INSTRUCTIONS
and
PARTS MANUAL

PIPER-BUG

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-PIPERBUG-IPM-0513

Bug-O Systems is guided by honesty, integrity and ethics in service to our customers and in all we do.

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

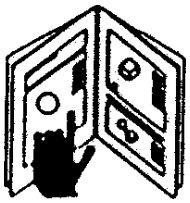
1) The equipment is not waterproof. Using the unit in a wet environment may result in serious injury. Do not touch equipment when wet or standing in a wet location.

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.

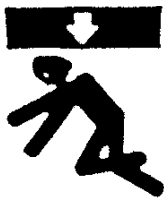
EQUIPMENT DAMAGE POSSIBLE

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 worksite 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.

PIPER-BUG
INSTRUCTIONS AND PARTS MANUAL
TABLE OF CONTENTS

PAGE

PIPER-BUG IMPORTANT NEW FEATURES

1. **Automatic Height Control:** This will automatically adjust the height of the torch to maintain a set current. Rather than having to have two people watching a single machine, the operator can make adjustments from the pendant and the machine will automatically adjust the height to maintain the set parameters.

2. **Nearly unlimited configurations:** Configurations can be stored on a compact flash card. An engineer can create configurations in an office, email them to a manager at a job site, and the manager can load them onto the machines. The machine is capable of storing thousands of configurations.

3. **Configurable limits on user adjustments:** Users can be given the ability to adjust nearly all welding parameters, or none of them. The limits and the amount changed on every adjustment can be configured.

4. **Discrete values:** No dials, no analog timers, no values between 1 and 999. If you want the machine to prepurge for 3.05 seconds, you enter 3.05. If you want the weave width to be .58 inches (or centimeters) you enter .58 into the parameter configuration.

5. **Easy calibration:** The machine will aid you in setting up for different wire diameters, track heights, and differences in current. These are the only things that need calibration. The weaver and timers never need calibrated.

6. **Intelligent, high performance motors that will alert you if they cannot perform the given procedures due to a jam or damage**. They can perform at much higher speeds and with greater accuracy than other motors.

PIPER-BUG TECHNICAL DATA / DIMENSIONS

Power Requirements:
120/240 VAC/50-60/1

Linear Speed:
0 – 2000 mm/m (0-80 ipm), +/-1%

Weave Speed:
125 – 3300 mm/m (5-130 ipm), +/- 1%

Wire Feed Speed:
125 – 1150 cm/m (50-450 ipm), +/- 1%

Wire Size:
0.9 – 1.6 mm (0.035 – 1/16")

Dwell Times:
0-10 seconds left & right, independent

Weave Width:
.25 – 50 mm (.01-2")

Steering:
50 mm (2") left & right of center, 100 mm (4") total

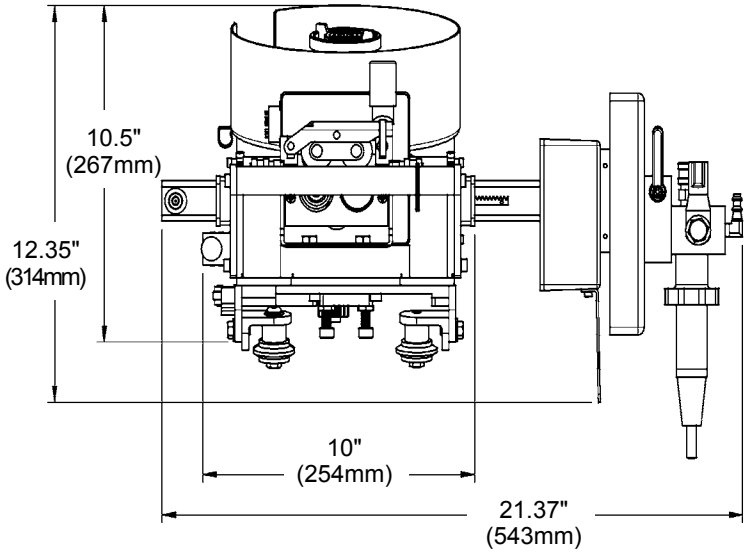
Load Capacity:
27 Kg (60 lbs.) total.

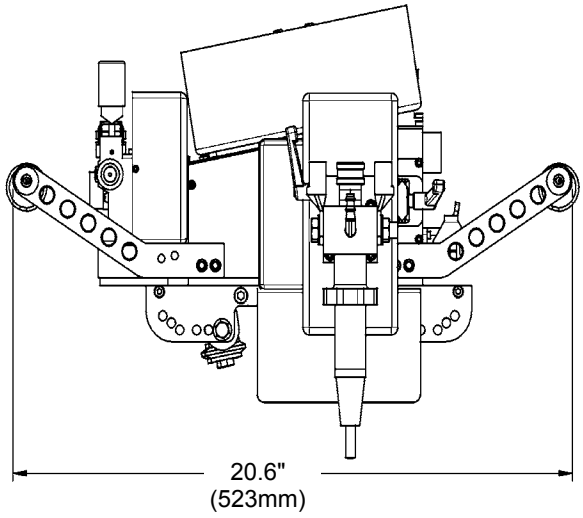
Net Weight (w/o spool):
17.1 Kg (37.7 lbs.) Feeder On Head
(Optional) 12.9 Kg (28.4 lbs) Feeder on Floor

Dimensions:
523 x 543 x 314 mm (20.6" x 21.37" x 12.35")

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

Dimensions:



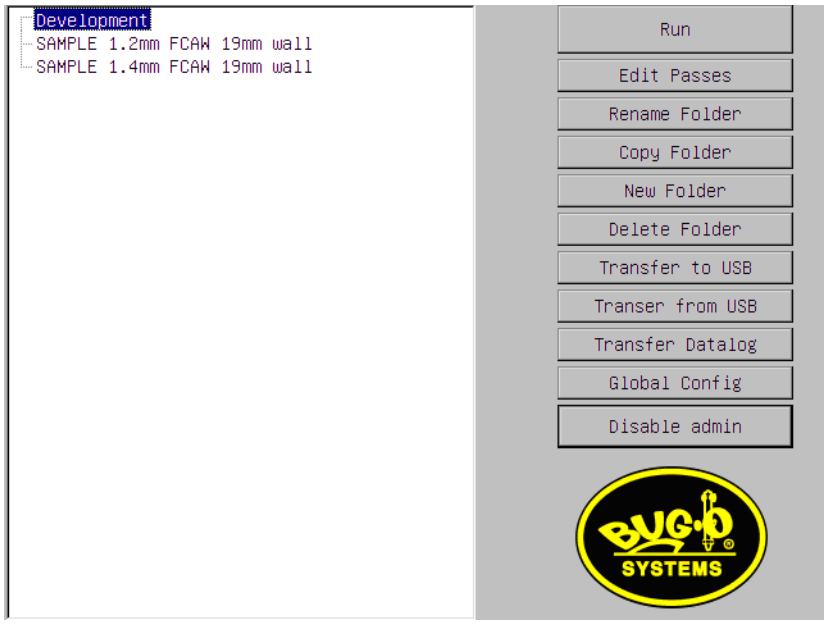


PIPER-BUG USER OPERATIONS

The user interface is very intuitive and user friendly. It displays the important information about parameters and what the machine is doing. The interface can be in almost any language to make it even easier to use by editing a simple XML file. An operator can have as much or as little interaction with the interface as they want. If they are not comfortable with the computer based interface, all they have to do is choose a pass and then control the machine from the pendant.

Choosing a Folder/Station

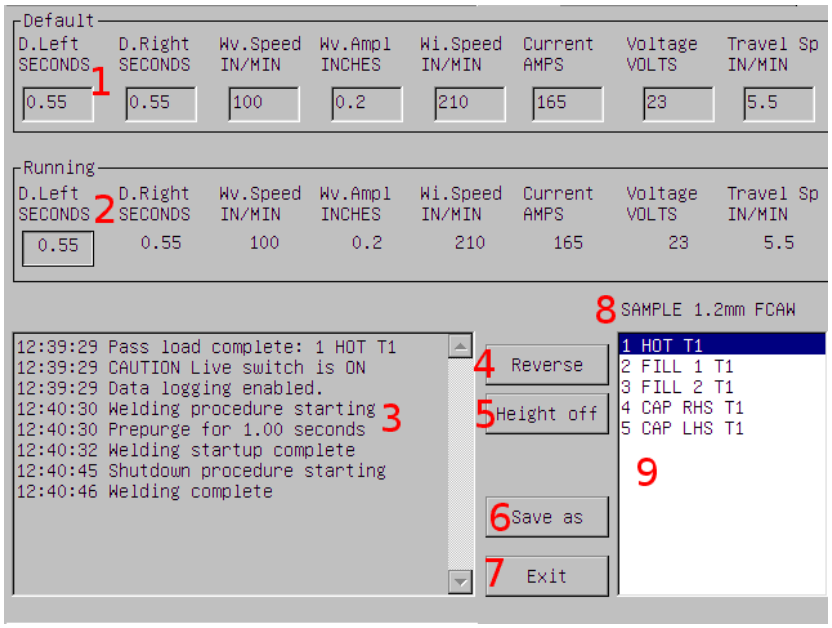
When the machine is first started, the user is presented with a screen that will allow them to choose a folder. To keep things simple for your users, consider making a folder for each station. These folders contain passes. They select the folder/station they need to use, and then click Run.



PIPER-BUG USER OPERATIONS, CONT'D.

