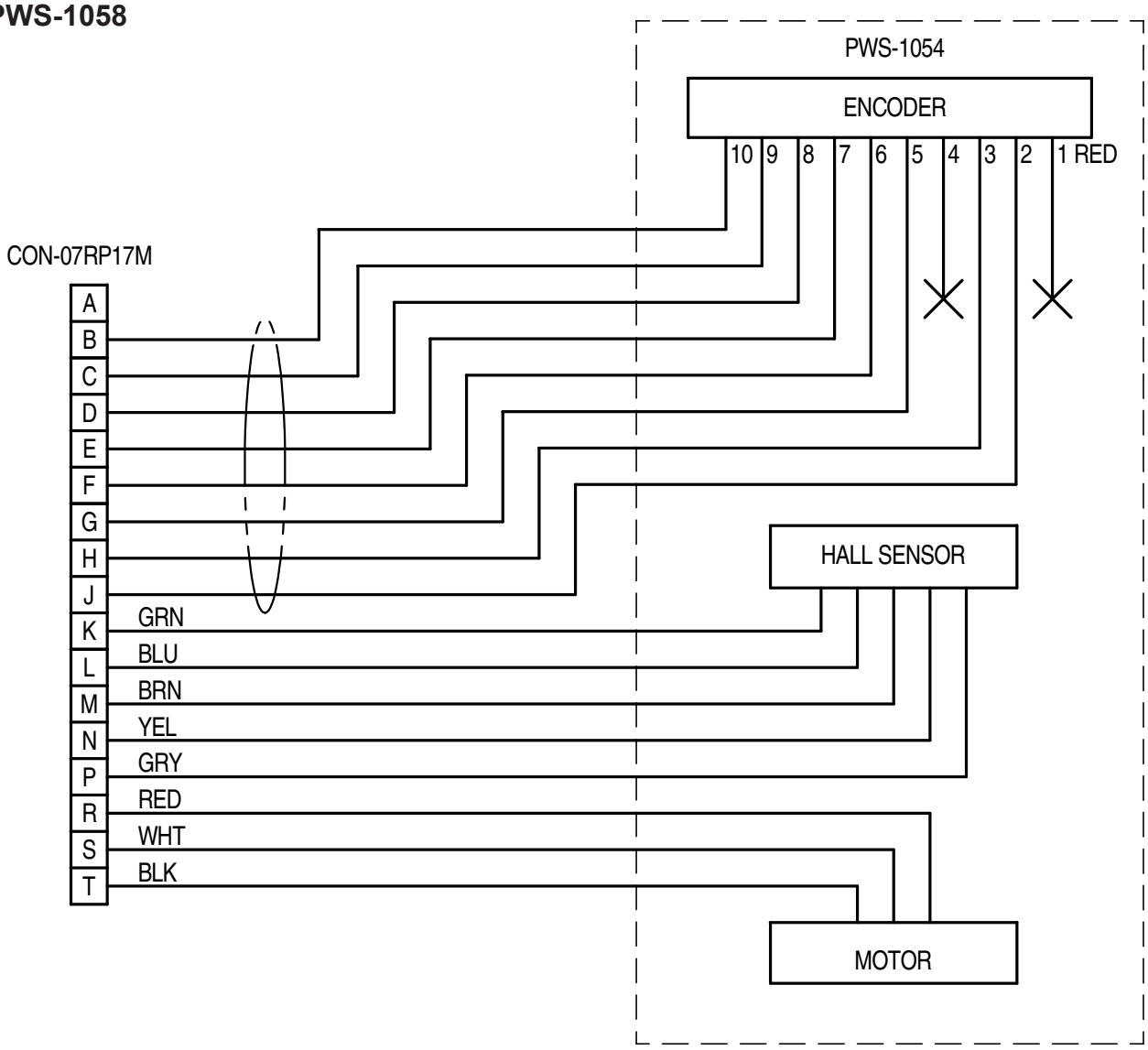


Figure 17.1

SECTION 17.0 WIRING DIAGRAMS / TRACTOR / WIRING HARNESSES

PWS-1075

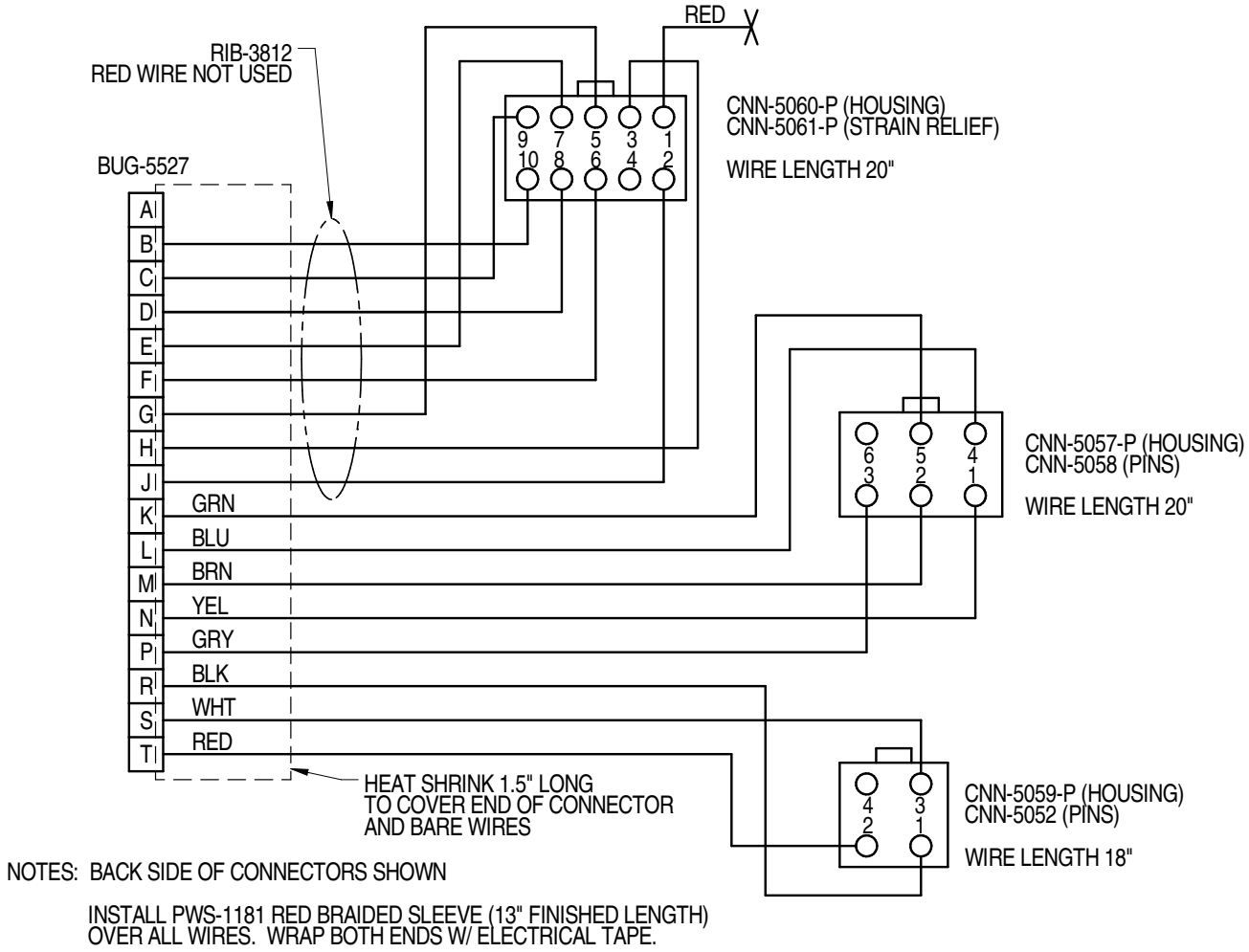
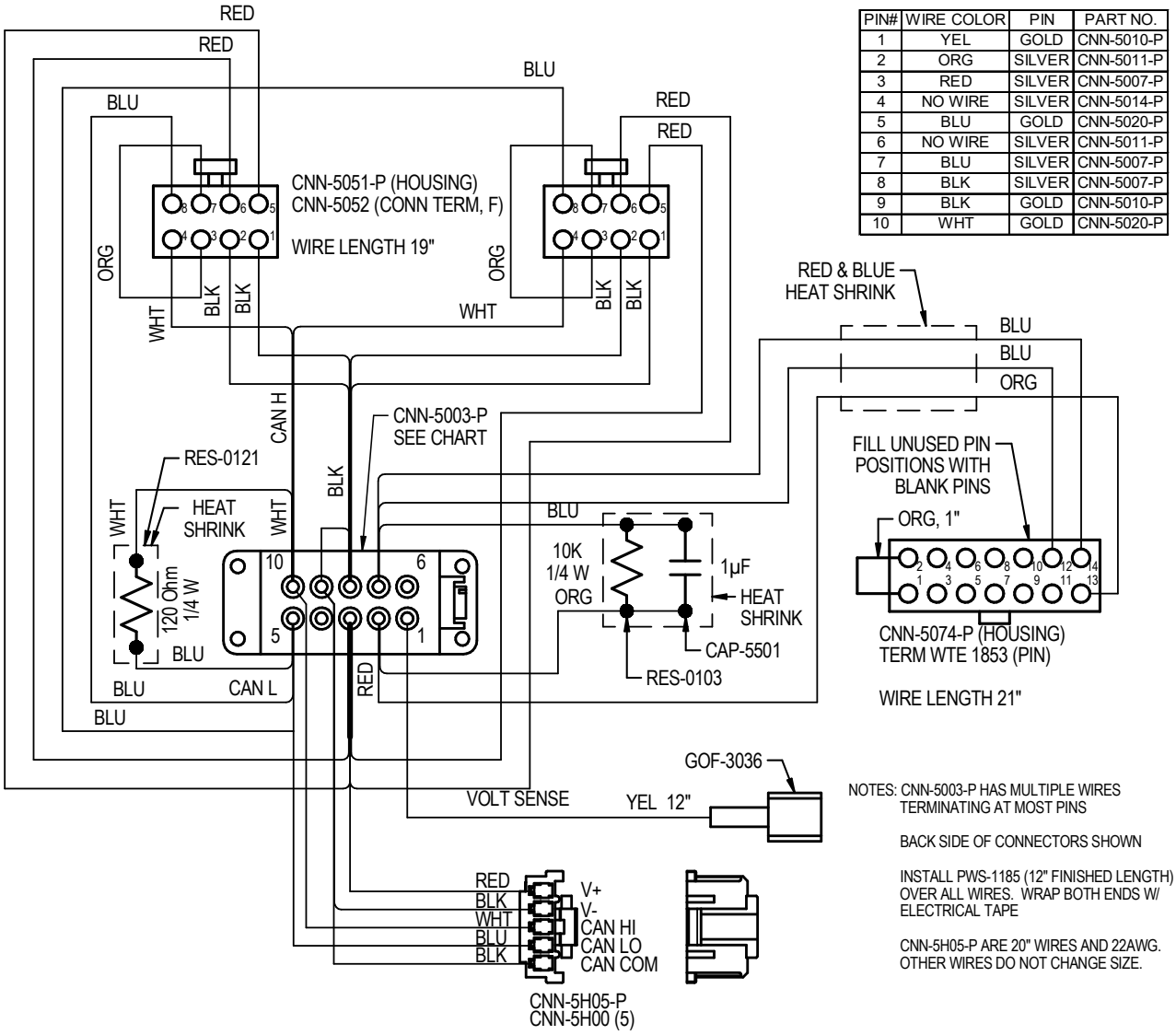


Figure 17.2

PWS-1087



PIN#	WIRE COLOR	PIN	PART NO.
1	YEL	GOLD	CNN-5010-P
2	ORG	SILVER	CNN-5011-P
3	RED	SILVER	CNN-5007-P
4	NO WIRE	SILVER	CNN-5014-P
5	BLU	GOLD	CNN-5020-P
6	NO WIRE	SILVER	CNN-5011-P
7	BLU	SILVER	CNN-5007-P
8	BLK	SILVER	CNN-5007-P
9	BLK	GOLD	CNN-5010-P
10	WHT	GOLD	CNN-5020-P

NOTES: CNN-5003-P HAS MULTIPLE WIRES TERMINATING AT MOST PINS

BACK SIDE OF CONNECTORS SHOWN

INSTALL PWS-1185 (12" FINISHED LENGTH) OVER ALL WIRES. WRAP BOTH ENDS W/ ELECTRICAL TAPE

CNN-5H05-P ARE 20" WIRES AND 22AWG. OTHER WIRES DO NOT CHANGE SIZE.