Running screen

The running screen is displayed after clicking Run. This screen displays information to the welder, allows them to select passes that are inside of the folder they chose, and make adjustments if the pass configuration allows it. Adjustments can be made on both the pendant and at the control box.



1. Default settings for this pass. This will display the original parameters loaded from the configuration file.

2. Running setting for this pass. These show 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.

3. Status box. Shows important events, errors and machine status.

4. Reverses the direction of the main drive. Can only be changed when the machine is idle. This will reload the default parameters for the selected pass. This also reverses the steering direction so you will not have to turn the steering knob backwards.

5. Turns the automatic height control off when pressed. This disables all current sensing functions and skips the run in phase. This can only be changed when the machine is idle. You would only turn the automatic height control off if there is a problem with it.

6. This is only visible if you run while logged in as an admin. It will ask you for the new pass name then save it with the current running parameters. It will use the same startup/crater/adjustment limit values of the pass being copied.

7. Returns to the main screen.

8. Displays the name of the current folder/station.

9. Pass selection. Selecting a new pass will load the default parameters for that pass. This can only be changed when the machine is idle.

PIPER-BUG USER OPERATIONS, CONT'D.

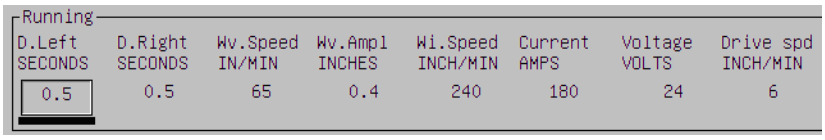
Choosing a pass

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.

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 past the set limits.

a. Using the running screen: By pressing left and right arrows 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.



b. 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.

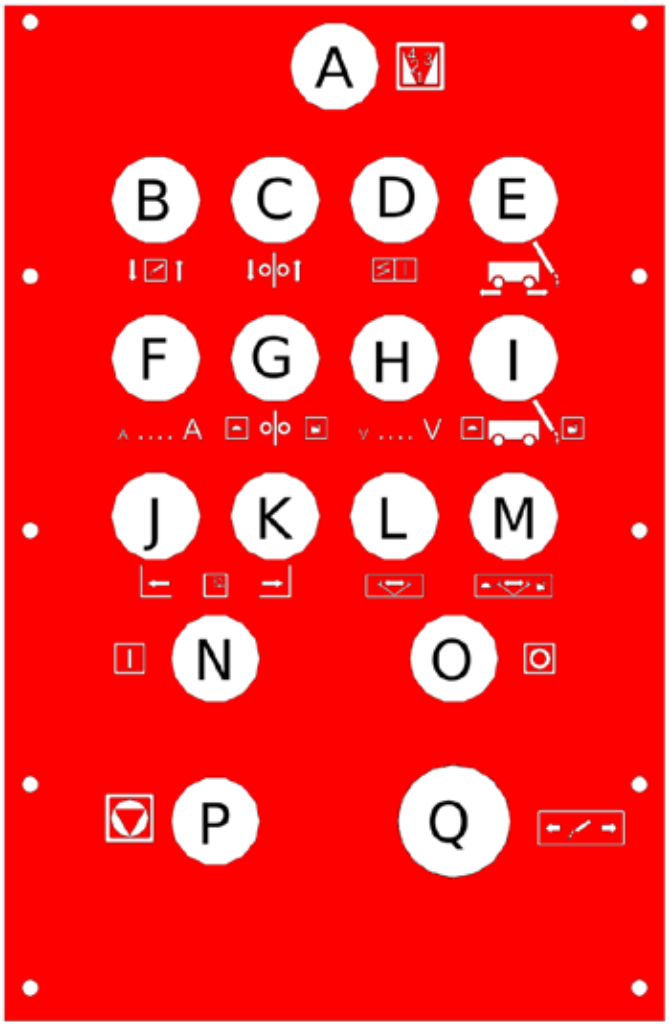
PIPER-BUG USER OPERATIONS, CONT'D.

Pendant operations

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. There are two (2) pendants available: 1) A full featured pendant with a display screen, and 2) 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. It is not a "manager's pendant." 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.

Full Function Pendant

The top four (4) switches move the machine while it is idle. The lower eight (8) switches will allow the user to adjust parameters, bound by the limits in the configuration of the pass. They can be used at any time, except when the machine is going through its startup or shutdown welding procedures. 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.



PIPER-BUG USER OPERATIONS, CONT'D.

A: Changes the parameters to the next available pass. Only usable while the machine is idle.

B: 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.

C: Jogs the wire up or down while idle.

D: Holding this switch either direction will cause the weaver to oscillate. Releasing it will make it center.

E: Moves/tracks the machine forward or backward. Normally it will be setup to move faster in reverse. It will move forward at the welding speed for five (5) seconds, then switch into a high speed mode.

F: Adjusts the target current. This will have no effect if the height control is disabled.

G: Adjusts the wire speed.

H: Adjusts the power source's voltage.

I: Adjusts the track speed.

J: Adjusts the left dwell.

K: Adjusts the right dwell.

L: Adjusts the weave amplitude.

M: Adjusts the weave speed.

N: Starts the welding process. All other switches must be released. If the "Live" switch on the front of the control box is on, the machine will weld. If it is off, it will dry run, running only the main drive and weaver.

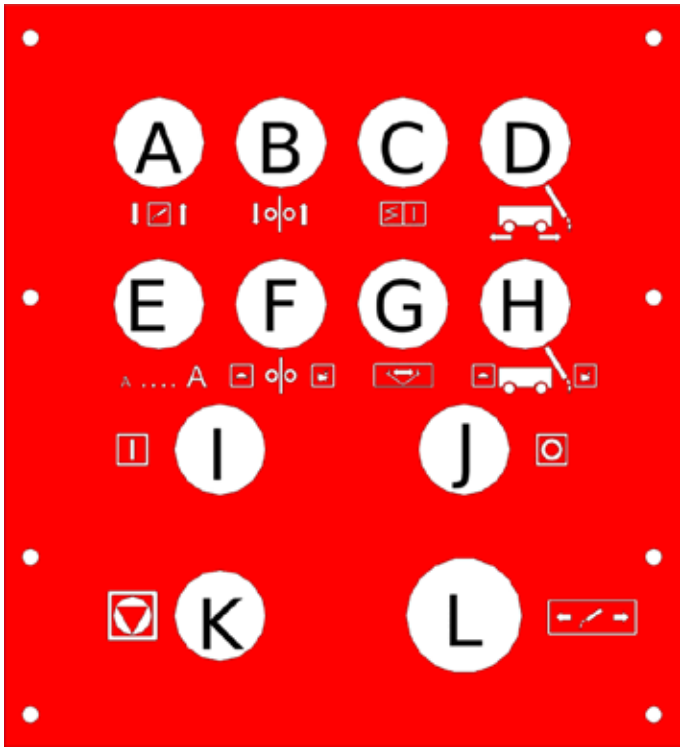
O: Stops the machine normally, making it go through the crater process. If it is pressed during startup or crater it will cause a quick stop. Pressing it two (2) times quickly will cause this to happen. If it is held while the machine is idle it will purge the gas.

P: Quick stop. This will immediately turn off the welding arc and stop all the motors.

Q: Steers the torch left and right.

PIPER-BUG USER OPERATIONS, CONT'D.

Limited Function Pendant
The top four (4) switches move the machine while it is idle. The lower four (4) switches will allow the user to adjust parameters, bound by the limits in the configuration of the pass. They can be used at any time, except when the machine is going through its startup or shutdown welding procedures. Each press will adjust the value of the parameter, if the pass settings allow it.



A: 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.

B: Jogs the wire up or down while idle.

C: Moving this switch either direction will cause the weaver to oscillate. Releasing it will make it center. You can use this switch along with the track switch to see how the pass will look without welding.

D: Moves/tracks the machine forward or backward. Normally it will be setup to move faster in reverse. It will move forward at the welding speed for five (5) seconds, then switch into a high speed mode.

E: Adjusts the target current. This will have no effect if the height control is disabled.

F: Adjusts the wire speed.

G: Adjusts the weave amplitude.

H: Adjusts the track speed.

PIPER-BUG USER OPERATIONS, CONT'D.

I: Starts the welding process. All other switches must be released. If the "Live" switch on the front of the control box is on, the machine will weld. If it is off, it will dry run, running only the main drive and weaver.

J: 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 (2) times quickly will cause this to happen. If it is held while the machine is idle it will purge the gas.

K: Quick stop. This will immediately turn off the welding arc and stop all the motors.

L: Steers the torch left and right.

Dry run switch

The switch on the front of the control box controls whether the machine will actually weld or just dry run. If it is set to cold, pressing start will make the machine travel forward and oscillate, allowing you to carefully observe the speed and oscillation. When the switch is set to hot, the machine will weld when the start button is pressed. If it is switched off during welding, an emergency stop will occur.

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 still 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 prepurge 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.