Figure 17.3

SECTION 17.0 WIRING DIAGRAMS / PENDANT WIRING

PWS-0238

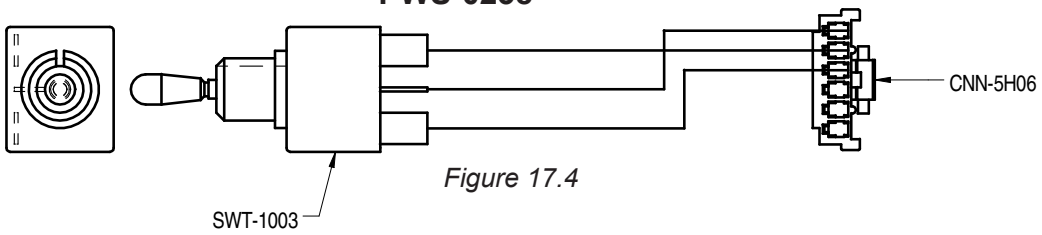


Figure 17.4

PWS-0239

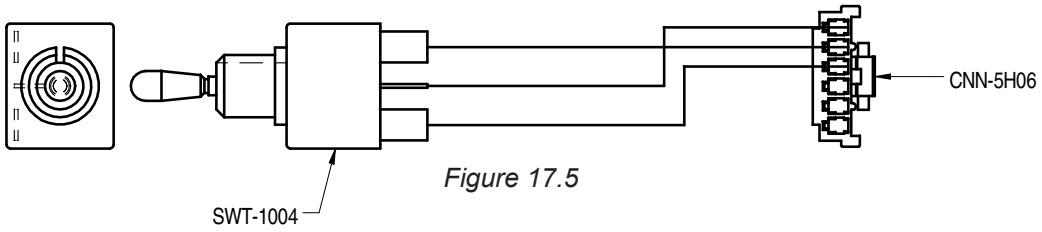


Figure 17.5

PWS-0240

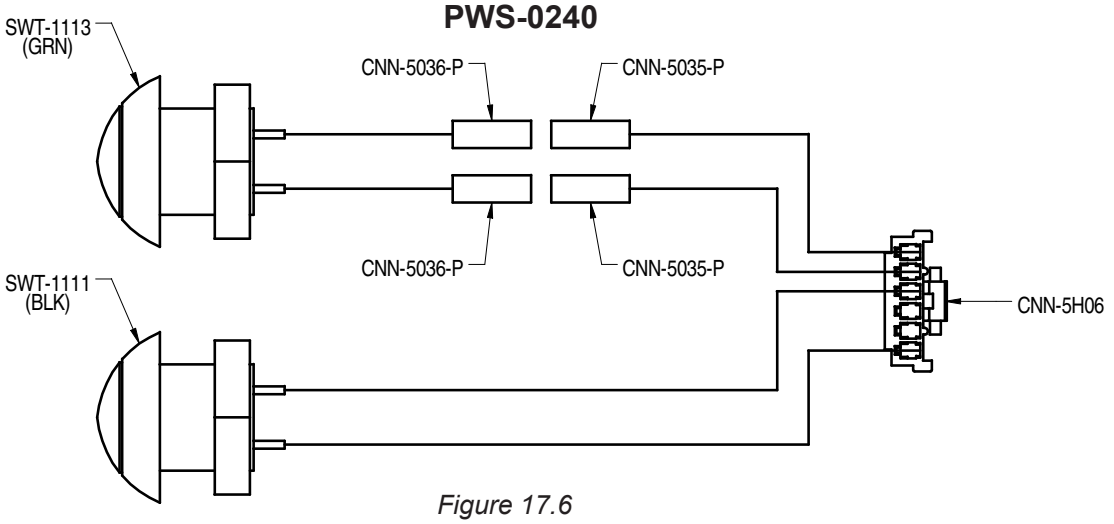


Figure 17.6

PWS-0241

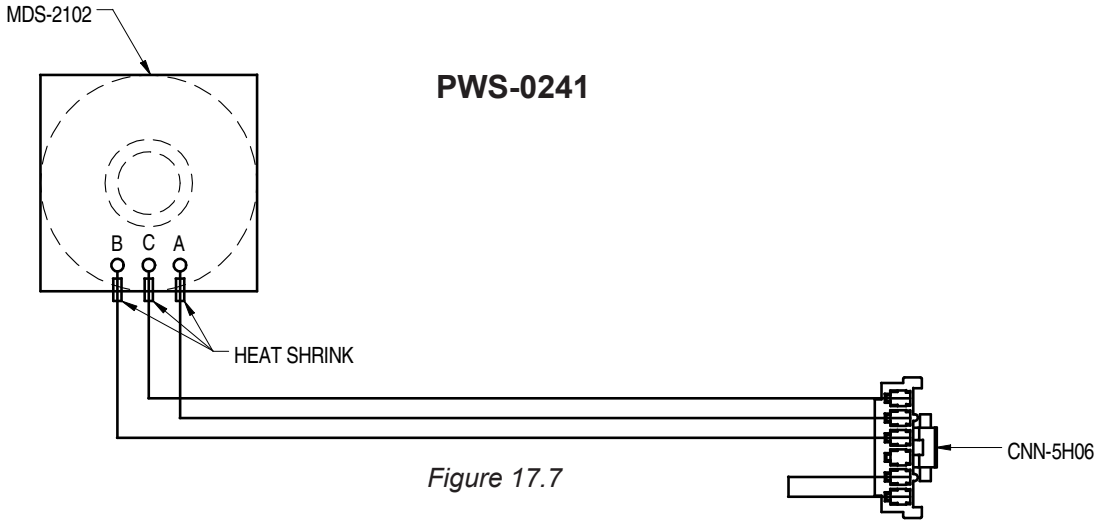


Figure 17.7

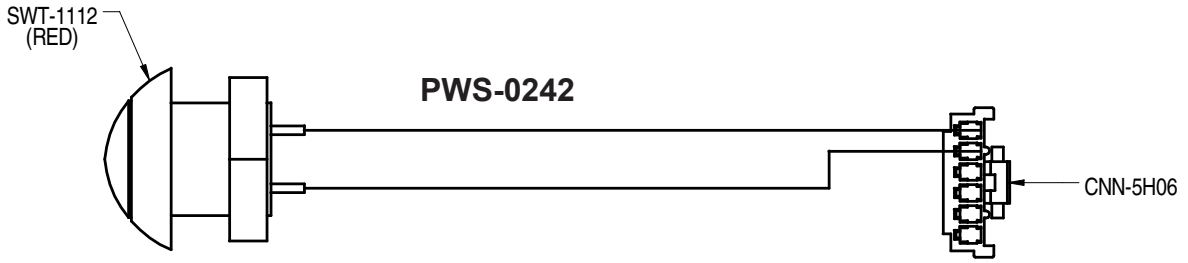


Figure 17.8

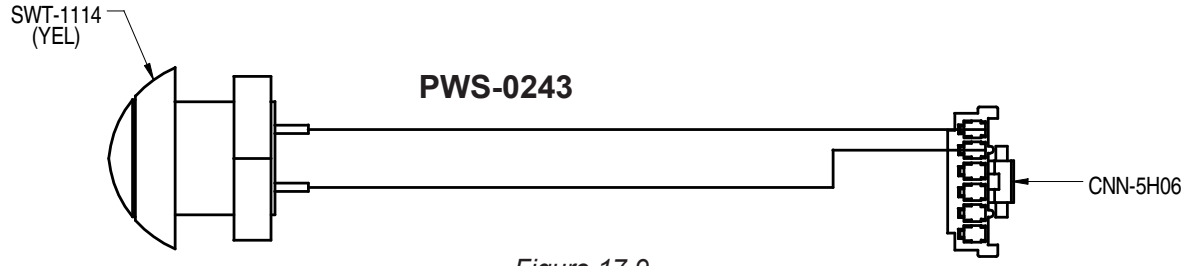


Figure 17.9

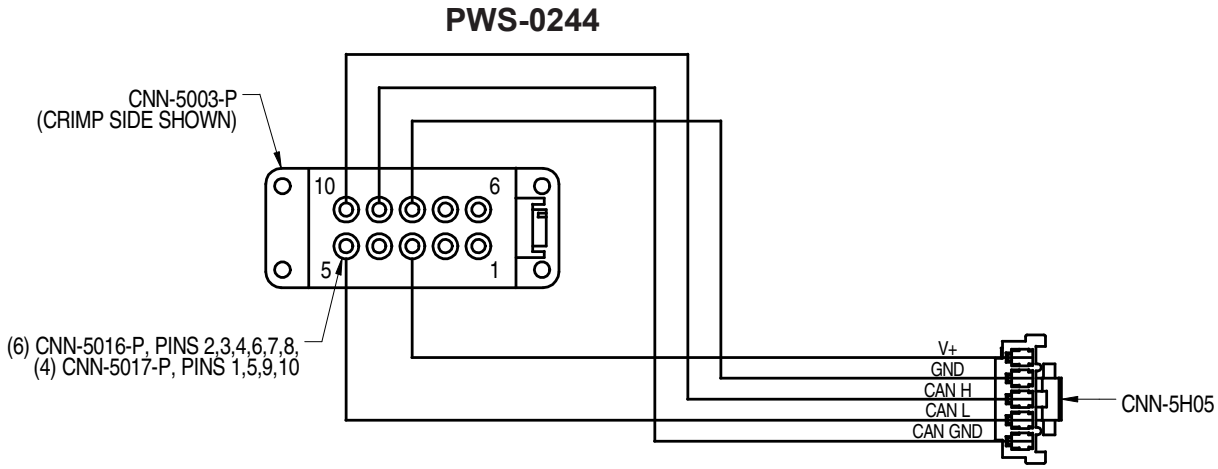


Figure 17.10

SECTION 17.0 WIRING DIAGRAMS / CONTROL BOX

PWS-0100/3100

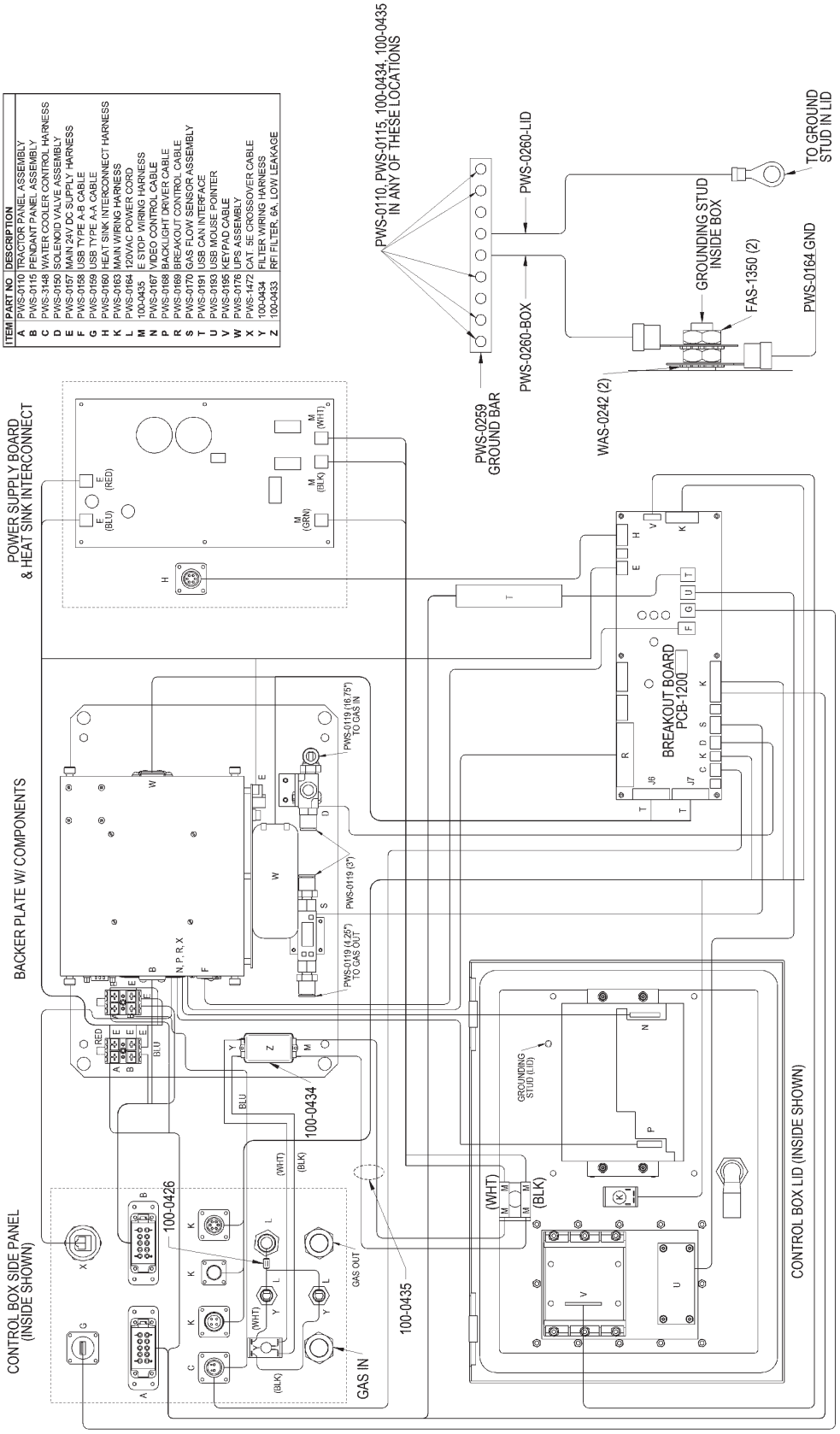


Figure 17.11

SECTION 17.0 WIRING DIAGRAMS / CONTROL BOX / WIRING HARNESSES

PWS-0157

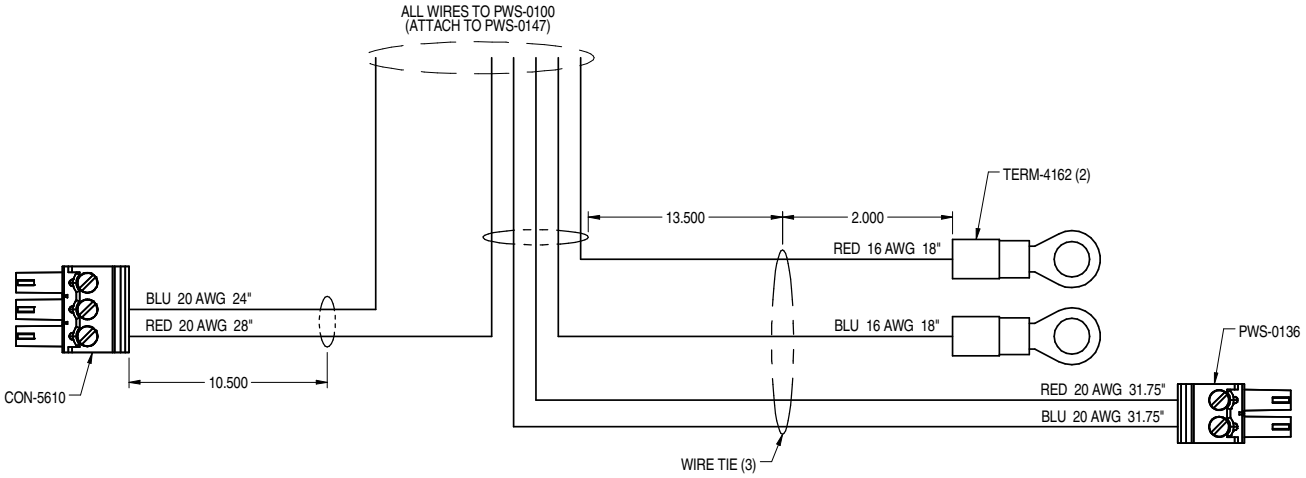


Figure 17.12

PWS-0163

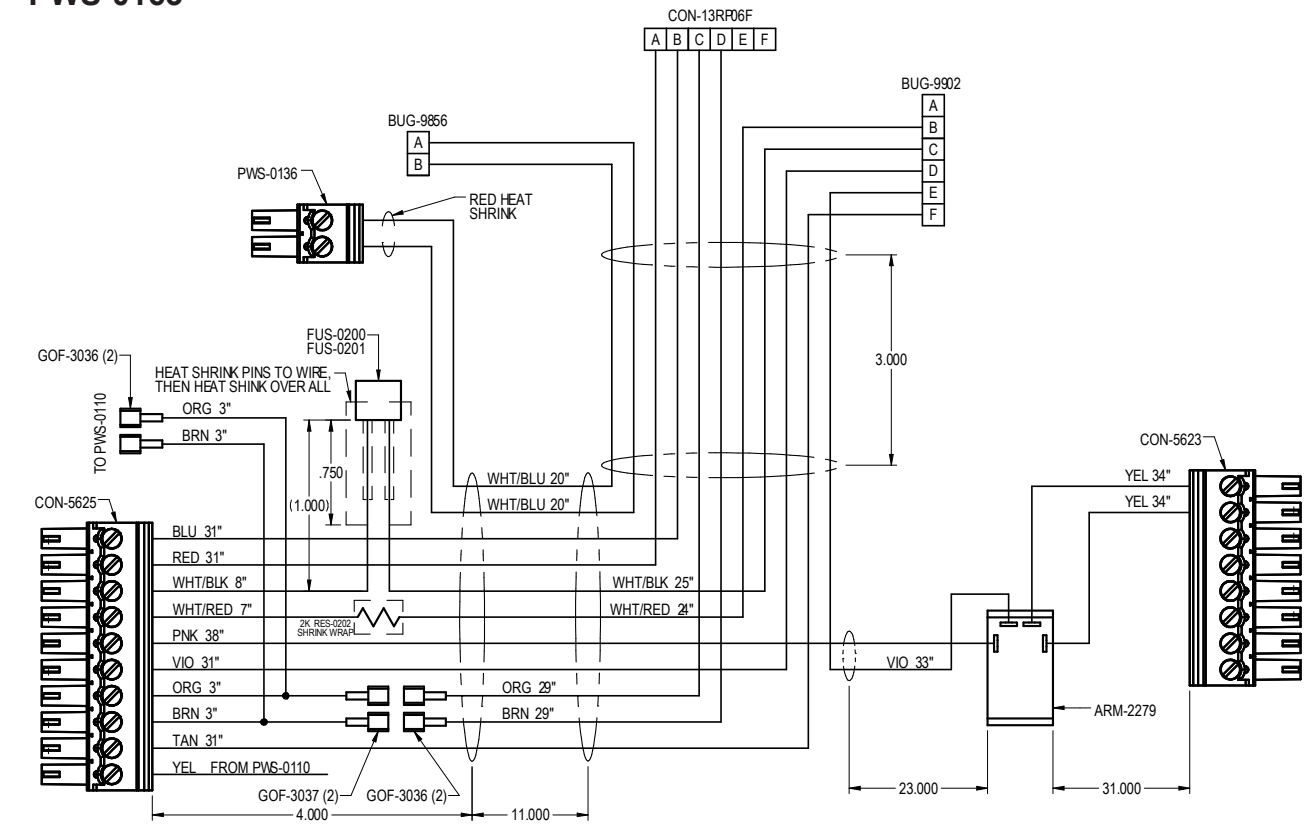


Figure 17.13

SECTION 17.0 WIRING DIAGRAMS / CONTROL BOX / WIRING HARNESSES, CONT'D.

PWS-3148

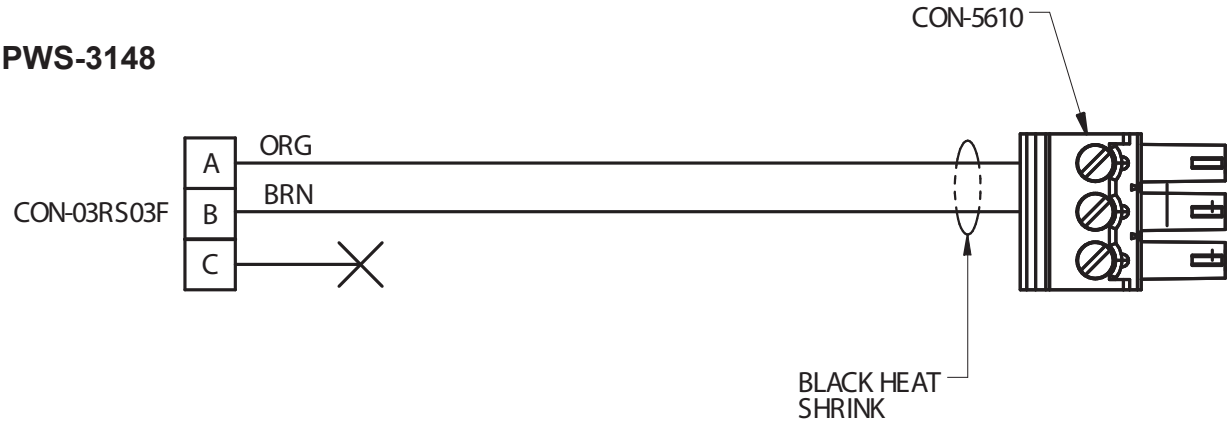


Figure 17.14

PWS-0160

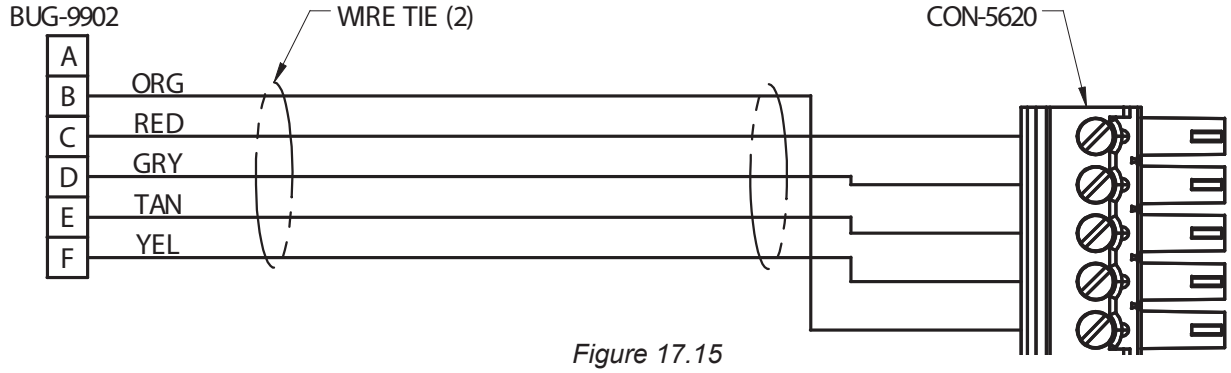


Figure 17.15

PWS-0162

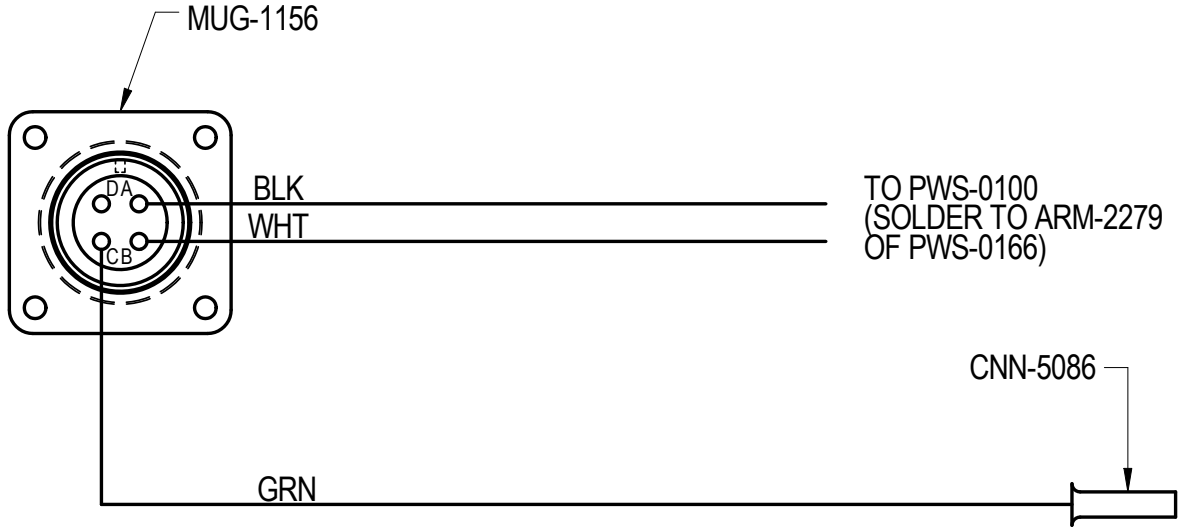
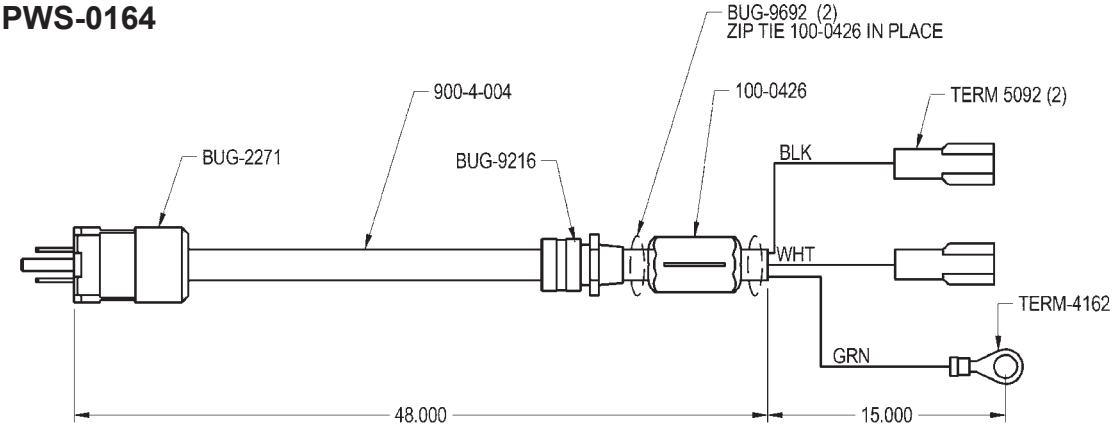


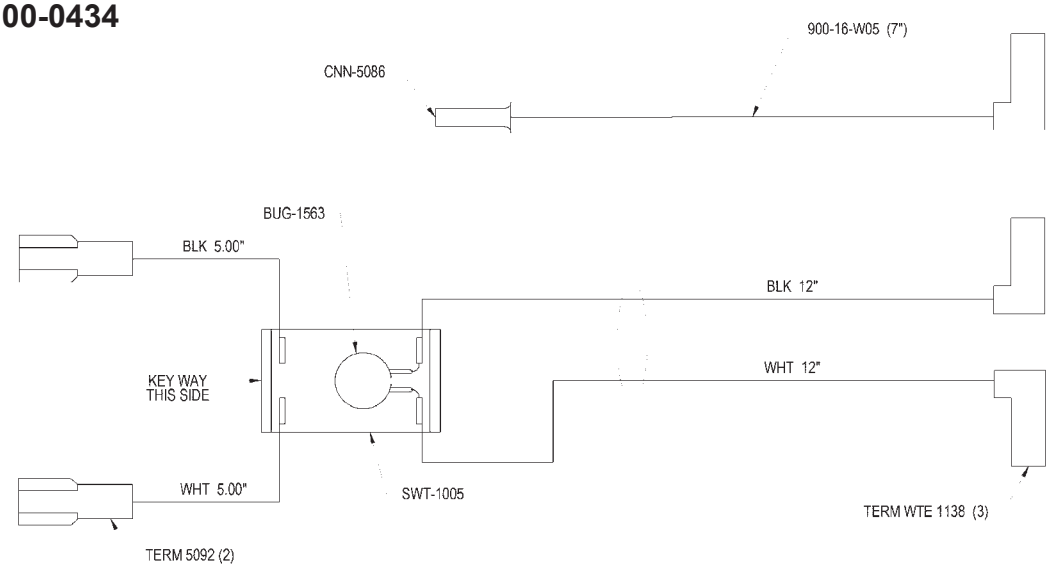
Figure 17.16

SECTION 17.0 WIRING DIAGRAMS / CONTROL BOX / WIRING HARNESSES, CONT'D.