PIPER-BUG USER OPERATIONS / ADMINISTRATION

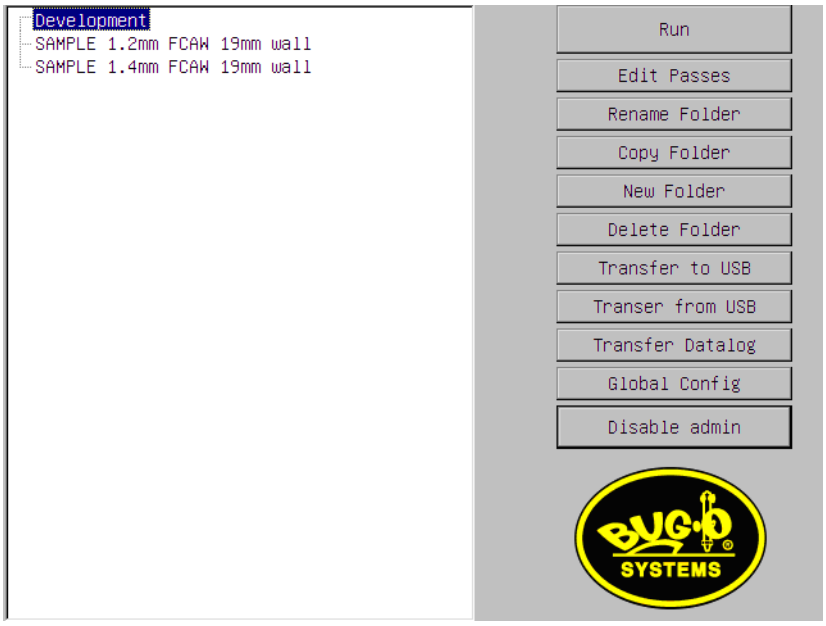
When Stop is pressed, the weaver and main drive will both stop. The weaver will center itself. The wire speed, current, and voltage will all change to their Crater values. The machine will continue welding in place at these settings until the crater timer finishes. It will then stop the wire feeder and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

Administration

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 (1) 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. This will reveal the hidden administrator buttons. **The default PIN number is 123.**

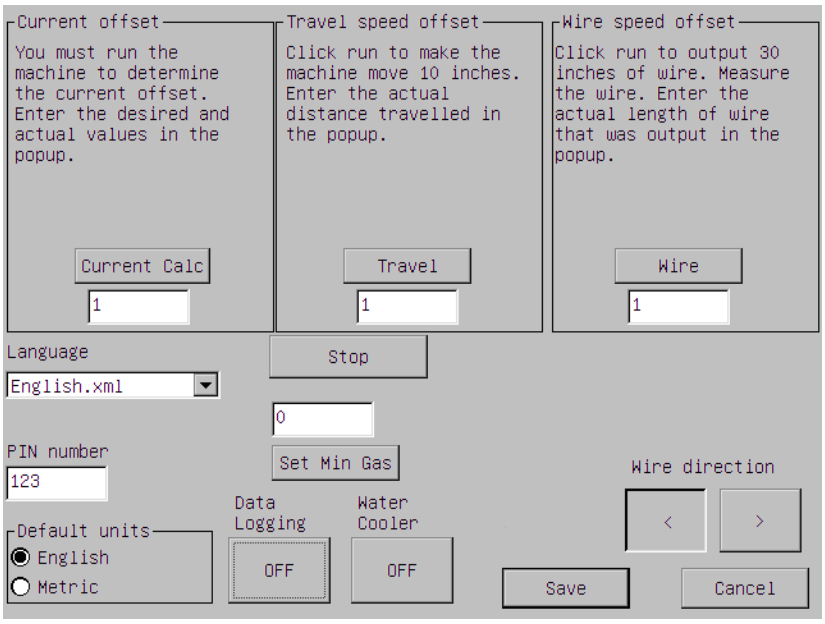
The main menu is a list of folders on the device. Each folder on the main screen can be a station, or it can be organized by country/city/location. The pass configuration files are XML files with the extension .bug. They cannot be placed directly into the root folder. (Pass editing and organizing software that will run on a desktop computer is available. It allows you to edit and organize configurations that have been transferred to a USB stick.)



PIPER-BUG USER OPERATIONS / ADMINISTRATION, CONT'D.

Global Configuration

The global configuration screen contains settings for the calibration of the device and options that affect the entire system. It allows you to set the language, administrator PIN number, default units, the direction of the drive and wire, the current offset, the drive speed offset, and the wire speed offset.



The drive speed and wire speed offsets can be setup before ever welding with the machine. This involves the drive and wire moving a set distance. Follow the onscreen guides to calculate the offsets. After clicking "Travel" or "Wire", wait for the machine to stop moving, and then enter the distance or length of wire (in inches) into the popup prompt. The stop button will stop the drive and wire feeder if necessary. The calibration is always performed in inches.

The current offset is only possible to determine while welding. The current will be different depending on where it is being measured and the accuracy of the device measuring it. Due to the nature of analog circuits, it is necessary to calibrate this to match the display on the welding power source. You must perform a test weld and record the desired value and the value displayed on the power supply. Click Current Calc and enter the numbers when prompted.

Data logging can be turned on and off. If you do not have a license for data logging, you will not be able to activate it. Please contact your Lincoln or Bugo representative if you would like to add this feature.

Water cooler monitoring can be turned on and off. If you have a water cooler and want to be warned if it is not functioning properly, turn this option on. If you do not have a water cooler, or have it turned off, turn this option off. If enabled, a buzzer will sound and a warning will be printed on the screen if water is not flowing. The machine will also stop. You will not be able to start a weld if water flow is not detected.

PIPER-BUG USER OPERATIONS / ADMINISTRATION, CONT'D.

By setting the minimum acceptable gas flow, the machine can stop itself if the gas flow drops below this value, preventing a weld that would be damaged by porosity. 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 cutoff value, and then click "Set Min Gas". The gas will purge for ten (10) seconds, giving you time to adjust the regulator. It will then sample values for five (5) 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 level, the machine will display an error three (3) times and then stop. If you want to disable this check, manually set the value to zero (0).

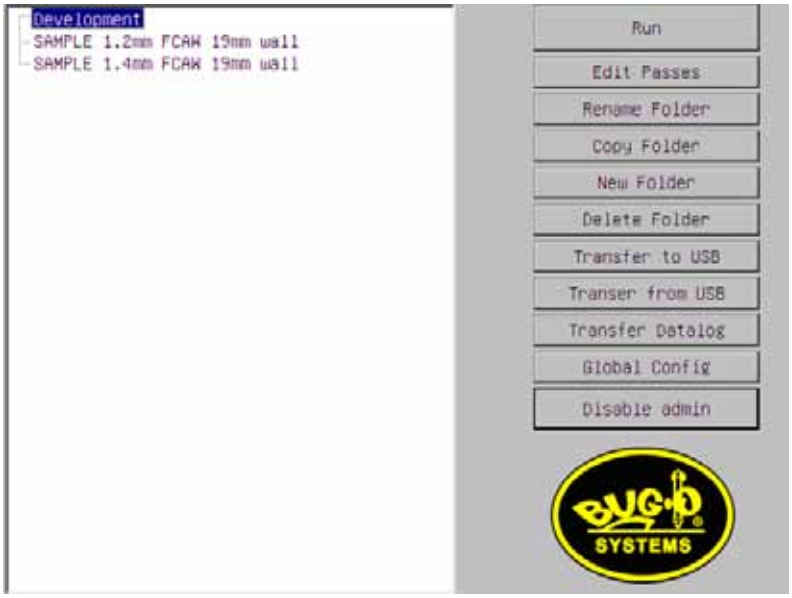
Changing the wire direction should only be done if you have moved the torch to the other side of the machine. **This is not recommended and should be avoided if at all possible.** You do not need to change this setting if you invert the machine without moving the torch.

The PIN number can be a maximum of five (5) digits. Only the numbers zero (0) through nine (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. Forgetting the PIN number is not recommended.

The default units setting will change the units for NEW passes. Passes are saved as either English or Metric. Changing this setting will not convert existing pass settings as that may result in unacceptable rounding errors. Individual passes can be converted while editing them.

Creating and Editing Folders

The main screen is a list of folders. Each folder can hold as many passes as you would like, but it is recommended that you separate folder for each station to make things easier for your operators.



Clicking "New Folder" will create a new folder. Folders can be renamed and deleted. Clicking "Copy Folder" will copy the folder.
The folders can be transferred to and from a USB memory stick. The parameters will be stored on the USB drive under a folder named "Bugo\Piper\Parameters." To transfer the parameters on the machine to a USB stick, click "Transfer to USB." You will be prompted to enter a name for the folder where the parameters will be stored. You must enter a new name.

To transfer files from the USB stick to the machine click "Transfer from USB." You will be shown a list of folders under the Bugo folder on your USB stick and will have the option to Replace or Merge. If you click Replace, all the current parameters on the machine will be deleted. If you select merge, the new passes will be added to the machine without removing the passes that are already stored on the machine. Passes that have the same name and folder as passes on the USB stick will be overwritten.

Creating and Editing Passes

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).

To create a new pass, select the folder you want it to be in, then click "Edit passes." This will display the pass list. If you have not created any passes, the list of passes will be blank. Otherwise it will display the passes that are in the folder.

Click "New" to create a new pass. Enter the pass name. It is a good idea 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 and will be selected on the screen. Click "Edit" to edit the pass.

The edit screens allow you to set the default parameters for all variables, and to configure the maximum, minimum, and the step per press for the parameters the machine will use during normal operation. It also allows you to change between English and Metric units. The values entered are all real discrete values. They are not percentages, values from potentiometers, or guesses. The wire speed, drive speed, and current offsets must be set in the global config menu to account for different wire diameters, height above the pipe, and different current sensors.

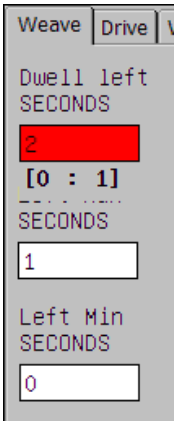
You have the option to give the operator a great deal of, or no control. Startup and shutdown parameters are not adjustable by the user. The normal value is the value that will be loaded initially. The max value is the max value the operator will be able to adjust the parameter to, and the minimum value is the minimum. The step is the amount the parameter will be changed by when the adjustment switch or buttons are pressed one (1) time. If you do not want the operator to be able to change a specific parameter, set the step to zero (0).