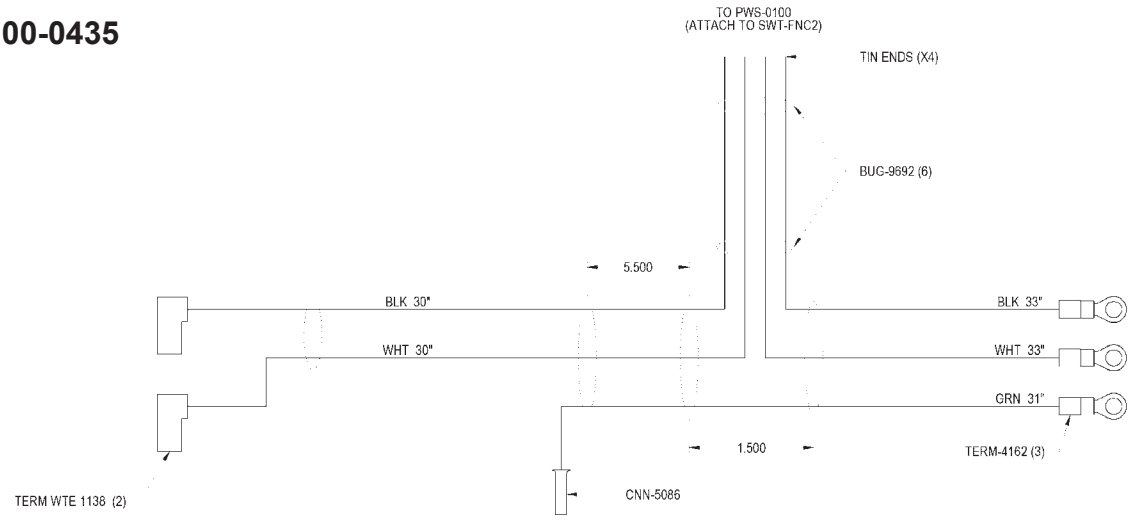
PWS-0164



100-0434



100-0435



SECTION 17.0 WIRING DIAGRAMS / CONTROL BOX / WIRING HARNESSES, CONT'D.

PWS-0193

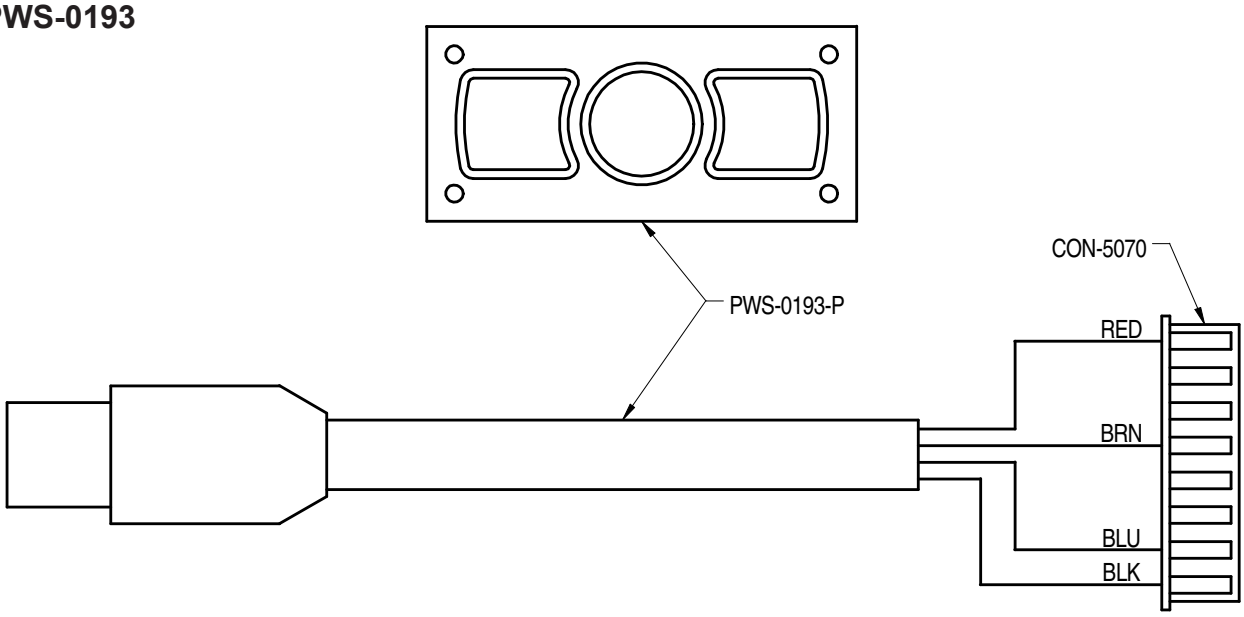


Figure 17.19

PWS-0275

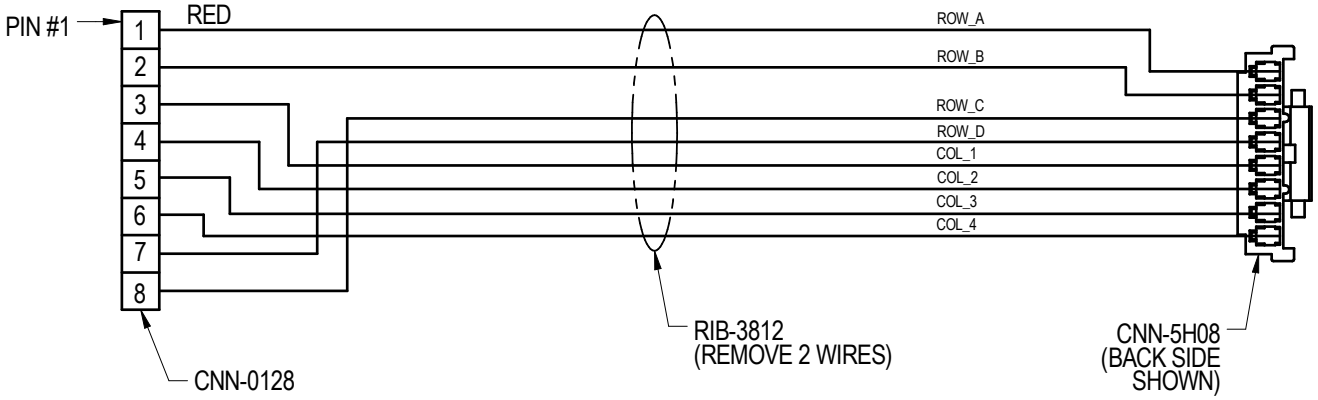


Figure 17.20

SECTION 17.0 WIRING DIAGRAMS / CONTROL BOX HEAT SINK ASSEMBLY / PWS-0120-WD

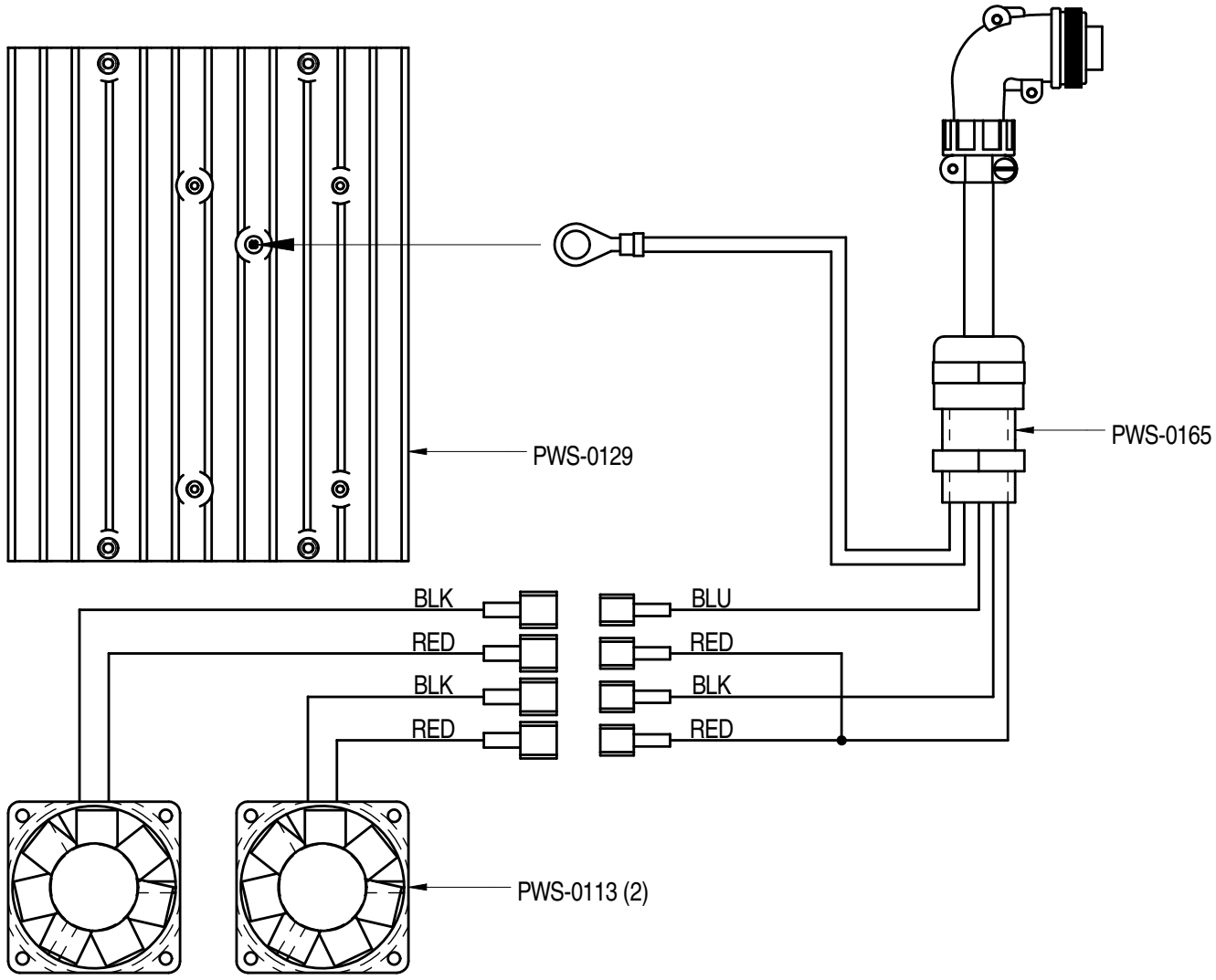


Figure 17.21

PWS-0130

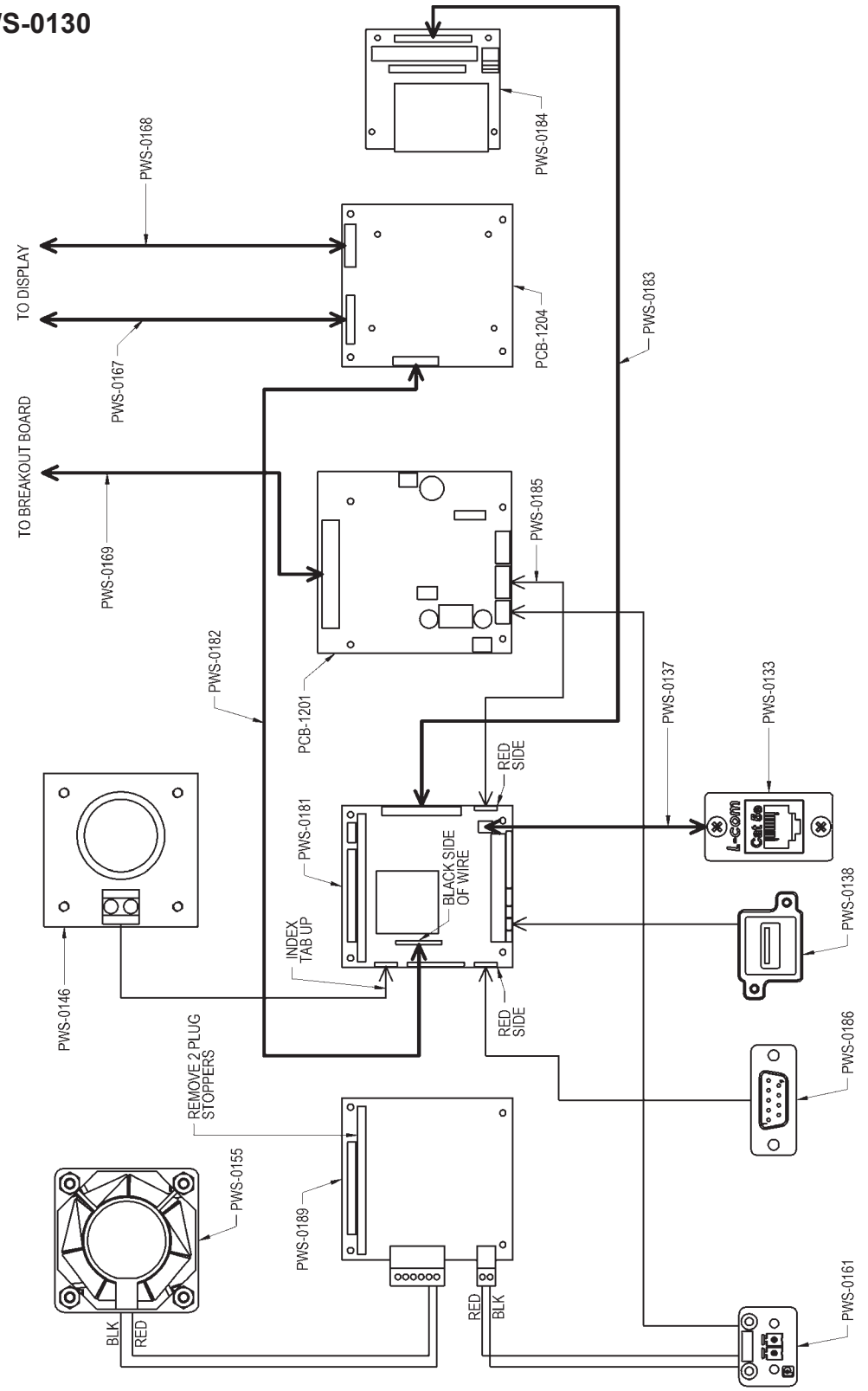


Figure 17.22

SECTION 17.0 WIRING DIAGRAMS / CONTROL BOX / PWS-0130 / WIRING HARNESSES

PWS-0137

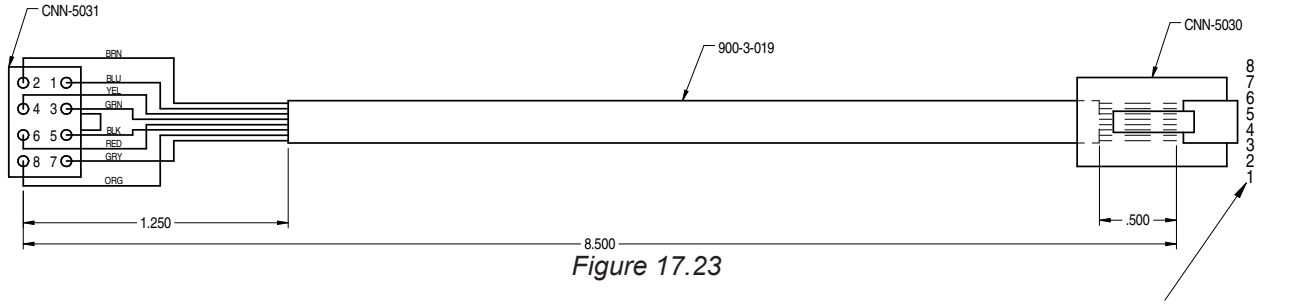
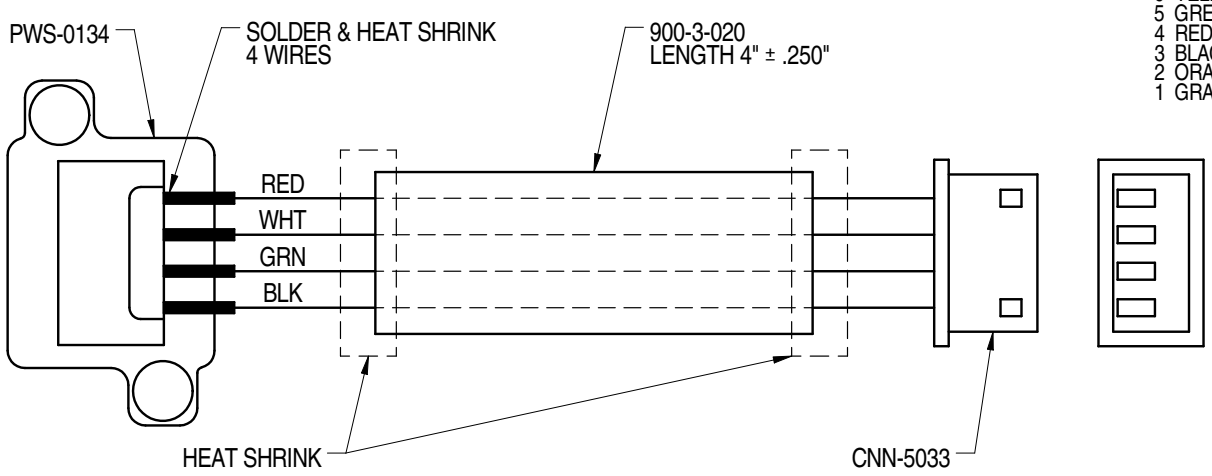


Figure 17.23

PWS-0138



NOTES: 1. REMOVE CABLE SHEATH 1" FROM END OF WIRE BOTH SIDES
2. KEEP WHITE & GREEN WIRES TWISTED AS MUCH AS POSSIBLE

Figure 17.24

SECTION 17.0 WIRING DIAGRAMS / CONTROL BOX / PWS-0130 / WIRING HARNESSES, CONT'D.