The editing screens will help you enter values that are valid. If you enter a value that is invalid, the box will turn red. It will display the range of allowed values below it. For minimum and maximum boxes, the range will be the machine's physical limits. For the actual values, the minimum and maximum will be whatever is entered in corresponding minimum and maximum boxes. If you make a mistake and want to undo your changes, select the text box you wish to undo and press the red cancel button on the keypad.

PIPER-BUG USER OPERATIONS / ADMINISTRATION, CONT'D.

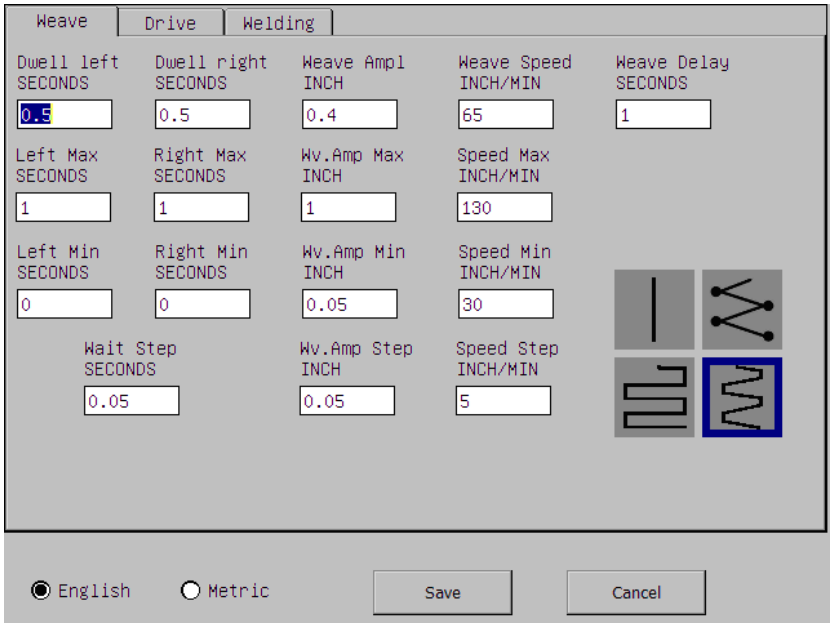
Parameter pages

There are three (3) pages, or tabs, of parameters. You can change between pages by clicking on the tabs at the top of the screen. You can press the left and right arrows on the keypad to move quickly between fields. You can change the units, save, or cancel on any page. It will not allow you to save values that would be invalid, like a minimum that is greater than a maximum.



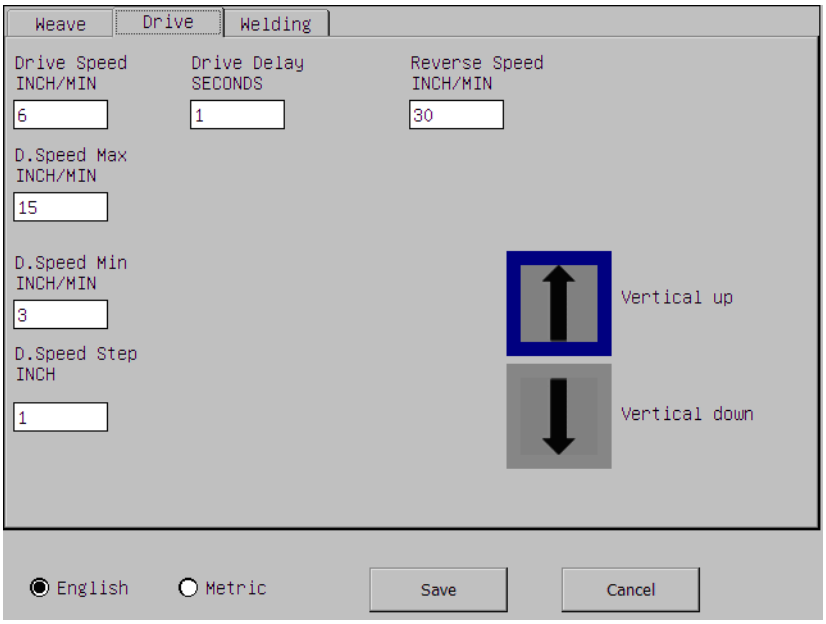
The Weave page contains parameters that will affect the weaver. The dwells, amplitude, speed, and delay can be set, along with the weave mode. The page will not allow you to enter values that would be invalid, like a minimum that is greater than a maximum. If you want to disable the weaver, select the straight line mode. It will ignore the weaving parameters. The machine can move in a straight line, pause in dwell, move only on dwell, or run with the track constantly moving and oscillating which is the default.

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 it did consider the acceleration and deceleration time, the motion would appear to pause for too long. 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 use on a pipeline.



PIPER-BUG USER OPERATIONS / ADMINISTRATION, CONT'D.

The drive page 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 you to create a vertical up or down pass.



The Welding page contains the settings for the wire speed, voltage, and current. It also controls the time the machine will spend in prepurge, start up, crater, and burnback. The top group contains the run in settings. The next group contains the Startup settings. The next group contains the welding settings. The three (3) groups under this contain the operator adjustment limits for the welding stage. The final group contains the crater settings.

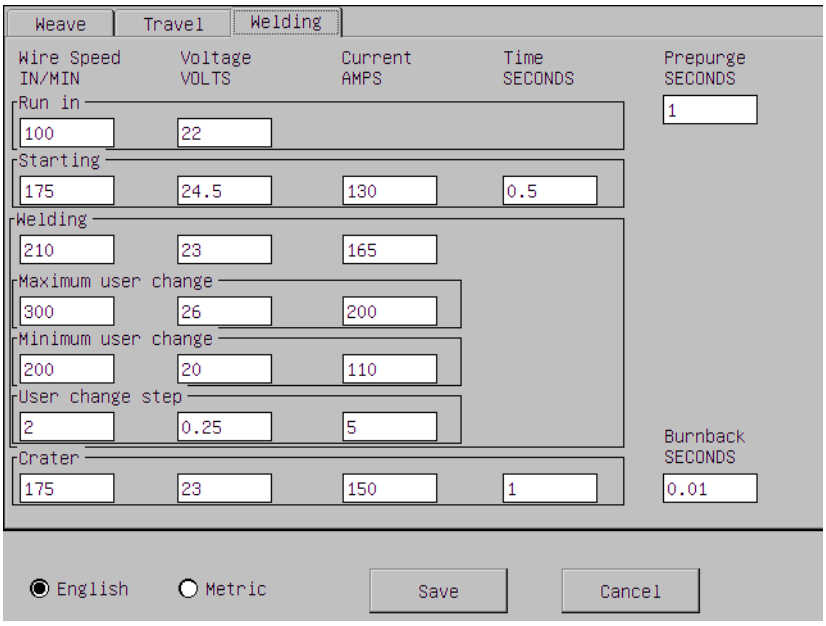
Prepurge occurs immediately before run in. Prepurging does not start the other timers. Immediately after Prepurge, the wire will run in at the run in speed. The run in stage only has two (2) settings: wire speed and voltage. This is because this stage only runs until an arc strikes. If the height control is disabled, it will skip the run in phase and instead go immediately to the starting phase.

The startup phase has settings for the wire speed, voltage, current, and time. This timer is what determines when the machine's startup is complete. It starts as soon as the height sensor sees an arc, or immediately if the height control is disabled.

The welding phase is the normal welding done by the machine. The operator will be able to make changes now if the configuration allows them to. This phase ends when the stop button is pressed once.

The crater phase contains all four (4) settings. After this timer ends, the machine will stop the wire feed, burnback for the defined time, and then shut off the arc and gas. It will raise the torch by a small amount during burnback to make sure it does not get caught on the pipe while returning the machine to the 6:00 o'clock position.

PIPER-BUG USER OPERATIONS / ADMINISTRATION, CONT'D.



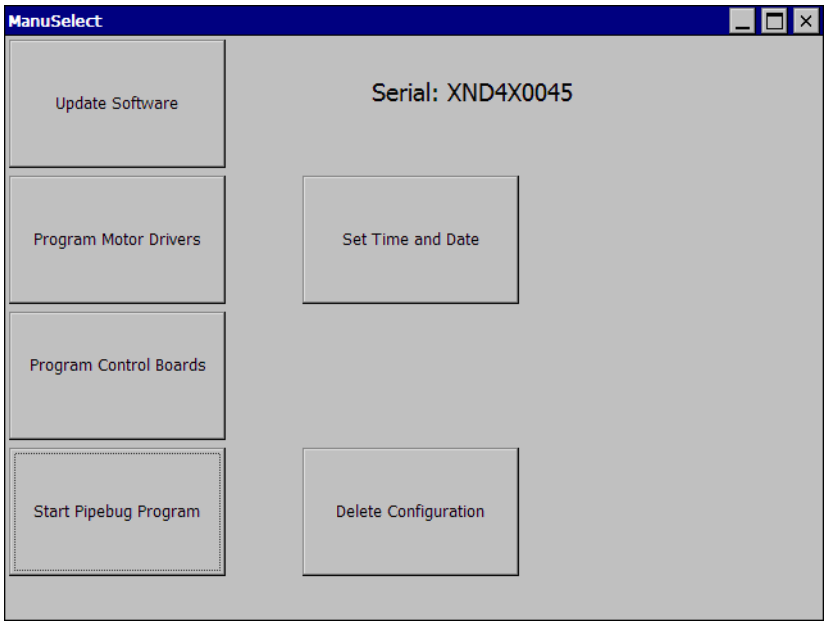
Advanced Administration

It may be necessary to update the software and firmware of the system to fix problems or add new features. The control software, control board and pendant firmware, and motor drivers are all field upgradable. You can also delete the configuration file if you have changed the PIN number and forgotten it. This requires a specially prepared USB stick (the "Key"). It is very easy to create and nearly any USB stick will work. Full instructions are included with updates that are provided by Bugo Systems. The Key can still be used as a normal USB stick for transferring passes and normal files with a desktop pc.