PWS-0185

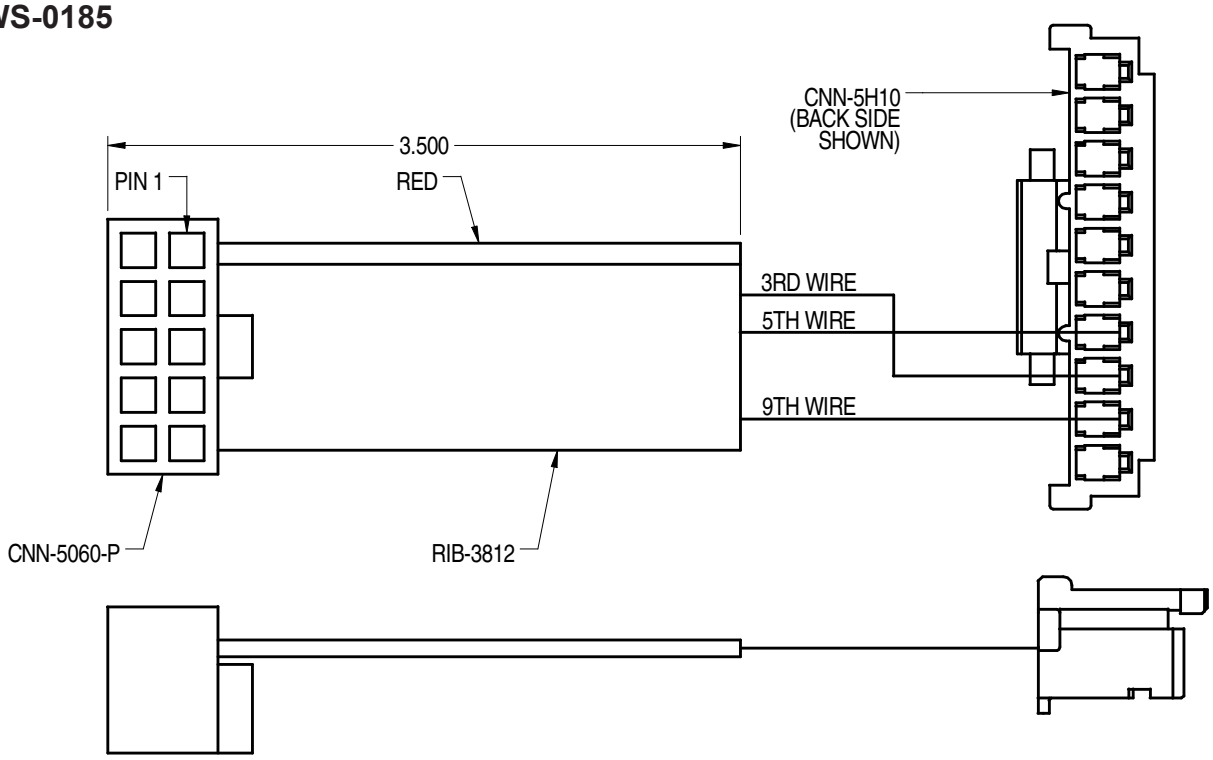


Figure 17.26

PWS-0161

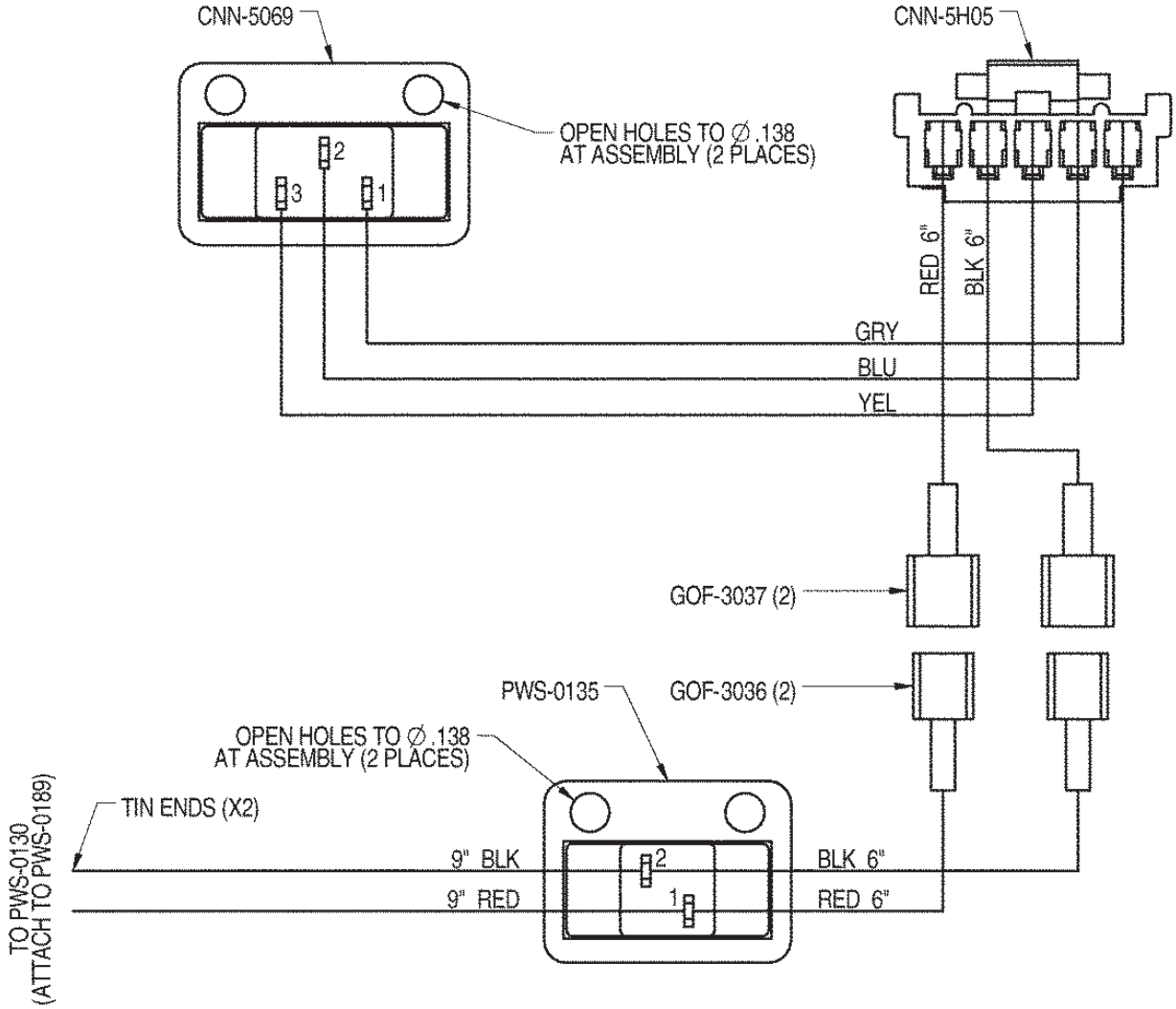


Figure 17.27

SECTION 17.0 WIRING DIAGRAMS / CONTROL BOX / PWS-0130 / WIRING HARNESSES, CONT'D.

PWS-0176

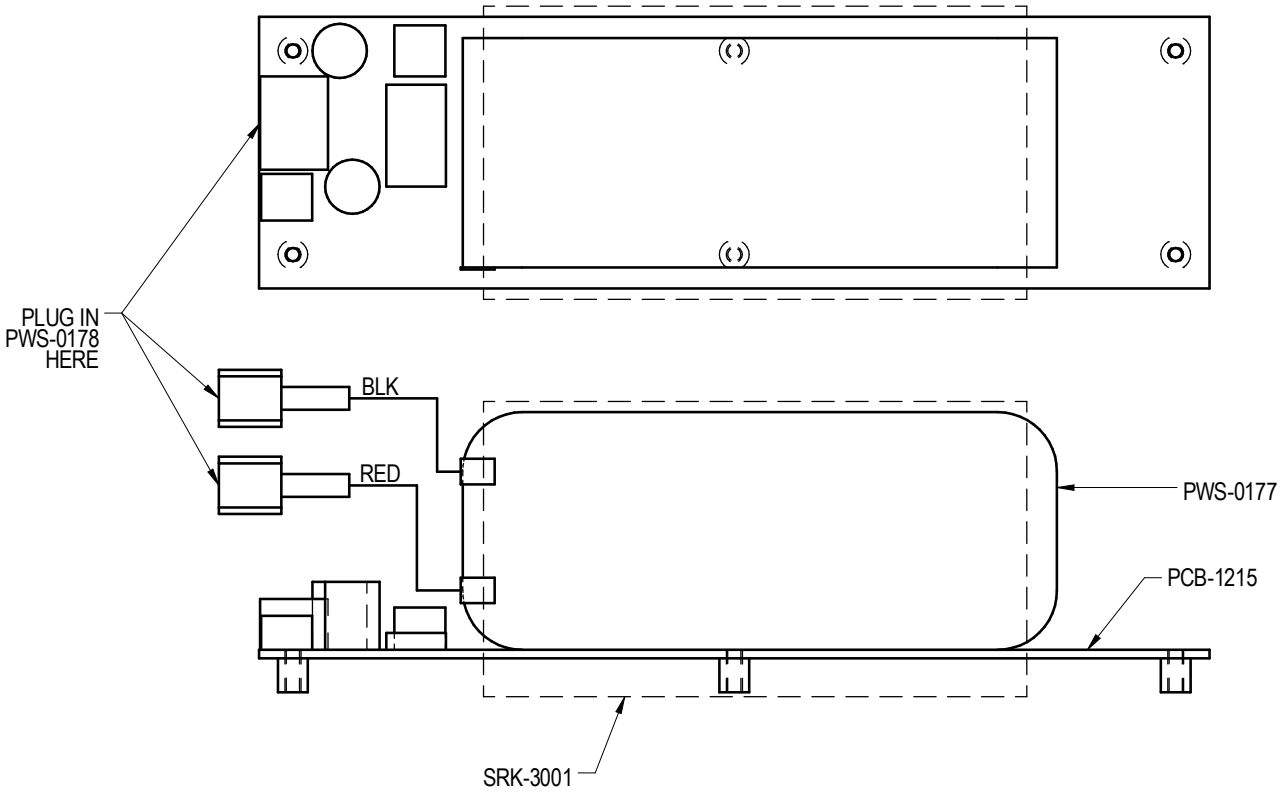


Figure 17.28

PWS-0177

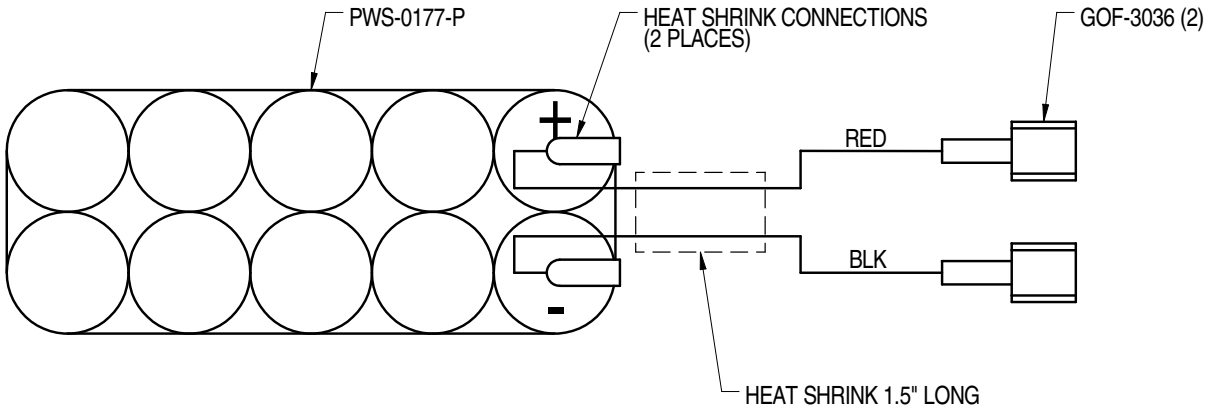


Figure 17.29

SECTION 17.0 WIRING DIAGRAMS / CONTROL BOX / PWS-0130 / WIRING HARNESSES, CONT'D.

PWS-0178

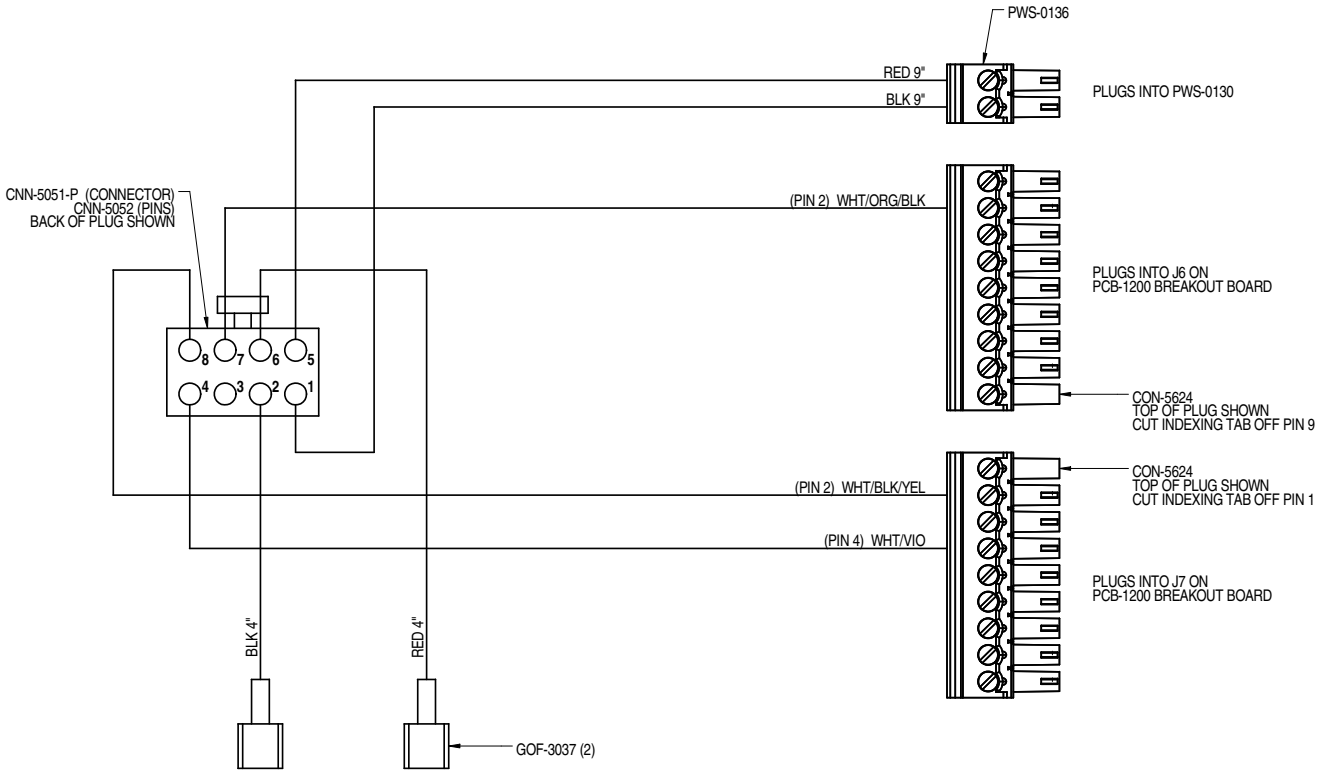


Figure 17.30

SECTION 17.0 WIRING DIAGRAMS / CONTROL BOX / PWS-0130 / WIRING HARNESSES, CONT'D.

PWS-0120

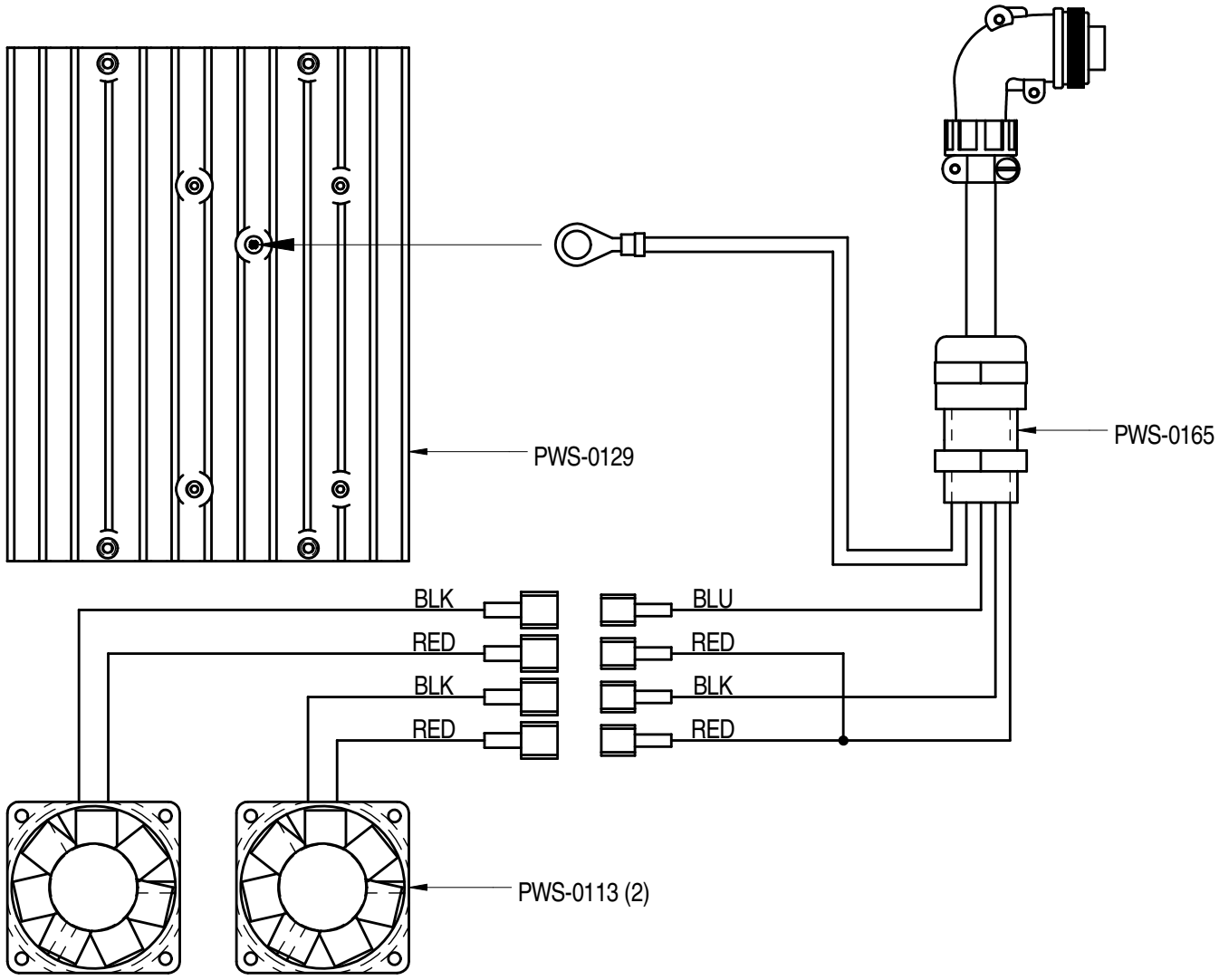


Figure 17.31

PWS-0165

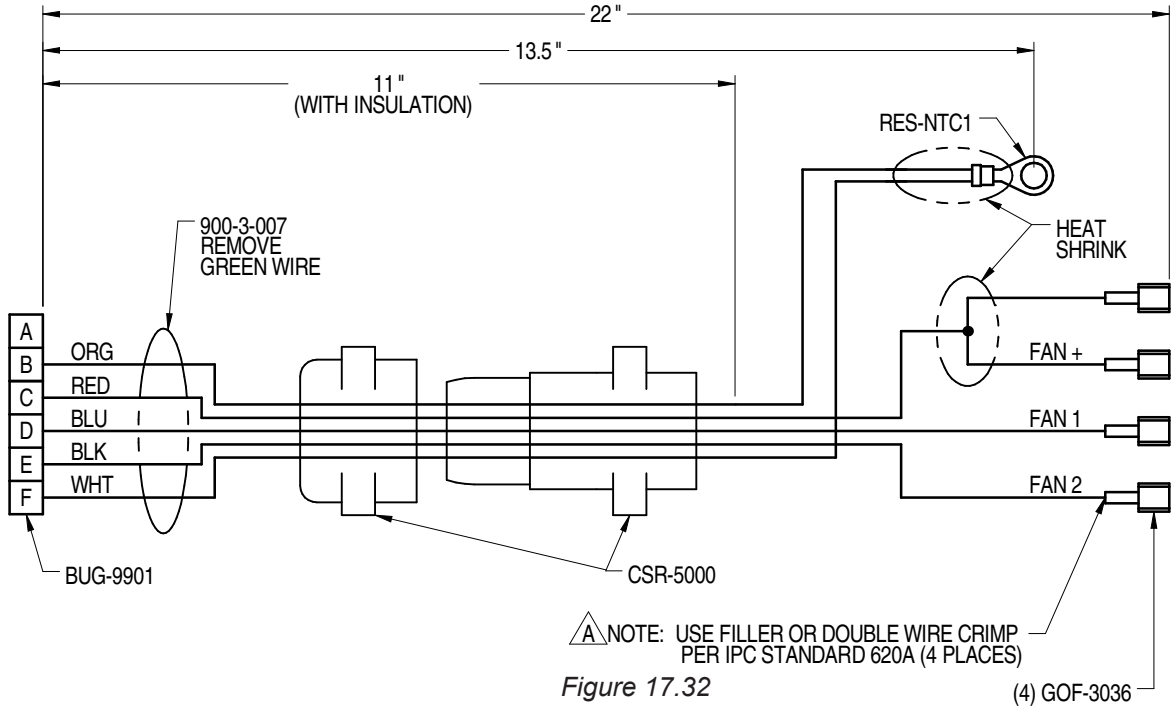


Figure 17.32

PWS-0151

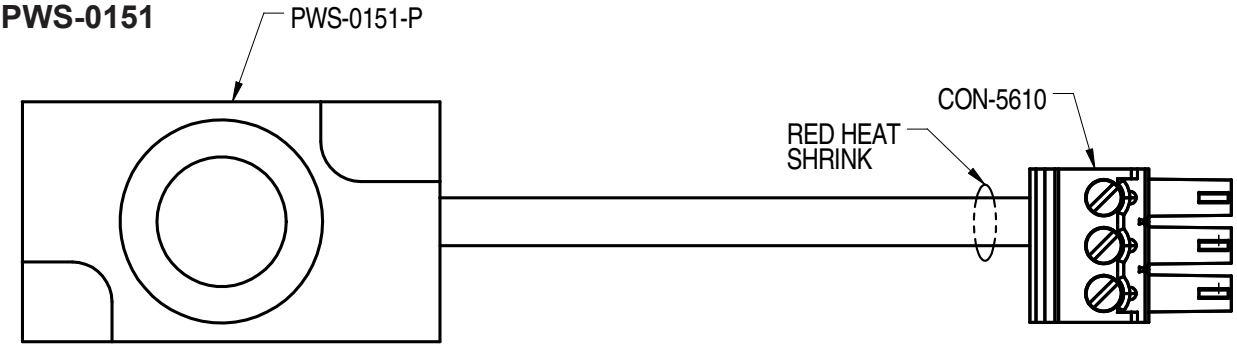


Figure 17.33

PWS-0170

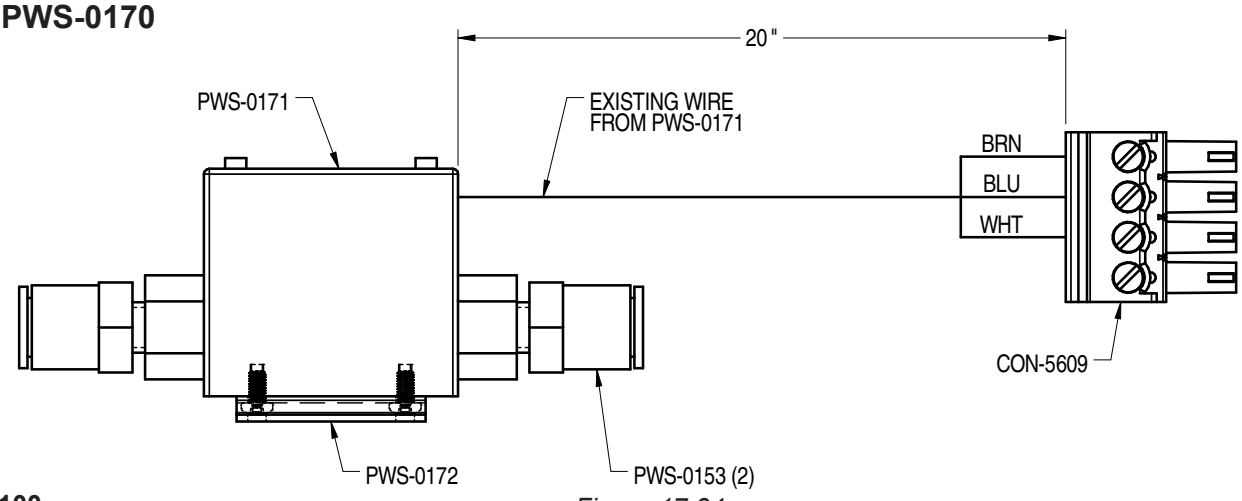
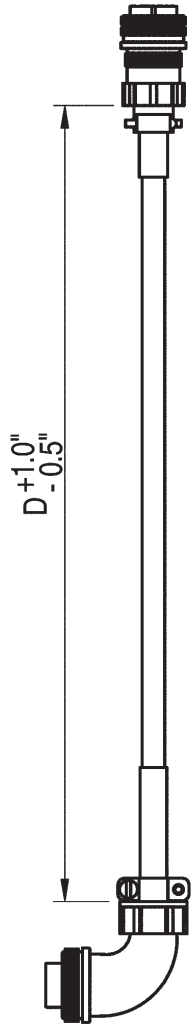


Figure 17.34

CABLE LENGTH (XX)	CABLE CUT LENGTH	DISTANCE BTW CONNECTORS (D)
1.3	16"	12"



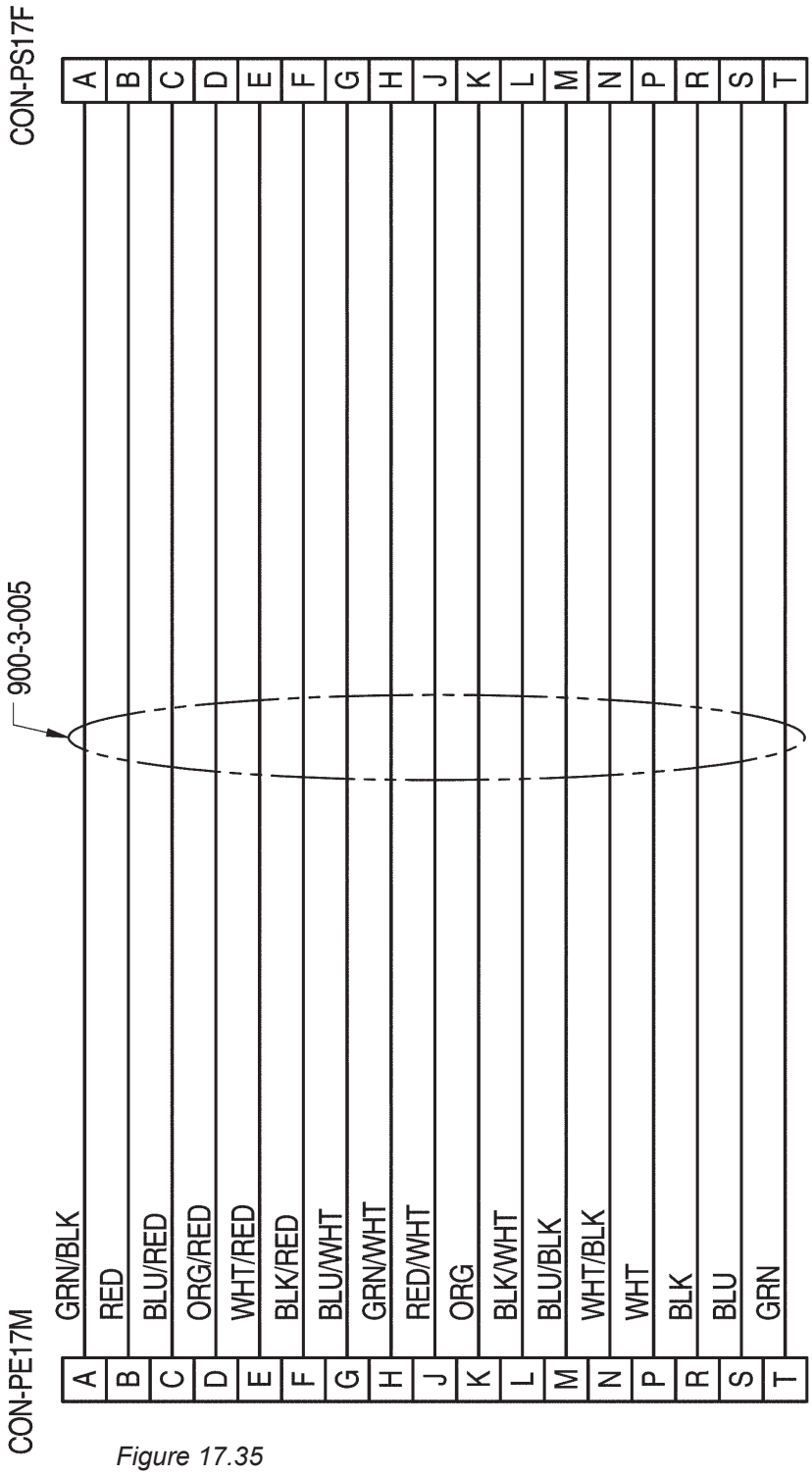


Figure 17.35

SECTION 18.0 ADDENDUMS / LINCOLN ELECTRIC POWER WAVE® S350

The information in this addendum applies to Piper Plus systems using the Lincoln Electric Power Wave® S350 power source. Section numbers match those in the base manual. The information provides supplements or supersedes information in the corresponding section of the base manual.

SECTION 1.0 TECHNICAL SPECIFICATIONS

Wire Feeder:
26.84" x 14.25" x 13.19" (68.17 x 36.2 x 33.5 cm)

Welding Processes:
• GMAW, GMAW-Pulse, FCAW, STT®*
*Requires STT® Module

Welding Wire Consumable Options:
Capable of welding all materials supported by the
Waveform Control Technology® Process Capabilities of the
Lincoln Electric Power Wave® S350.

Welding Power Source:
• Lincoln Electric Power Wave® S350 (Optional STT® Module)
• Parts and Service by any Lincoln Electric Distributor around the world, www.lincolnelectric.com

Torch:
• 450 amp consumable parts
• 500 amp conduit cable

Cooling Options:
• Air Cooled (Standard)
• Water Cooled Neck and Nozzle option available using Lincoln Electric Cool-Arc® 40
— Available in 120 and 240 volt options
— 2 gallon reservoir
• Water cooled torch system has integrated flow sensor to prevent welding if water flow is not present.

Lincoln Electric Cool Arc® 40:
(Only used if water cooled option is installed.)

34" x 9" x 9" (86.3 x 22.9 x 22.9 cm)
Empty: 45 lbs (20.4 kg)
Full: 61.2 lbs (27.7 kg)
2 gallon (7.57 liter)
115 and 220 Volt options:
CE (EUROPE) and C-Tick (Australia Compliant (220 Volt unit only)
For Use Above Freezing: Clean tap, distilled or de-ionized water.
For Use Below Freezing: 50% water and 50% pure ethylene glycol (reagent or industrial grade) mixture.

DO NOT USE: Automotive anti-freeze that contains rust inhibitors or lead stoppers. These coolants will damage the pump and block the small internal passageways of the heat exchanger, affecting cooling performance. To acquire the proper coolant contact a local welding distributor.

SECTION 12.0 SETUP

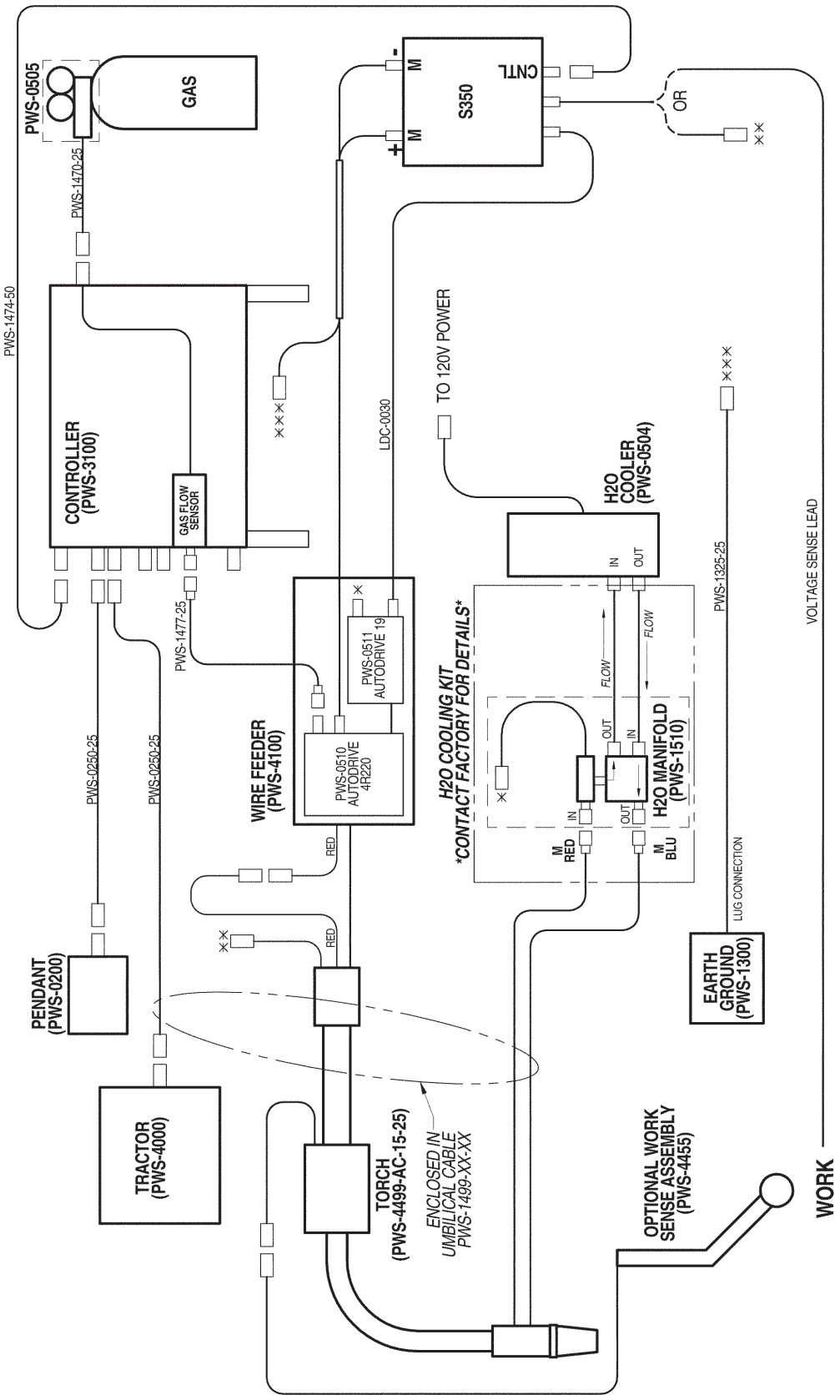


Figure 12.0

SECTION 18.0 ADDENDUMS / LINCOLN ELECTRIC POWER WAVE® S350, CONT'D.

SECTION 14.0 WIRE FEED ASSEMBLY / PWS-4100 WIRE FEED ASSEMBLY / EXPLODED VIEW / PARTS LIST

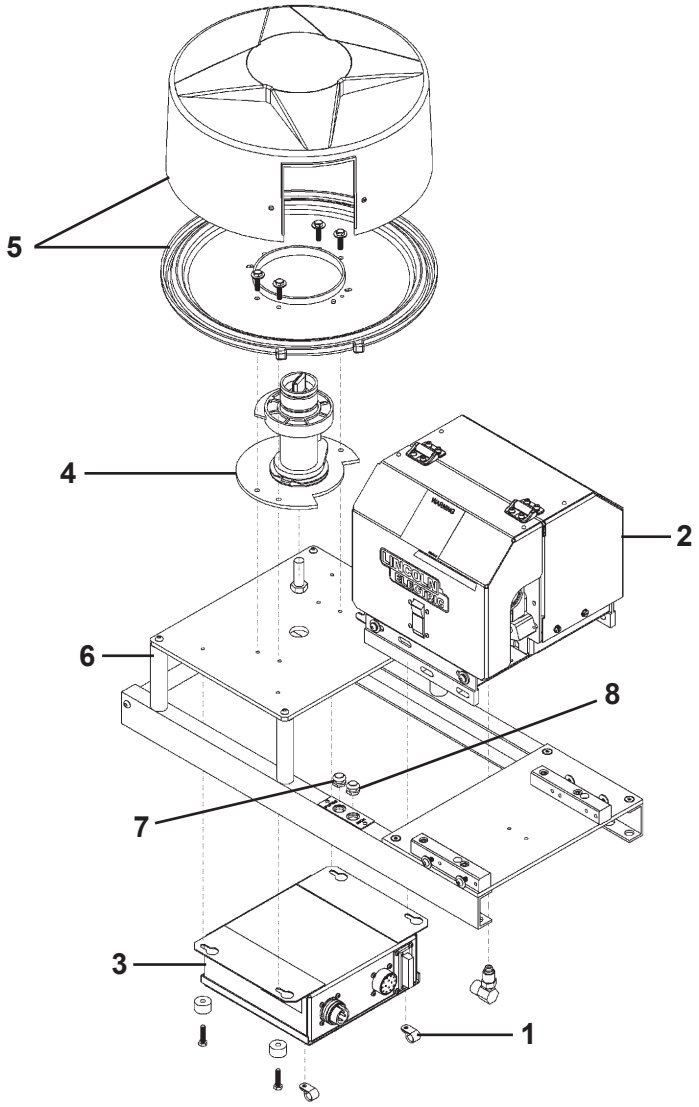


Figure 14.0

ITEM	QTY	PART NO.	DESCRIPTION
1	2	MDS-1030	Cable Clamp, Nylon, Black 7/16
2	1	PWS-0510	Modified Autodrive 4R220
3	1	PWS-0511	Autodrive 19
4	1	PWS-0512	30# Spindle Kit
5	1	PWS-0513	Wire Reel Enclosure Kit
6	1	PWS-4110	Piper Plus Wire Feeder Frame
7	1	SWT-1111	N. O. Open Push Button, Black
8	1	SWT-1113	N. O. Push Button Switch, Green

SECTION 17.0 WIRING DIAGRAMS / PIPER-PLUS CONNECTION

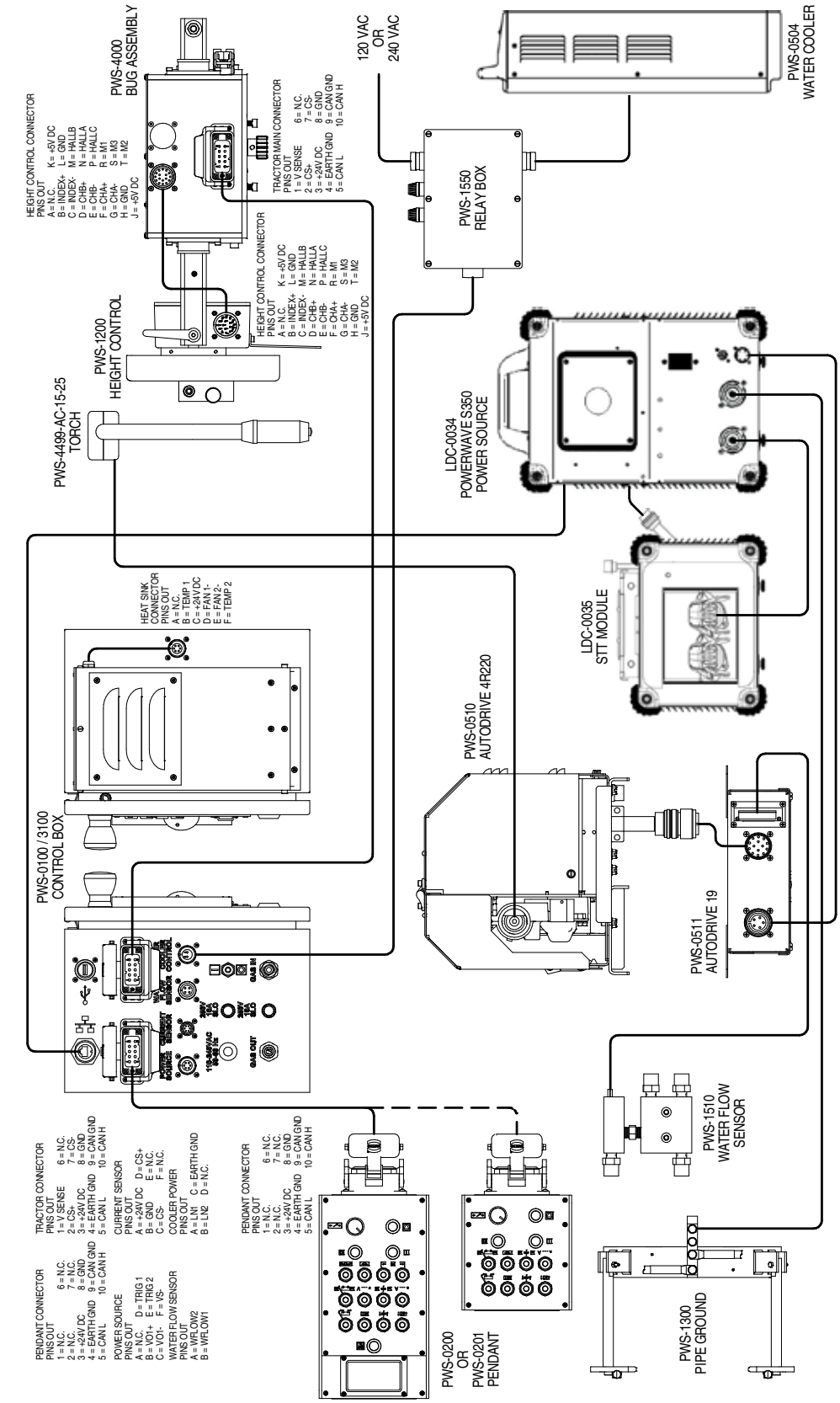


Figure 18.0

SECTION 18.1 ADDENDUMS / MILLER PIPEWORX 400

The information in this addendum applies to Piper Plus systems using the Miller PipeWorx 400 power source. Section numbers match those in the base manual. The information provides supplements or supersedes information in the corresponding section of the base manual.