Please note that if the special administration menu is unlocked, it is possible to do permanent damage to the machine, possibly requiring the replacement of the internal storage, control circuit boards, pendants, and motor drivers. Do not shut off the machine while updates are being performed. Do not leave the Key in the machine or allow normal users access to it. The machine will tell you if you need to update the control boards or motor drivers. Only update them when it tells you they need updated or when instructed by Bugo Systems.

To access the special administration menu you must turn the machine off, insert your Key, and then turn it on. When the machine starts up, you will be presented with the special administration menu. From this menu you can update the software and firmware of the machine. It will also display the machine's serial number. You will need this number if you wish to add additional features.

PIPER-BUG USER OPERATIONS / ADMINISTRATION, CONT'D.



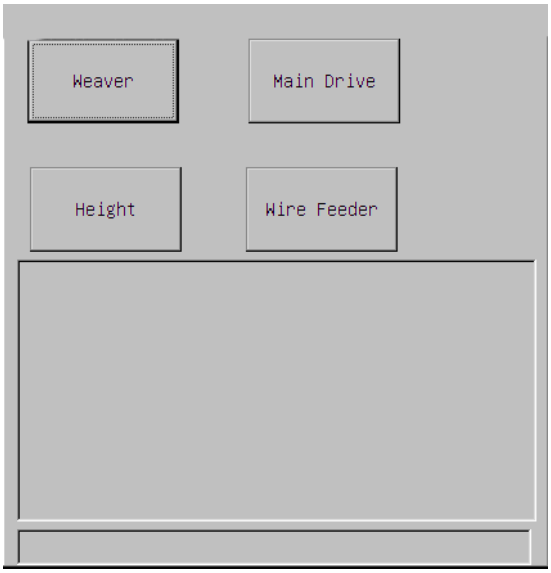
If you have changed the PIN number and forgotten it, you must click "Delete Configuration." This will reset all the settings on the global configuration screen. The PIN will be reset to "123." You will have to recalibrate the current and travel speeds. Forgetting the PIN number is not recommended.

Clicking "Set Time and Date" will allow you to change the current time, date, and time zone. Enter the new date and time, then click OK.

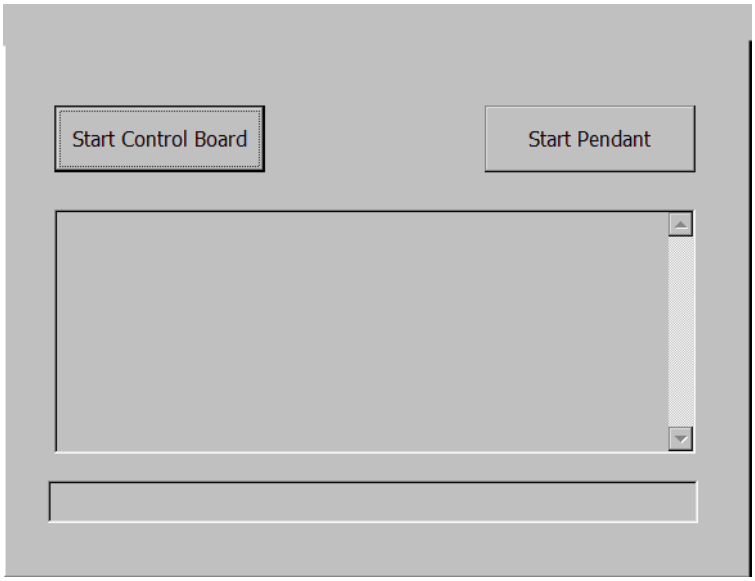
Clicking "Update Software" will update all the software on the machine. You must do this before attempting to update the motor drivers or control boards. When you click update software, a warning will pop up telling you to not turn off the machine. When the update completes it will open the special administration menu again. It is recommended that you restart the machine after updating the software.

Clicking "Program Motor Drivers" will launch the motor driver programmer. It will check for the presence of the motor drivers and that they have automatically detected their ID numbers correctly. Simply click the name of the motor driver you want to program. If the button is disabled and you are unable to click it, the motor driver was not detected. Check the repair and wiring manual then contact Bugo Systems.

PIPER-BUG USER OPERATIONS / ADMINISTRATION, CONT'D.



Clicking "Program Control Boards" will allow you to update the control boards and the pendant. This must be done with care. Only update the board the system tells you to update. Do not interrupt the update once it has begun. It is recommended to restart the system after a successful reprogramming.



PIPER-BUG USER OPERATIONS / ADMINISTRATION, CONT'D.

Common Problems

1. A motor stops after moving a small distance and gives an error message about speed or position tracking:
   The wires leading to the encoder may be loose or broken. Check that the encoder is securely attached to the motor and to the drive controller. A hall effect sensor may also be improperly wired. If the encoder is securely attached, verify that the hall effect wires are correct.

2. The machine creates an arc when "Start" is pressed, but quickly stops with an error message saying that the machine did not sense any current:
   Make sure that the cable leading to the current sensing box is connected.

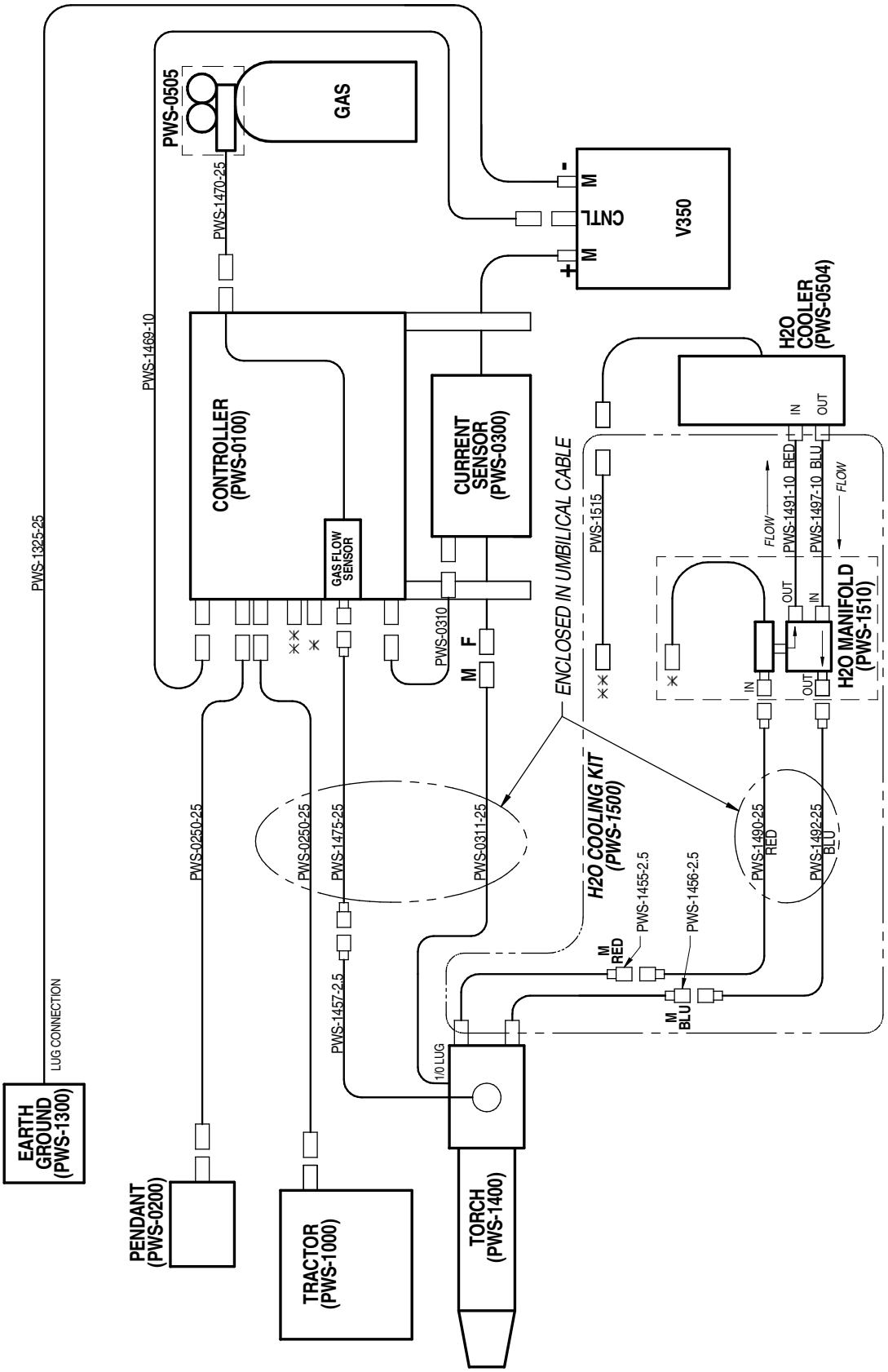
3. The machine is moving in the wrong direction.
   Reverse the direction of the machine on the running screen.