SECTION 1.0 TECHNICAL SPECIFICATIONS

WIRE FEEDER:
19" x 14" x 29" (48.3 x 35.6 x 73.7 cm)

- Power Source Mounted, Bench Mounted
- Spool Size: 60 lbs. (27 kg) MAX
- Wire Dia: 0.035" - .062" (0.9 - 1.6 mm)
- Speed: 50 - 780 ipm (1.3 – 19.8 m/min)
- Push Type

WELDING PROCESSES:
- GMAW, GMAW-Pulse, FCAW, RMD, GTAW*

*Not supported by the Piper Plus

WELDING WIRE CONSUMABLE OPTIONS:
Capable of welding all materials listed in the Miller PipeWorx 400 Owner's Manual and falling within the specifications listed above.

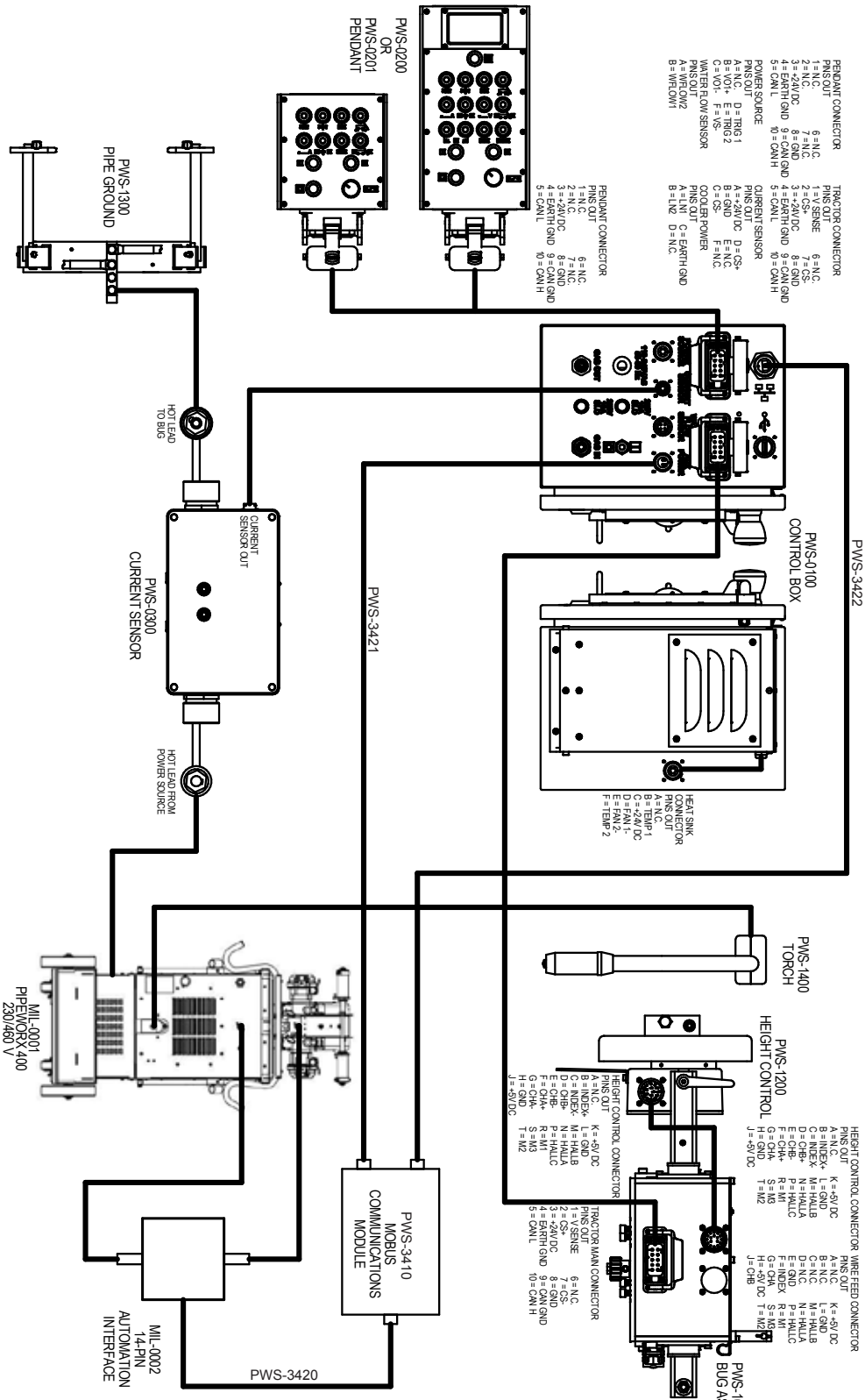
WELDING POWER SOURCE:
- Miller Electric PipeWorx 400
- Parts and Service by any Miller Electric Distributor around the world, www.millerwelds.com

TORCH:
- 450 amp consumable parts
- 500 amp conduit cable

COOLING OPTIONS:
- Air Cooled (Standard)

SECTION 18.1 ADDENDUMS / MILLER PIPEWORX 400, CONT'D.

SECTION 17.0 WIRING DIAGRAMS / PIPER-PLUS CONNECTION



SECTION 18.2 ADDENDUMS / TILT SENSOR

The information in this addendum applies to Piper Plus systems licensed to use the tilt sensor. Machines sold after the release of this manual already have the required hardware installed; older machines will require retrofitting as well as a software license. Section numbers match those in the base manual. The information provided supplements or supersedes information in the corresponding section of the base manual.

SECTION 1.0 TECHNICAL SPECIFICATIONS

Pitch Reading Accuracy*:

Motion type**	Rail Tilt from Vertical (Degrees)	Pitch Error Mean (Degrees)	Pitch Error Standard Deviation (Degrees)
Stationary	10	0.1	0.13
Stationary	45	0.12	0.41
Straight	10	0.42	0.44
Straight	45	1.06	0.5
Step	10	0.76	0.74
Step	45	0.76	2.17
Run	10	1.05	0.49
Run	45	1.08	0.55
Stop on Dwell	10	0.85	2.98
Stop on Dwell	45	1.04	1.71

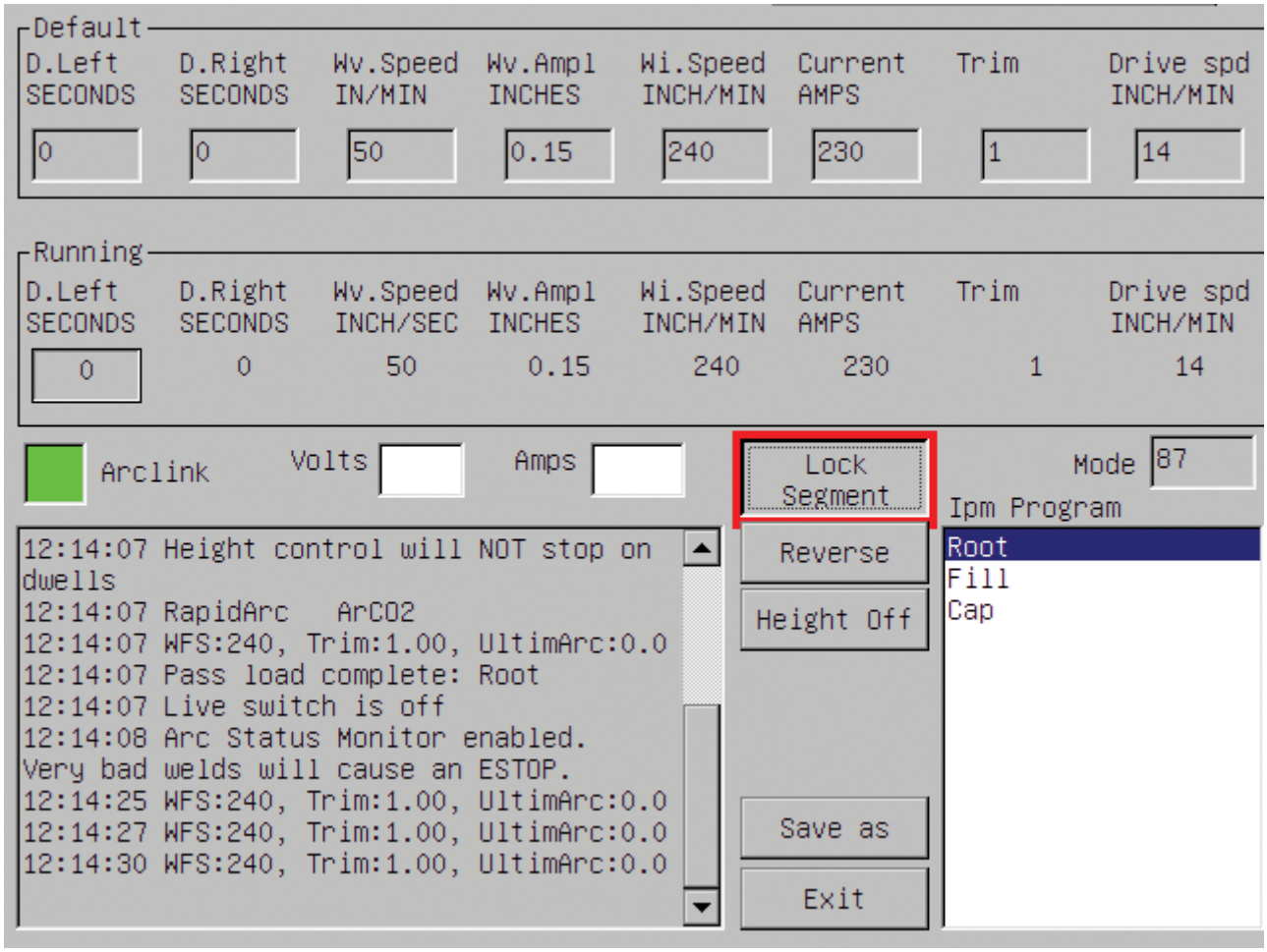
Segment Programming:
Smallest permitted angular change: 1 degree

*Stated values assume factory calibration. Accuracy is relative to the zero angle, which is user-specified.
**Stationary measurements compared to NIST-calibrated sensor while at rest at various pitch angles around the ring. Moving measurements determined by having the machine triggered to stop at various angle readings around the ring, and comparing the final resting angle to the intended angle. Motion parameters were set to “worst case” of maximum travel speed and, if applicable, maximum weave speed with a weave amplitude set to maximize acceleration, on a 12" pipe tack welded in place at one end; slower speeds, larger pipe diameters, and more rigidly supported work-pieces are all expected to bring accuracy closer to the stationary accuracy.

SECTION 18.2 ADDENDUMS / TILT SENSOR, CONT'D.

SECTION 4.0 RUN SCREEN

When in administration functions are active, the run screen includes a “Lock Segment” button.



The purpose of the “Lock Segment” button is to provide a means to control which segment the machine is in for development or testing of pass parameters.

When first selected, the Lock Segment button will cause the machine to pretend to be in the first segment (starting at 0 degrees), regardless of data from the sensor. The segment can be changed using a menu on the pendant that can be activated by pressing the “pass change” button while the Lock Segment button is active.

SECTION 18.2 ADDENDUMS / TILT SENSOR, CONT'D.

SECTION 5.0 PENDANT OPERATIONS

Full Function Pendant

5.2.A Pass Select – In administration mode, when the “Lock Segment” button is activated from the Run screen, this button is used to enter or select an option in the segment menu instead of its normal function.
5.2.D Weave Jog – When the Segment Menu is active, this knob will scroll through menu items instead of its normal function.

5.2.01 Segment Menu

The segment menu includes the following options:

Exit Segment Menu: Hitting pass change with the cursor selecting this menu item will leave the segment menu and return to the normal pendant screen.
Next Segment: Advance the locked segment to the next segment.
Previous Segment: Revert the segment to the prior segment.
Save All Segments: Save pending parameter changes in all segments.
Save This Segment: Save pending parameter changes in the currently active segment.
Review Segment: Bring up a sub-menu of pending changes.

5.2.02 Review Segment sub-menu

The Review Segment sub-menu allows for pending changes to be reviewed. It includes the following options:

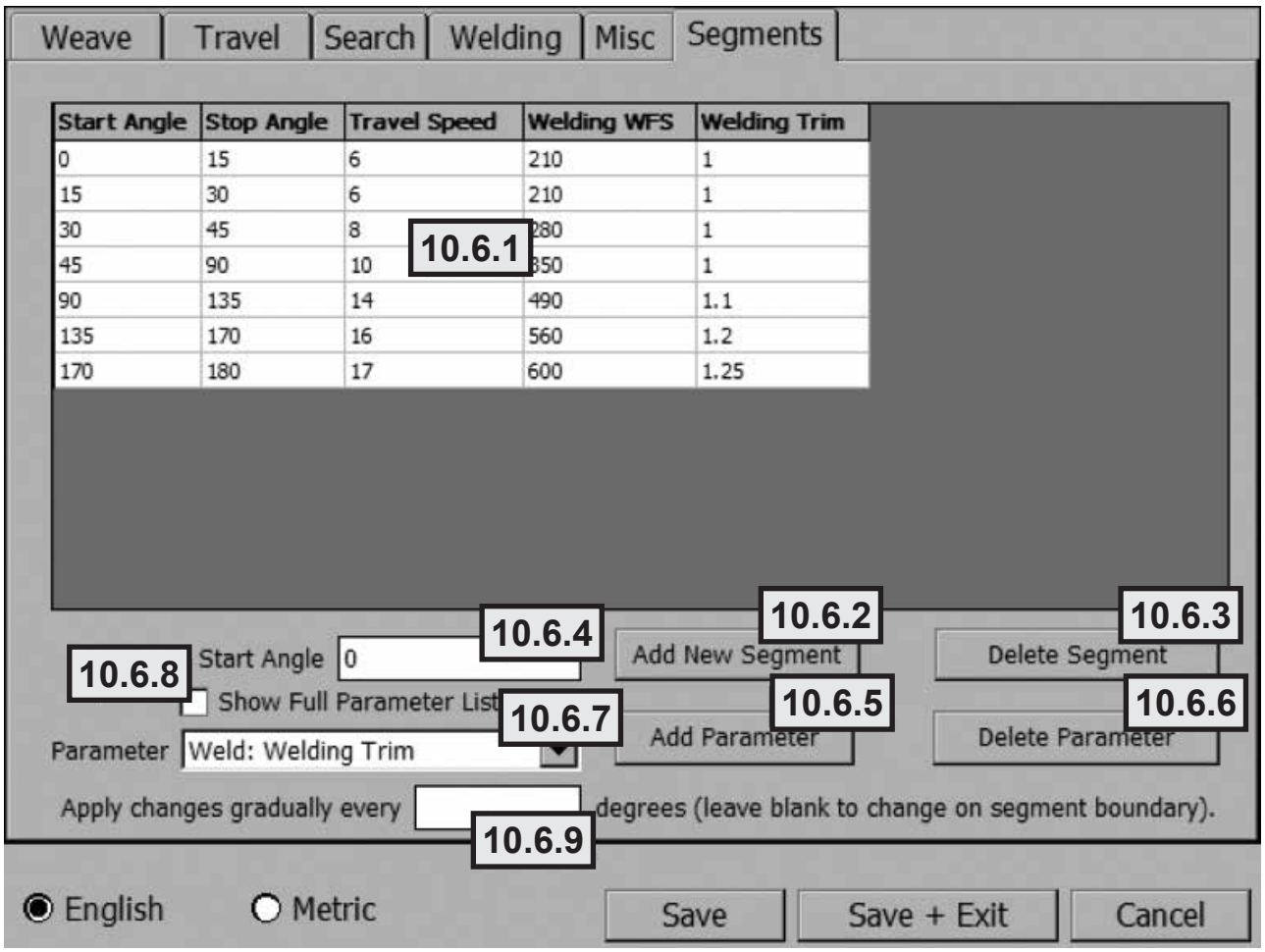
Cancel: Abandon any alterations made in this menu.
Done Reviewing: Applies alterations but does not save the pending changes (changes are saved from the Segment Menu)
Parameters (zero or more): One item for each changed parameter in this segment, with a notation on how it is to be applied when saving. A change with “S” in front of it will be applied to the currently active segment; a change with “A” in front of it will be applied to all segments; a change marked “DISCARDED” will not be applied. The pass change button will rotate between these markings.

SECTION 18.2 ADDENDUMS / TILT SENSOR, CONT'D.

SECTION 10.0 PARAMETER INPUT PAGES

SECTION 10.6 SEGMENT TAB

The Segments tab allows for control over changes to the parameters on other tabs based on the position of the machine around a pipe or other surface.



10.6.1 Parameter Table: this shows which parameters are changing, and what their values are in each segment. Clicking on a parameter cell will allow you to change its value. The Stop Angle cell, however, cannot be changed and is automatically calculated for you based on the next segment's starting angle. The machine will mirror these angles to the other side of the circle; that is, if you had a segment from 0 to 15 degrees, the parameters for that segment would also apply to angles between 345 and 360 degrees. When a parameter is included in the segment table, its box on the other tab is disabled, and all changes must be made in the segment table.

10.6.2 Add New Segment: inserts a segment row into the table starting at the angle entered in the "Start Angle" text box, and ending at the starting angle of the next segment (or 180 degrees if this is the last segment).

SECTION 18.2 ADDENDUMS / TILT SENSOR, CONT'D.

10.6.3 Delete Segment: removes from the table the segment with the starting angle in the “Start Angle” text box. Clicking on the row you want to delete will automatically fill the “Start Angle” box with that row’s starting angle, so you don’t have to type it in.

10.6.4 Start Angle: Used with the Add New Segment and Delete Segment buttons.

10.6.5 Add Parameter: Inserts a column for the parameter in the “Parameter” dropdown into the segment table.

10.6.6 Delete Parameter: Removes from the segment table the column for the parameter in the “Parameter” dropdown. Clicking on the column you want to delete will automatically select its parameter in the dropdown, so you don’t have to manually select it.

10.6.7 Welding Parameter Dropdown: Used with Add Parameter and Delete Parameter.

10.6.8 Show Full Parameter List: When checked, this will include every numeric parameter in the other tabs to vary based on the angle. When unchecked, only the parameters most likely to be needed are included, which makes them easier to find in the dropdown.

10.6.9 Segment Smoothing: If an angle value is entered in this field, the machine will smooth out the transition between values of adjacent segments. The machine will use the values entered for a segment at the center of that segment, and will linearly interpolate the value to the center of the next segment, updating it at an interval equal to the angle value provided for segment smoothing.

For example, if you varied wire speed from 100 ipm in a segment from 20 to 40 degrees, to 200 ipm in a segment from 40 to 80 degrees, with a segment smoothing angle of 5, the wire speed the machine used would be as follows:

Pitch Angle (Degrees)	Wire Speed (in./min.)
30 - 34.9	100
35 - 39.9	117
40 - 44.9	133
45 - 49.9	150
50 - 54.9	167
55 - 59.9	183
60 - 64.9	200

SECTION 18.3 ADDENDUMS / SPINARC®

The information in this addendum applies to Piper Plus systems sold with the Weld Revolution® SpinArc® torch. Section numbers match those in the base manual. The information provided supplements or supersedes information in the corresponding section of the base manual.

SECTION 1.0 TECHNICAL SPECIFICATIONS

Wire Rotation Speed (RPM): 200 – 5000
Spin Direction: Selectable (clockwise or counter-clockwise)

SECTION 5.0 PENDANT OPERATIONS

5.3 Full Function Pendant with SpinArc®: The SpinArc® addition adds one control to the standard Full Function Pendant.

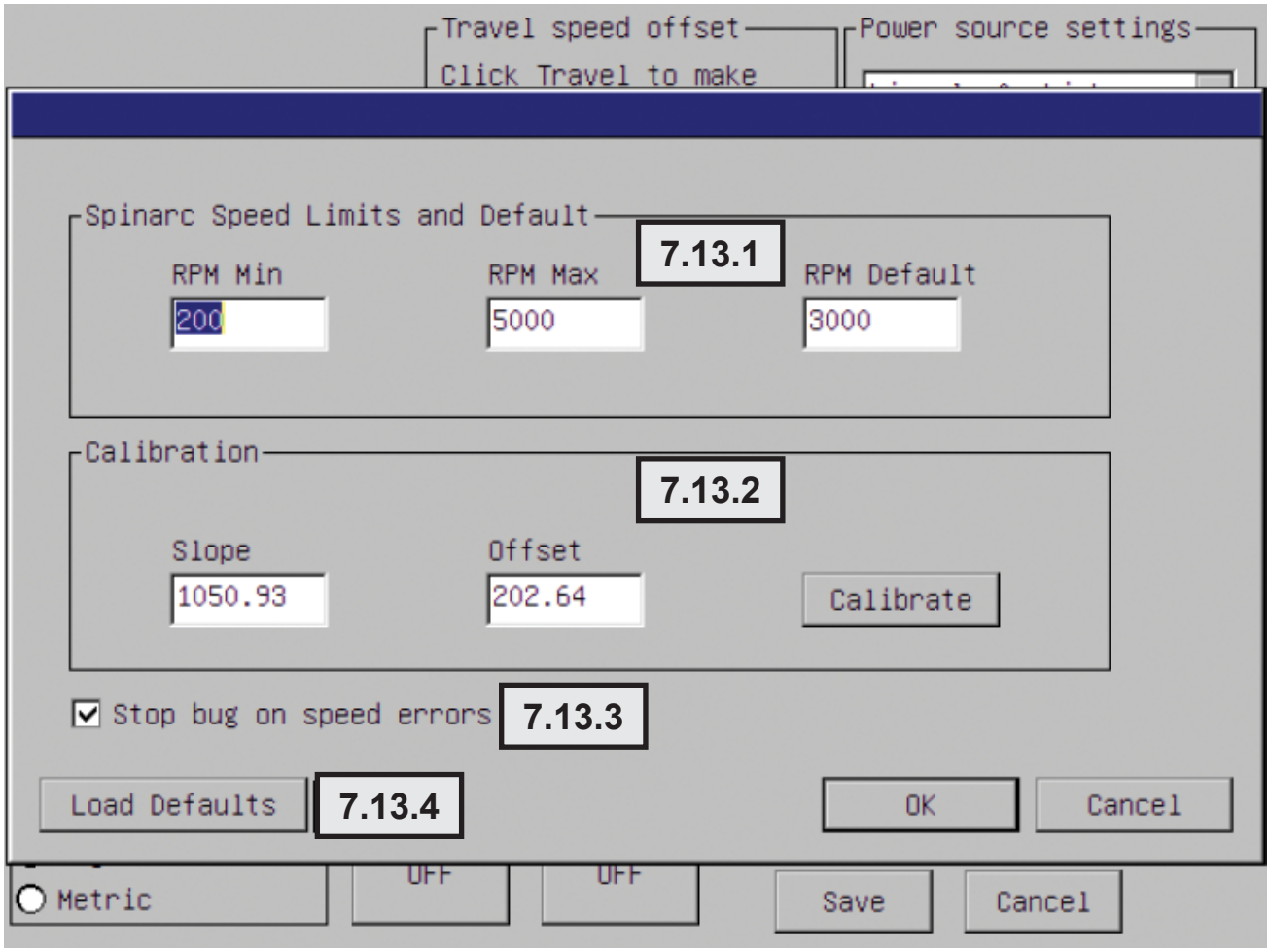
5.3.A – 5.3.Q: These controls match the standard Full Function Pendant.

5.3.R Spin Speed: Adjusts SpinArc® rotation speed. Pushing to the right increases speed; pushing to the left decreases speed.

SECTION 18.3 ADDENDUMS / SPINARC®, CONT'D.

SECTION 7.0 GLOBAL CONFIGURATION

7.13 SpinArc® Settings



7.13.1 Limits and Default: These inputs allow setting the default value when creating new passes, and the limits used when opening a pass or creating a new pass.

7.13.2 Calibration: These numbers are used to calibrate the SpinArc® speed control, and may need to be applied whenever starting to use a new torch or interface box, or when you have other reason to suspect the torch speed is no longer accurate. Pressing the “Calibrate” button will have the machine run through calibration for you.

7.13.3 SpinArc® Monitoring: When checked, this will cause the machine to stop if the SpinArc® speed reading is 0 for 2 seconds, or is at least 150 RPM away from the intended speed for 5 seconds. When unchecked, the machine will proceed regardless of whether or not the SpinArc® is working.

7.13.4 Load Defaults: Resets values on this page to default values. Note you will probably want to recalibrate after this.

SECTION 18.3 ADDENDUMS / SPINARC®, CONT'D.

SECTION 10.0 PARAMETER INPUT PAGES

SECTION 10.5 MISC TAB

The Miscellaneous tab contains the parameters for the SpinArc® torch.

10.5.1 Use SpinArc®: This determines whether the SpinArc® torch is used for a pass.

10.5.2 Rotation Speed RPM: This sets the SpinArc® rotation speed for this pass.

10.5.3 Min Rotation Speed RPM: This sets a lower limit for operator changes to the rotation speed.

10.5.4 Max Rotation Speed RPM: This sets an upper limit for operator changes to the rotation speed.

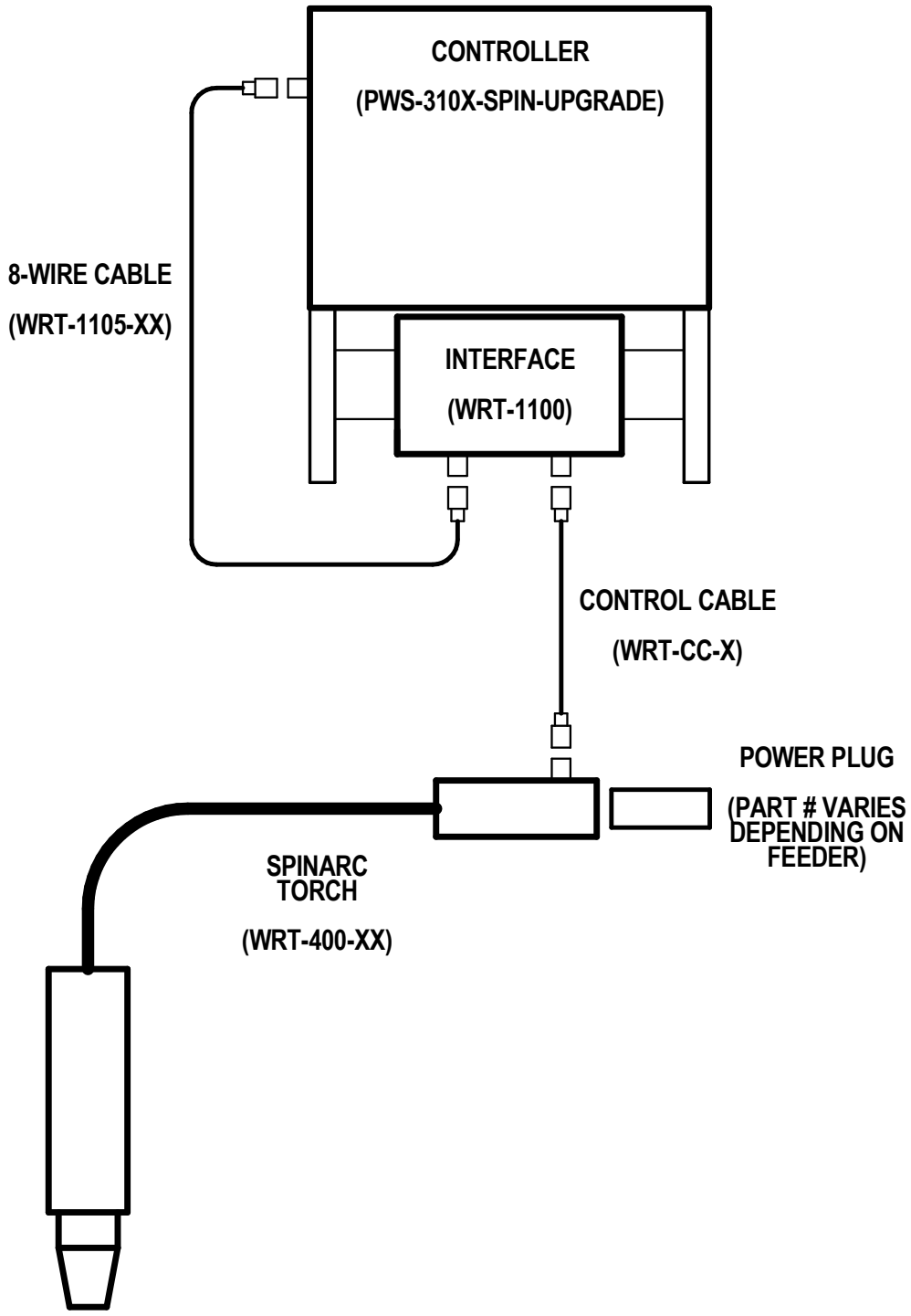
10.5.5 Spin Start Delay SECONDS: This sets the delay between starting the pass and starting the SpinArc® rotation. This can permit arc strike and puddle buildup to be accomplished before the rotation begins.

10.5.1 Spin Direction: This is used to control the direction of the rotation. This is useful when welding in the horizontal position, where the direction and position of the tractor impact which spin direction results in a better weld bead.

SECTION 18.3 ADDENDUMS / SPINARC®, CONT'D.

SECTION 12.0 SETUP

Additional connection for the SpinArc® torch.

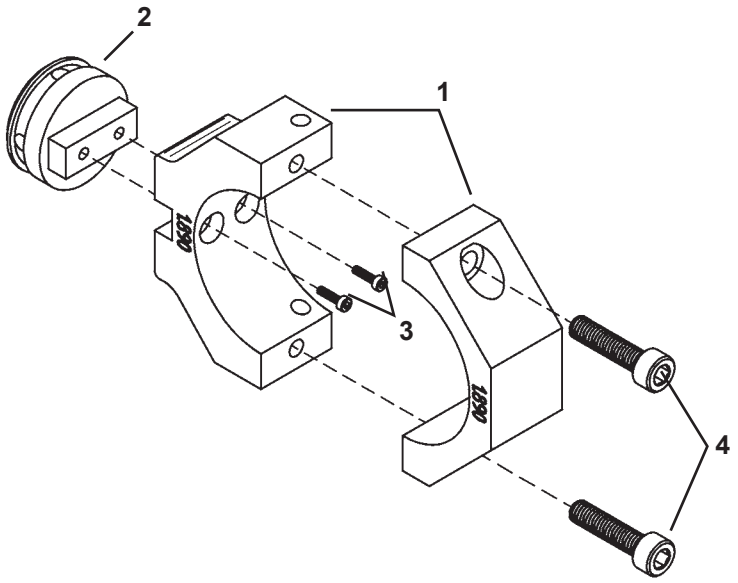


SECTION 18.3 ADDENDUMS / SPINARC®, CONT'D.

SECTION 16.0 ACCESSORIES / HARDWARE

WRT-1087: Flexure nut tool

PWS-4490 TORCH HOLDER ASSEMBLY / EXPLODED VIEW / PARTS LIST



ITEM	QTY	PART NO.	DESCRIPTION
1	1	PWS-4491	Torch Holder Block
2	1	PWS-4492	Torch Holder Mount
3	2	MET-0522-SS	Soc Hd Cap Scr M4 x 8
4	2	MET-2572-SS	Soc Hd Cap Scr M6 x 25

SECTION 16.0 ACCESSORIES / TORCHES

WRT-400-15: 15' torch is included in the PWS-SPIN-UPGRADE upgrade kit. Other lengths may be available upon request.

SECTION 18.3 ADDENDUMS / SPINARC®, CONT'D.

SECTION 16.0 ACCESSORIES / NOZZLES

PART NO.	DESCRIPTION
WRT-401-4-75*	Nozzle, ¾" (19mm) bore, 1/8" (3mm) BG-10 recessed
WRT-401-48-62*	Nozzle, 5/8" bore-flush, BG-10 HD Bottleneck
WRT-401-5-75	Nozzle, ¾" (19mm) bore, BG-10, ¼" (6mm) recessed, HD
WRT-401-6-75	Nozzle, ¾" (19mm) bore, BG-10, 1/8" (3mm) recessed copper
WRT-401-7-75	Nozzle,3/4" (19mm) bore, BG-10, 1/8" recessed, HD
WRT-401-81-62*	Nozzle, 5/8" bore, BG-10, 1/8" stick out, HD
WRT-S401-5-75	Nozzle, ¼ Tip Rec, BG-10 Tregakiss Style
WRT-S401-7-87	Nozzle, 1.4 Tip Rec, BG-10 Tregakiss Style (NON STK)

SECTION 16.0 ACCESSORIES / TIPS

PART NO.	DESCRIPTION
WRT-403-20-075	Contact Tip, Teach Tough Lock, ¾"
WRT-403-20-116	Contact Tip, 1/16" (1.6mm), BG-25 Heavy Duty
WRT-403-20-45*	Tip, F/0.045" (1.2mm) wire, BG-25, Heavy Duty
WRT-403-20-52	Contact Tip, HD, BG-25, 0.052" (1.33mm) wire
WRT-403-21-1.0	Contact Tip, 0.040", BG-25 1.0mm wire, tapered
WRT-403-21-45	Contact Tip, .045", BG-25 1.2mm, tapered
WRT-403-27-1.0	Contact Tip, 0.040", BG-25 1.0mm, EXT LIFE HD TIP
WRT-403-27-35	Contact Tip, 0.035", BG-25 CR ZR
WRT-403-37-45	Contact Tip, .045" BG-25 1.2mm, crzr EXT LIFE HD
WRT-603-20-116	Contact Tip, 1/16", BG-25 1.6mm, EXT HEAD
WRT-603-20-45	Contact Tip, .045", BG-25 1.2mm EXT HEAD

SECTION 16.0 ACCESSORIES / LINERS

PART NO.	DESCRIPTION
WRT-415-116-2	Liner, 15', 0.045-1/16"
WRT-415-35-15*	Liner, 15', 0.035-.045"
WRT-415-45-03	Liner, 15', HDPE

*Included in the PWS-SPIN-UPGRADE kit

SECTION 16.0 ACCESSORIES / O-RINGS

WRT-K1750 O-Ring Kit MA-400 (included in PWS-SPIN-UPGRADE kit)

SECTION 18.3 ADDENDUMS / SPINARC®, CONT'D.

SECTION 16.0 ACCESSORIES / POWER PINS

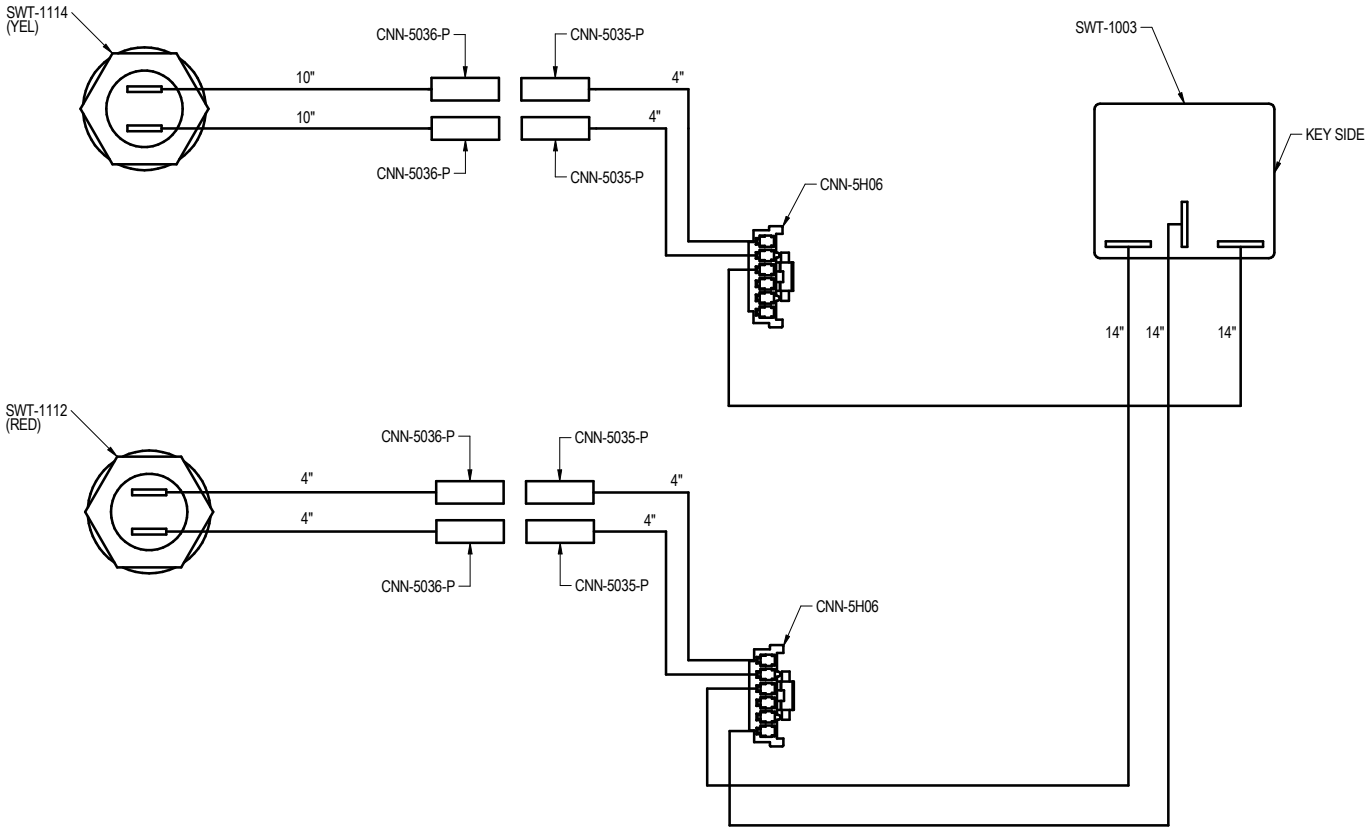
PART NO.	DESCRIPTION
WRT-PP-EURO	Power Pin, Euro style
WRT-PP-EURO1	Power Pin, Euro StyleLincoln Synergic 7 Fast Mate
WRT-PP-EURO2	Power Pin, Euro Style (CLOOS)
WRT-PP-EURO3	Power Pin, Euro Style
WRT-PP-F1	Power Pin, Fronius Thru Arm Style
WRT-PP-F2	Power Pin, Fronius North American Style
WRT-PP-F3	Power Pin, F++ Connector
WRT-PP-HB2	Power Pin, Quick Connect Hobart & ESAB MT
WRT-PP-HB3W	Power Pin, Hobart Water Cooled Version: PP-TW5
WRT-PP-L2	Power Pin, Lincoln Style
WRT-PP-L2W	Power Pin, Lincoln Water Cooled: PP-L2
WRT-PP-L3	Power Pin, Lincoln LN7, LN8, LN9, LN22, LN2
WRT-PP-L4*	Power Pin, Lincoln PowerWave 4R series
WRT-PP-L4W	Power Pin, Lincoln Water Cooled PP-L4
WRT-PP-M1W	Power Pin, Water Cooled Miller & Hobart version
WRT-PP-M2	Power Pin, Miller Semi-Auto Torch Style
WRT-PP-M3	Power Pin, Miller 130 Hobary 135 Handler 175 Style
WRT-PP-OTC	Power Pin, OTC CM741, CMRE741, AF4001
WRT-PP-OXO	Power Pin OXO PS-60Q, AVC-30Q Style
WRT-PP-PAN1	Power Pin, Panasonic Gun Slinger 260 style
WRT-PP-PAN2	Power Pin, Panasonic
WRT-PP-PAN3	Power Pin, Panasonic
WRT-PP-PAN3W	Power Pin, Panasonic Water Cooled: PP-PAN3
WRT-PP-TW4W	Power Pin Water Cooled: PP-PAN3
WRT-PP-TW5	Power Pin Tweco #5 Style
WRT-TW4	Power Pin, .625 Dia TWECO #4 Style

*Included in the PWS-SPIN-UPGRADE kit

SECTION 18.3 ADDENDUMS / SPINARC®, CONT'D.