4. The machine is displaying an error code number without an explanation:
   Refer to the supplied documentation for the MF (Motor Failure) and EC (Error Code) numbers.

5. The machine cannot connect to the control board:
   Check that the wires leading from the pc104 CPU board to the control board have not been damaged. If the board previously worked, but stopped working after an update, it will need to be sent in for repair. The board should sound a buzzer when the machine is first turned on.

Advanced motor drive diagnostics can be performed on site with a computer.

PWS ASSEMBLY DIAGRAM



PIPER-BUG CARRIAGE SETUP

1. Install Rail

The Piper-Bug 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 18 inches (450 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.

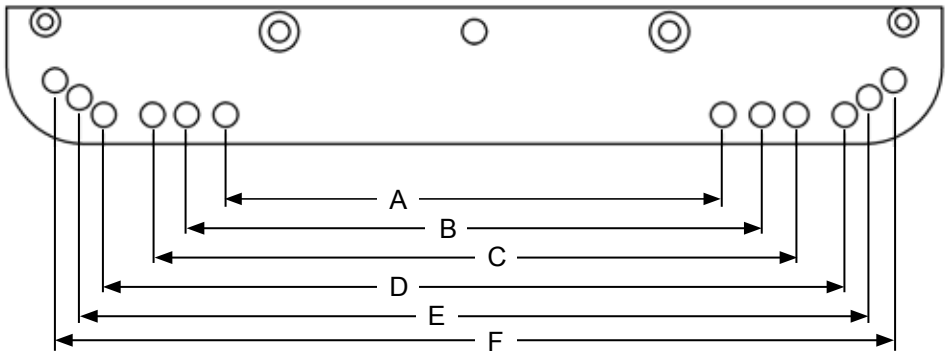
C. Place the carriage on the ring rail with the wheels in the rail grooves. Close the cam handle and move the carriage back and forth a few inches. The wheels on their mounting brackets will align themselves correctly with the rail grooves.

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.

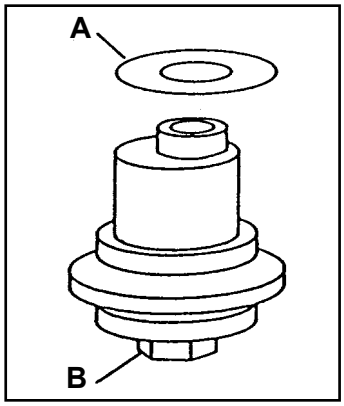
Carriage Wheel Hole Set	Rail ID		Pipe OD	
	in	mm	in	mm
A	20 - 25	500 - 635	9 - 21	230 - 530
B	23 - 35	585 - 890	12 - 31	300 - 790
C	30 - 44	760 - 1120	18 - 40	455 - 1015
D	41 - 60	1040 - 1525	29 - 54	735 - 1375
E	75 - 174	1905 - 4420	64 - 170	1625 - 4320
F	flat rail		flat work	

Note: Chart values are for reference only



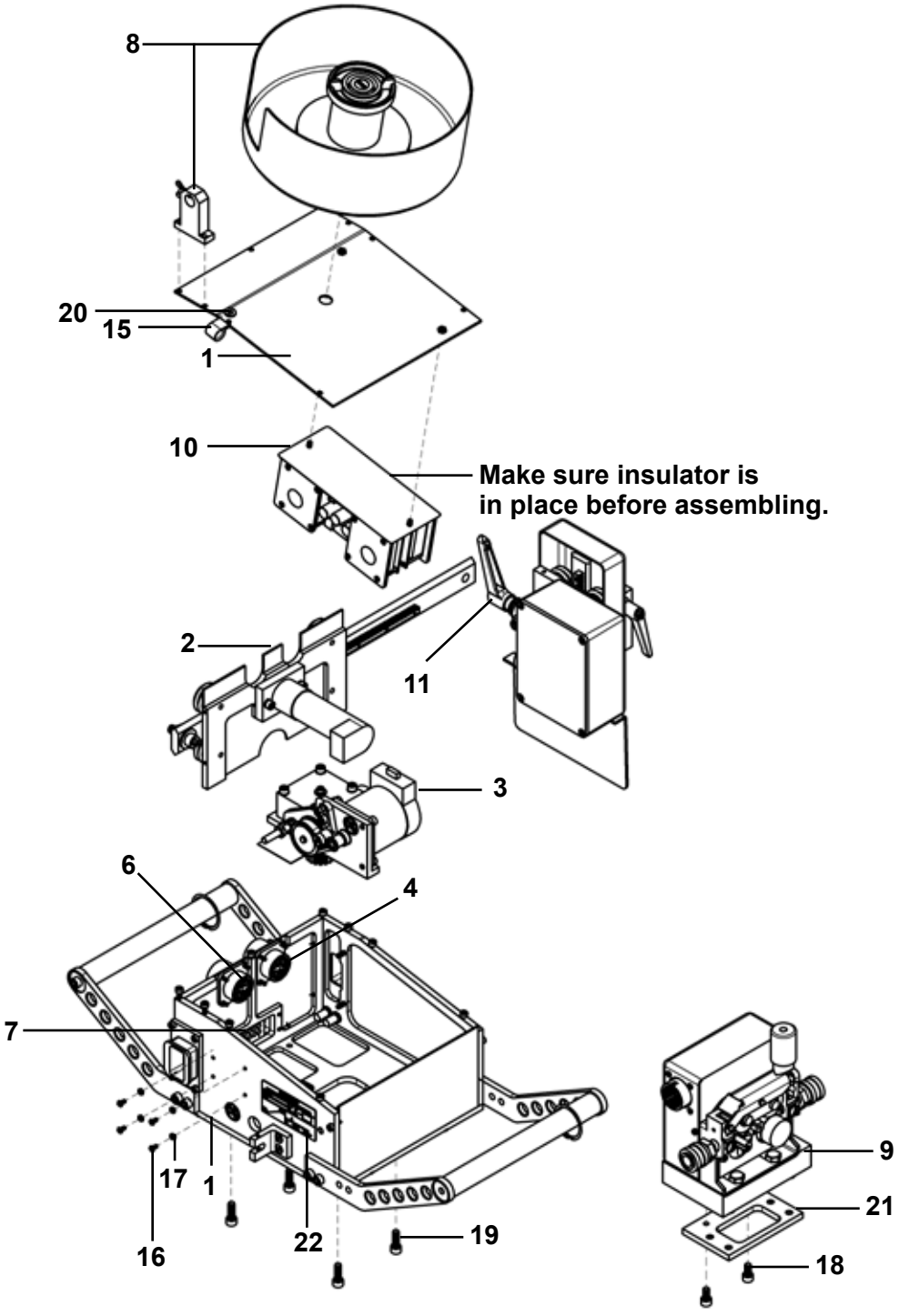
CARRIAGE WHEEL ADJUSTMENT

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.

PWS-1000 PWS BUG ASSEMBLY / EXPLODED VIEW

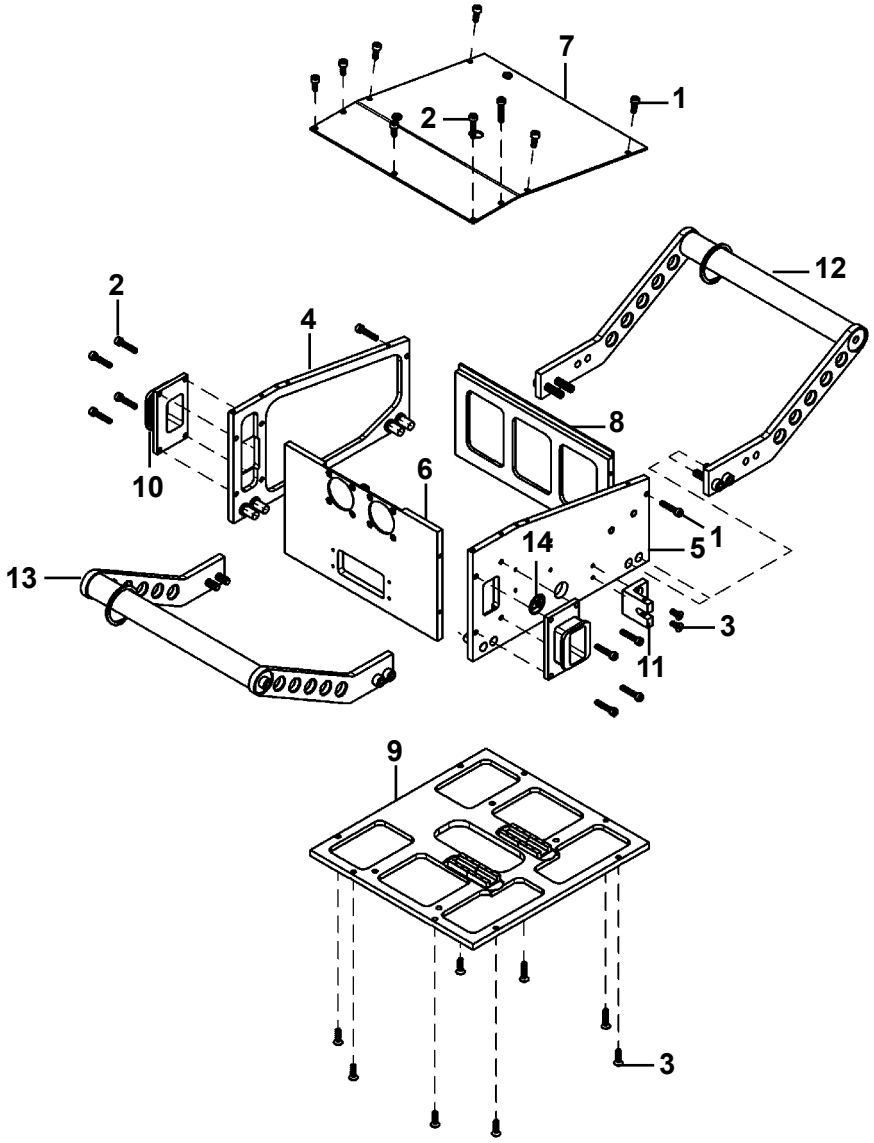


PWS-1000 PWS BUG ASSEMBLY / PARTS LIST

ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	PWS-1010	Tractor Frame Assembly
2	1	PWS-1020	Weaver Assembly
3	1	PWS-1030	Main Drive Assembly
4	1	PWS-1075	Height Axis Wiring Harness
5	2	PWS-1084*	Weaver Arm Sleeve
6	1	PWS-1085	Wire Feeder Wiring Harness
7	1	PWS-1087	Bug Control Wiring Harness
8	1	PWS-1090	Wire Spool Cover Assembly
9	1	PWS-1100	Wire Feed Assembly
10	1	PWS-1120	Bug Motor Drivers Assembly
11	1	PWS-1200	Height Control Assembly
12	1	PWS-1489-1.5*	18" Motor Control Cable
13	2	PWS-1495-1.3*	16" Motor Control Cable
14	2	TIE-4002*	Black Nylon Cable Tie
15	1	MDS-1030	Cable Clamp
16	4	MET-0141-SS	Pan Hd Phil Scr M3 x 6
17	4	MET-1340-SS	M3 Hex Nut
18	2	MET-0574-SS	Soc Hd Cap Scr M6 x 12
19	4	MET-0578-SS	Soc Hd Cap Scr M6 x 18
20	1	WAS-0220	#8 SAE Flat Washer
21	1	PWS-1136	Wire Feed Mount Plate
22	1	BUG-1338	Nameplate

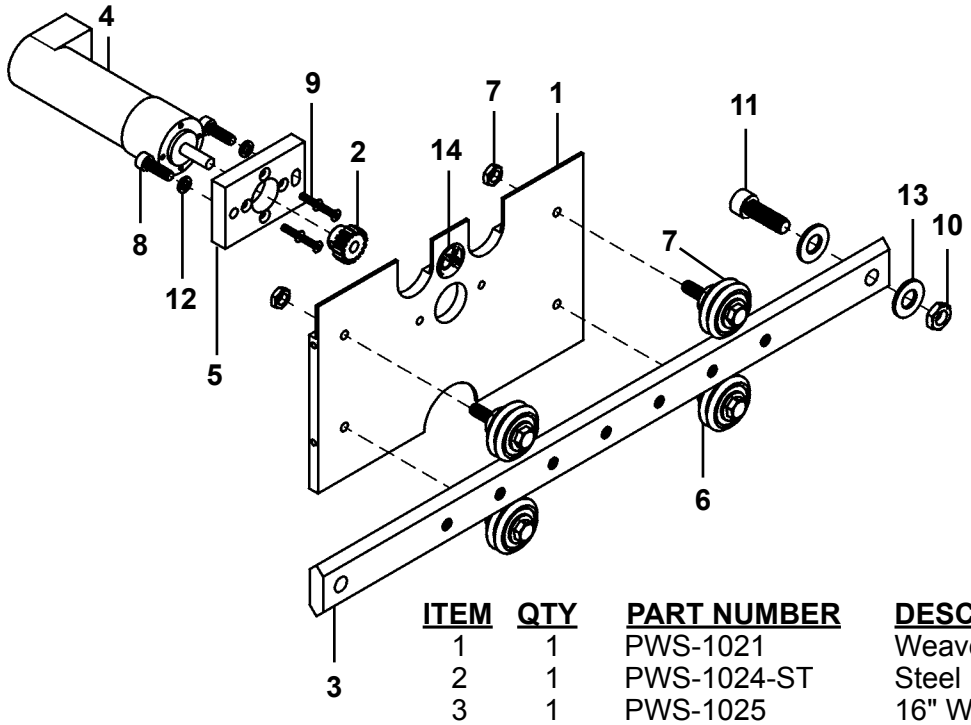
* = Not Shown

PWS-1010 TRACTOR FRAME ASSEMBLY / EXPLODED VIEW / PARTS LIST



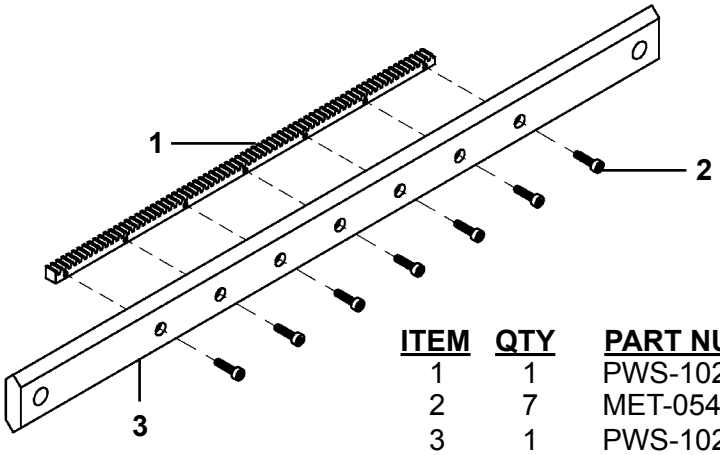
ITEM	QTY	PART NUMBER	DESCRIPTION
1	9	MET-0553-SS	Soc Hd Cap Scr M4 x 10
2	10	MET-0559-SS	Soc Hd Cap Scr M4 x 20
3	10	MET-0953-SS	Flt Hd Soc Scr M4 x 10
4	1	PWS-1012	Left Side Plate Assembly
5	1	PWS-1013	Right Side Plate Assembly
6	1	PWS-1014	End Plate
7	1	PWS-1015	Sheet Metal Cover
8	1	PWS-1017	Insulator Panel
9	1	PWS-1019	Bed Plate Assembly
10	2	PWS-1095	Sleeve Retention Bracket
11	1	PWS-1125	Clutch Handle Catch Assembly
12	1	PWS-1126	Front Handle Assembly
13	1	PWS-1127	Rear Handle Assembly
14	2	PWS-1196	Pinch Point Label, 1"

PWS-1020 WEAVER ASSEMBLY / EXPLODED VIEW / PARTS LIST

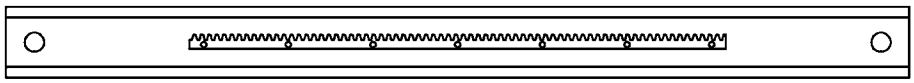


ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	PWS-1021	Weaver Mounting Plate
2	1	PWS-1024-ST	Steel Pinion Assembly
3	1	PWS-1025	16" Weaver Arm Assembly
4	1	PWS-1026	Weaver Motor
5	1	PWS-1027	Weaver Motor Mounting Block
6	2	PWS-1028	Fixed Wheel & Leg Assy
7	2	PWS-1029	Adjustable Wheel & Leg Assy
8	2	MET-0567-SS	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"