SECTION 17.0 WIRING DIAGRAMS / PENDANT WIRING

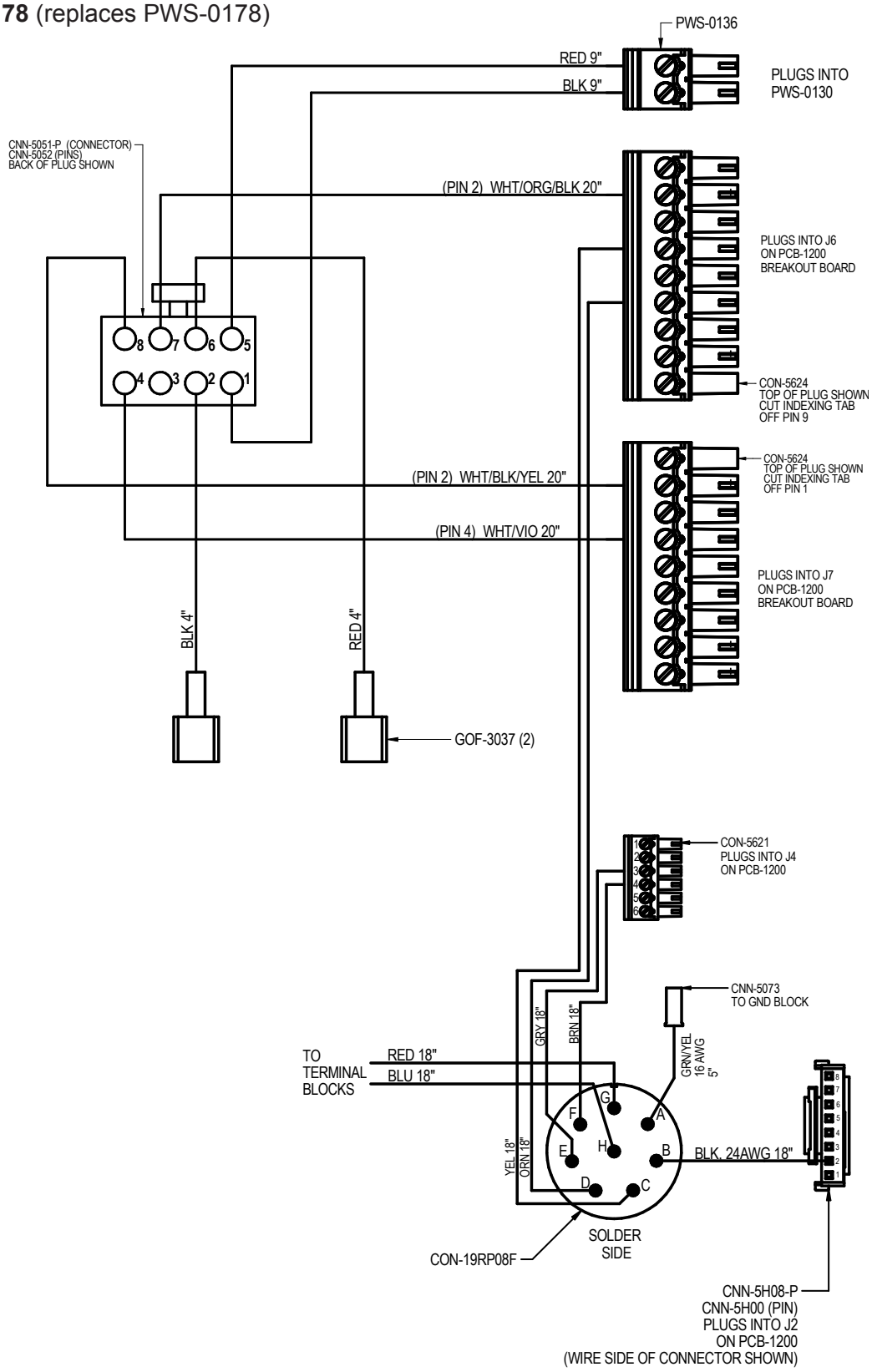
PWS-0237 (replaces PWS-0242 and PWS-0243 in the standard Full-Function pendant PWS-0200)



SECTION 18.3 ADDENDUMS / SPINARC®, CONT'D.

SECTION 17.0 WIRING DIAGRAMS / CONTROL BOX

PWS-3178 (replaces PWS-0178)



SECTION 19.0 SPARE PARTS KITS

SPK-PWS-4000 SPARE PARTS KIT / PARTS LIST

PART NO.	QTY	DESCRIPTION
PWS-1075	1	HEIGHT AXIS WIRING HARNESS
PWS-1087	1	BUG CONTROL WIRING HARNESS
PWS-1495-1.3	1	16" MOTOR CONTROL CABLE
SPK-PWS-1010	1	SPARE PARTS KIT
SPK-PWS-1020	1	SPARE PARTS KIT
SPK-PWS-1030	1	SPARE PARTS KIT
SPK-PWS-1200	1	SPARE PARTS KIT
SPK-PWS-4120	1	SPARE PARTS KIT

SPK-PWS-1010 SPARE PARTS KIT / PARTS LIST

PART NO.	QTY	DESCRIPTION
MET-0522-SS	16	SOC HD CAP SCR M2 x 8
MET-0553-SS	17	SOC HD CAP SCR M4 x 10
MET-0953-SS	8	FLT HD SOC SCR M4 X 10
PWS-1036	4	SLIDER BLOCK
PWS-1088	2	SPLIT RING, 1.48 OD

SPK-PWS-1020 SPARE PARTS KIT / PARTS LIST

PART NO.	QTY	DESCRIPTION
CAS-1511	1	STEEL PINION
MET-0553-SS	4	SOC HD CAP SCR M4 x 10
MET-0567-SS	2	SOC HD CAP SCR M5 x 16
MET-0944-SS	4	FLT HD SOC SCR M3 x 12
PWS-1025	1	16" WEAVER ARM ASSEMBLY
PWS-1028	2	FIXED WHEEL & LEG ASSEMBLY
PWS-1159	1	PWS WEAVER MOTOR ASSEMBLY
PWS-1198	2	ADJUSTABLE WHEEL & LEG ASSEMBLY
WAS-0232	2	#10 SPLIT LOCK WASHER

SECTION 19.0 SPARE PARTS KITS

SPK-PWS-1030 SPARE PARTS KIT / PARTS LIST

PART NO.	QTY	DESCRIPTION
FAS-0959	1	1/4-20 X 1" FLAT HD SOCKET
FAS-1350	2	HEX JAM NUT 1/4-20
MET-0522-SS	10	SOC HD CAP SCR M2 x 8
MET-0552-SS	5	SOC HD CAP SCR M4 x 8
MET-0564-SS	4	SOC HD CAP SCR M5 x 12
MET-1360-SS	2	M5 HEX NUT
MET-2562-SS	1	SOC HD CAP SCR M5 x 25
MET-2564-SS	4	SOC HD CAP M5 x 35 PARTIAL THR
PWS-1032	1	MODIFIED GEARBOX
PWS-1034	1	DRIVING TIMING PULLEY ASSEMBLY
PWS-1035	1	FLANGED ALUM. TIMING PULLEY
PWS-1037	2	SLIDER GUIDE RAIL
PWS-1039	1	OUTPUT SHAFT
PWS-1040	1	PANEL MOUNT CLAMPING LEVER
PWS-1041	1	MODIFIED DRIVE PINION
PWS-1043	1	HTD TIMING BELT, 9MM WIDE
PWS-1044	1	NEEDLE BNG, 11/16 OD, 1/2 ID
PWS-1046	1	2MM SQUARE KEY .75" LG
PWS-1048	1	TENSIONER ASSEMBLY
PWS-1049	1	CLUTCH HANDLE CATCH BLOCK
PWS-1081	1	DRIVE MOTOR W/ WIRING HARNESS
WAS-0220	1	#8 SAE FLAT
WAS-0231	4	#10 INTERNAL STAR LOCKWASHER

SPK-PWS-1200 SPARE PARTS KIT / PARTS LIST

PART NO.	QTY	DESCRIPTION
MET-0542-SS	4	SOC HD CAP SCR M3 x 8
MET-0552-SS	4	SOC HD CAP SCR M4 x 8
MET-0978-SS	4	FLT HD SOC SCR M6 x 18
MET-1340-SS	4	M3 HEX NUT
MET-2554-SS	2	SOC HD CAP M4 x 35 PARTIAL THR
MET-2555-SS	2	SOC HD CAP M4 x 40 PARTIAL THR
MET-2562-SS	3	SOC HD CAP SCR M5 x 25
PWS-1024-ST	1	STEEL PINION
PWS-1028	1	FIXED WHEEL & LEG ASSEMBLY
PWS-1046	2	2MM SQUARE KEY .75" LG
PWS-1055	1	HEIGHT CONTROL GEARBOX
PWS-1057	1	3/8" WIDE MXL TIMING BELT
PWS-1059	1	MODIFIED MOTOR PULLEY
PWS-1060	1	SPATTER SHIELD
PWS-1061	1	MODIFIED GEARBOX PULLEY
PWS-1065	1	HEIGHT CONTROL ARM ASSEMBLY
PWS-1074	1	OUTPUT SHAFT
PWS-1079	1	TORCH MOUNTING ASSEMBLY
PWS-1083	1	M8 x 16 ADJ. LEVER
PWS-1198	2	ADJUSTABLE WHEEL & LEG ASSEMBLY
WAS-0232	2	#10 SPLIT LOCK WASHER

SECTION 19.0 SPARE PARTS KITS

SPK-PWS-4120 SPARE PARTS KIT / PARTS LIST

PART NO.	QTY	DESCRIPTION
MET-0552-SS	2	SOC HD CAP SCR M4 x 8
MET-0932-SS	32	FLT HD SOC SCR M2.5 x 8
PCB-1067	2	AMPCARD MOTHERBOARD
PCB-1220	3	5A BLDC MOTOR DRIVER CARD
PWS-1121	1	AMPCARD HEATSINK / MOUNT
STOF-5002	16	M2.5 HEX STANDOFF F/F 20MM LG

SPK-PWS-1200 SPARE PARTS KIT / PARTS LIST

PART NO.	QTY	DESCRIPTION
MET-0542-SS	4	SOC HD CAP SCR M3 x 8
MET-0552-SS	4	SOC HD CAP SCR M4 x 8
MET-0978-SS	4	FLT HD SOC SCR M6 x 18
MET-1340-SS	4	M3 HEX NUT
MET-2554-SS	2	SOC HD CAP M4 x 35 PARTIAL THR
MET-2555-SS	2	SOC HD CAP M4 x 40 PARTIAL THR
MET-2562-SS	3	SOC HD CAP SCR M5 x 25
PWS-1024-ST	1	STEEL PINION
PWS-1028	1	FIXED WHEEL & LEG ASSEMBLY
PWS-1046	2	2MM SQUARE KEY .75" LG
PWS-1055	1	HEIGHT CONTROL GEARBOX
PWS-1057	1	3/8" WIDE MXL TIMING BELT
PWS-1059	1	MODIFIED MOTOR PULLEY
PWS-1060	1	SPATTER SHIELD
PWS-1061	1	MODIFIED GEARBOX PULLEY
PWS-1065	1	HEIGHT CONTROL ARM ASSEMBLY
PWS-1074	1	OUTPUT SHAFT
PWS-1079	1	TORCH MOUNTING ASSEMBLY
PWS-1083	1	M8 x 16 ADJ. LEVER
PWS-1198	2	ADJUSTABLE WHEEL & LEG ASSEMBLY
WAS-0232	2	#10 SPLIT LOCK WASHER

SECTION 19.0 SPARE PARTS KITS

SPK-PWS-0200 SPARE PARTS KIT / PARTS LIST

PART NO.	QTY	DESCRIPTION
MET-0141-SS	8	PAN HD PHIL SCR M3 x 6
MET-0543-SS	16	SOC HD CAP SCR M3 x 10
PCB-1202	1	PENDANT CONTROL BOARD
PCB-1203	1	SWITCH INTERFACE BOARD
PCB-1205	1	DISPLAY MODULE
PWS-0228	1	LEGEND PLATE
PWS-0238	6	MOM-OFF-MOM TOGGLE
PWS-0239	2	ON-OFF-ON TOGGLE
PWS-0240	1	GRN+BLK PUSHBUTTONS
PWS-0241	2	ENCODER W/ HARNESS & KNOB
PWS-0242	1	RED PUSHBUTTON
PWS-0243	1	SWITCH, YEL W/ HARNESS
PWS-0247	3	LENS

SPK-PWS-0201 SPARE PARTS KIT / PARTS LIST

PART NO.	QTY	DESCRIPTION
MET-0141-SS	8	PAN HD PHIL SCR M3 x 6
MET-0543-SS	8	SOC HD CAP SCR M3 x 10
PCB-1202	1	PENDANT CONTROL BOARD
PCB-1203	1	SWITCH INTERFACE BOARD
PWS-0229	1	SMALL LEGEND PLATE
PWS-0238	4	MOM-OFF-MOM TOGGLE
PWS-0239	2	ON-OFF-ON TOGGLE
PWS-0240	1	GRN+BLK PUSHBUTTONS
PWS-0241	2	ENCODER W/ HARNESS & KNOB
PWS-0242	1	RED PUSHBUTTON

SPK-PWS-0100 SPARE PARTS KIT / PARTS LIST

PART NO.	QTY	DESCRIPTION
PCB-1200	1	BREAKOUT BOARD
PWS-0107-P	1	COLOR LCD MODULE
PWS-0109	1	GLASS FOR DISPLAY
PWS-0113	1	24V DC WATERPROOF FAN ASSY
PWS-0119	1.25'	BLACK POLYURETHANE TUBING
PWS-0130	1	PC104 COMPUTER BOX ASSEMBLY
PWS-0142	2	KEYPAD MOUNTING BRACKET
PWS-0148-P	1	SOLID STATE RELAY,30A 420VAC
PWS-0151	1	SOLENOID VALVE
PWS-0164	1	120VAC POWER CORD
PWS-0171	1	FLOW SENSOR, 50LPM, 1-5V
PWS-0192	1	EAO M SERIES KEYPAD
PWS-0193	1	USB MOUSE POINTER
SWT-FNC2	1	E-STOP 2 N.C. CONTACTS

BUG-O SYSTEMS INTERNATIONAL

EC DECLARATION OF CONFORMITY

Manufacturer and technical Documentation Holder:	Bug-O Systems International a Division of Weld Tooling Corporation 280 Technology Drive Canonsburg, PA 15317-9564
Hereby declare that machinery:	**Piper Plus**, including options and accessories, **Piper Bug**, including options and accessories
Sales codes:	PWS-0100, PWS-0200, PWS-0201, PWS-1000, PWS-3100, PWS-3102, PWS-4000, PWS-4100. (sales codes may also contain prefixes and suffixes)
Kits that include the above:	PWS-2000 series Piper Bug Kits PWS-5000 series Piper Plus Kits (kits in each series may also contain prefixes and suffixes)

Is in conformity with Council Directives and amendments:

- 2006/42/EC – Machinery Directive.
- 2014/35/EU – Electromagnetic Compatibility (EMC) Directive
- 2011/65/EU – Restriction of the use of certain hazardous substances (RoHS)

Standards:

- EN 12100:2010 – Safety of Machinery – General principles for design – Risk assessment and risk reduction.
- EN 60204-1:2016 – Safety of machinery – Electrical equipment of machines Part 1: General Requirements.
- EN 61000-6-2 – Electromagnetic compatibility (EMC) – Part 6-2 Generic standards – Immunity for industrial environments.
- EN 61000-6-4 – Electromagnetic compatibility (EMC) – Part 6-4 Generic standards – Emissions for industrial environments.
- EN 50581:2012 – Technical documentation for the assessment of electrical and electronic products with respect to restriction of hazardous substances.

The machinery, product, assembly or sub-assembly covered by this Declaration of Conformity must not be put into service until the machinery into which it is to be incorporated (if applicable) is declared in conformity with provisions of the applicable directives(s).

Authorized representative for the compilation of the relevant technical documentation and issuer of EC Declaration of Conformity:

Date of Issue: MAY 23,2019
Place of issue: 280 Technology Drive, Canonsburg, PA 15317, USA
Typed Name of Authorized Person: MATTHEW W. CABLE - PRESIDENT

Limited 3-Year Warranty

Model _____
Serial No. _____
Date Purchased: _____
Where Purchased:_____

For a period ending one (1) year from the date of invoice, Manufacturer warrants that any new machine or part is free from defects in materials and workmanship and Manufacturer agrees to repair or replace at its option, any defective part or machine. HOWEVER, if the invoiced customer registers the Product Warranty by returning the Warranty Registration Card supplied with the product within 90 days of the invoice date, or by registering on-line at www.bugo.com, Manufacturer will extend the warranty period an additional two (2) years which will provide three (3) total years from the date of original invoice to customer. This warranty does not apply to machines which, after Manufacture's inspection are determined by Manufacturer to have been damaged due to neglect, abuse, overloading, accident or improper usage. All shipping and handling charges will be paid by the customer.

The foregoing express warranty is exclusive and Manufacturer makes no representation or warranty (either express or implied) other than as set forth expressly in the preceding sentence. Specifically, Manufacturer makes no express or implied warranty of merchantability or fitness for any particular purpose with respect to any goods. Manufacturer shall not be subject to any other obligations or liabilities whatsoever with respect to machines or parts furnished by Manufacturer.

Manufacturer shall not in any event be liable to Distributor or any customer for any loss of profits, incidental or consequential damages or special damages of any kind. Distributor's or customer's sole and exclusive remedy against Manufacturer for any breach of warranty, negligence, strict liability or any other claim relating to goods delivered pursuant hereto shall be for repair or replacement (at Manufacturer's option) of the machines or parts affected by such breach.

Distributor's Warranty:

In no event shall Manufacturer be liable to Distributor or to any customer thereof for any warranties, representations or promises, express or implied, extended by Distributor without the advance written consent of Manufacturer, including but not limited to any and all warranties of merchantability or fitness for a particular purpose and all warranties, representations or promises which exceed or are different from the express limited warranty set forth above. Distributor agrees to indemnify and hold Manufacturer harmless from any claim by a customer based upon any express or implied warranty by Distributor which exceeds or differs from Manufacturer's express limited warranty set forth above.

HOW TO OBTAIN SERVICE:
If you think this machine is not operating properly, re-read the instruction manual carefully, then call your Authorized BUG-O dealer/distributor. If they cannot give you the necessary service, write or phone us to tell us exactly what difficulty you have experienced. BE SURE to mention the MODEL and SERIAL numbers.