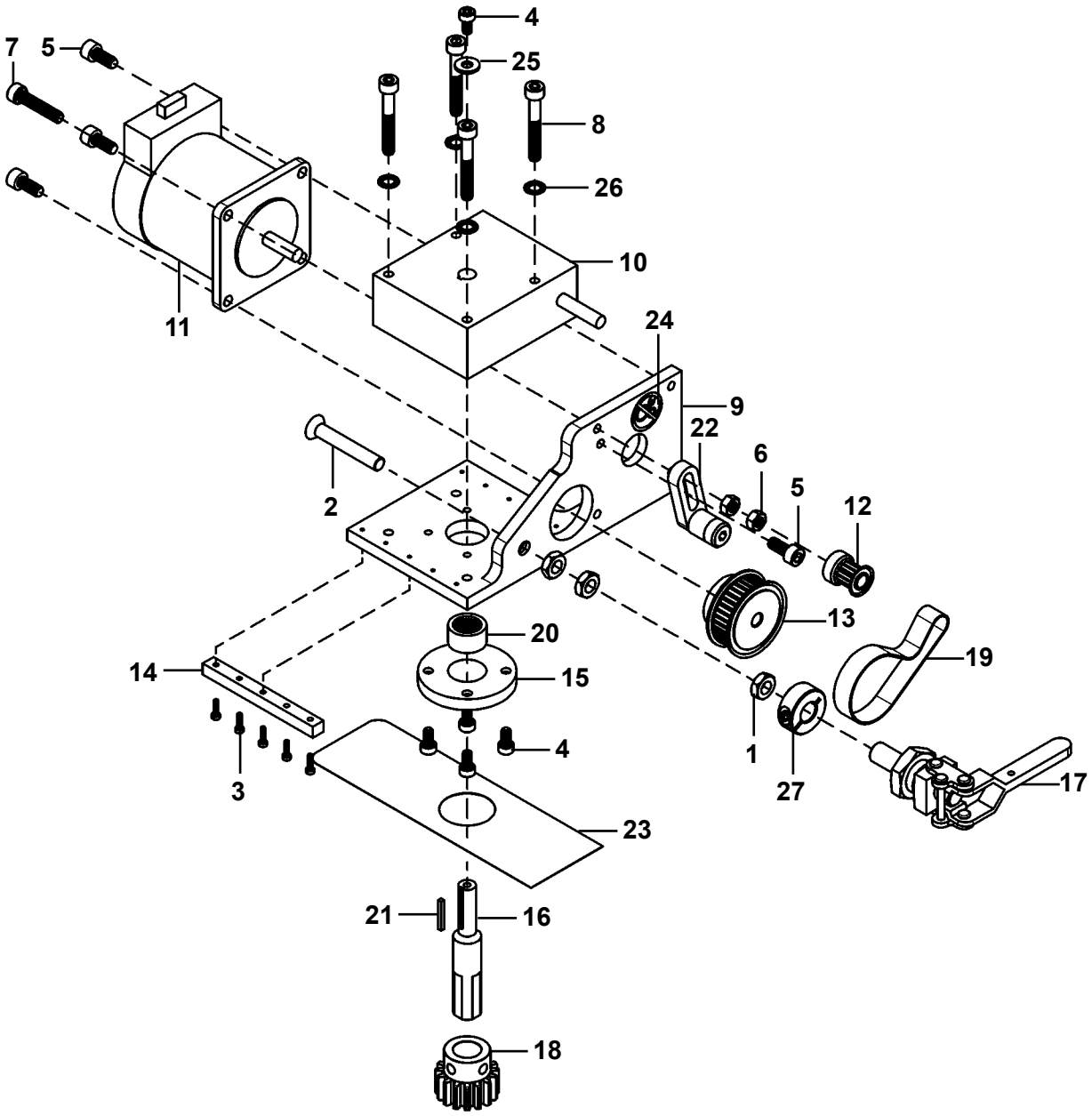
PWS-1025 WEAVER ARM / EXPLODED VIEW / PARTS LIST



ITEM	QTY	PART NUMBER	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 420 SS Machined



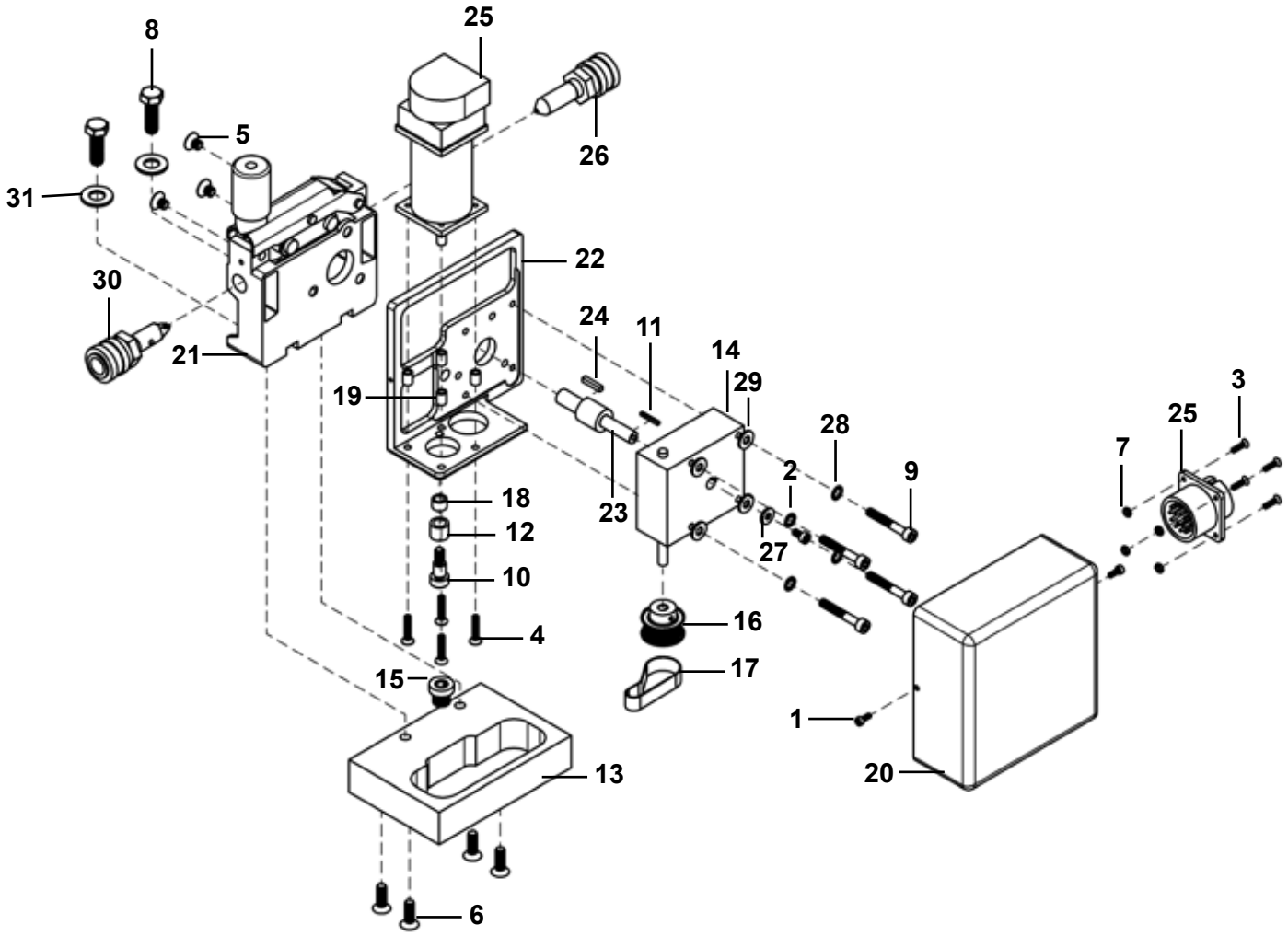
PWS-1030 MAIN DRIVE ASSEMBLY / EXPLODED VIEW



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 1-1/2 Full 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 Assy
13	1	PWS-1035	Alum Timing Pulley, 36 Teeth
14	2	PWS-1037	Slider Guide Rail
15	1	PWS-1038	Pillow Block
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-1097	Delrin 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

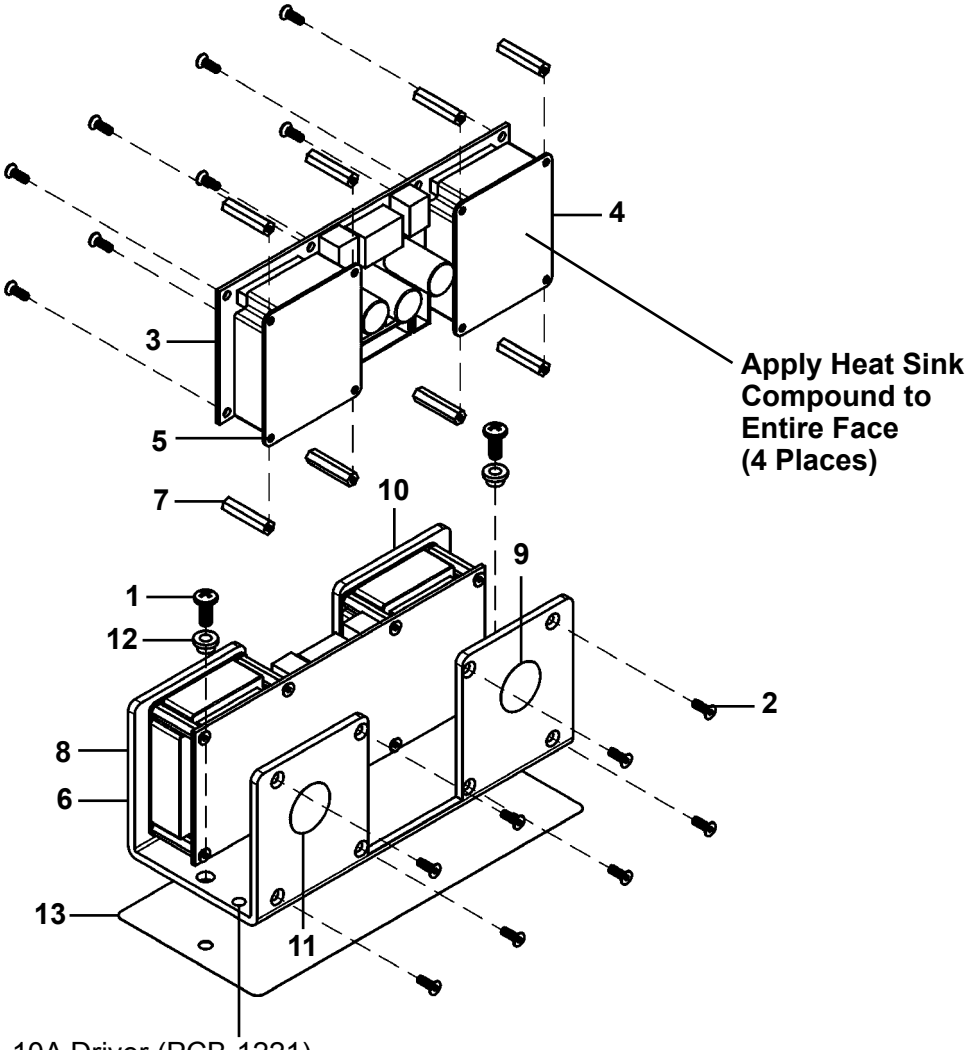
PWS-1100 WIRE FEED ASSEMBLY / EXPLODED VIEW



PWS-1100 WIRE FEED ASSEMBLY / PARTS LIST

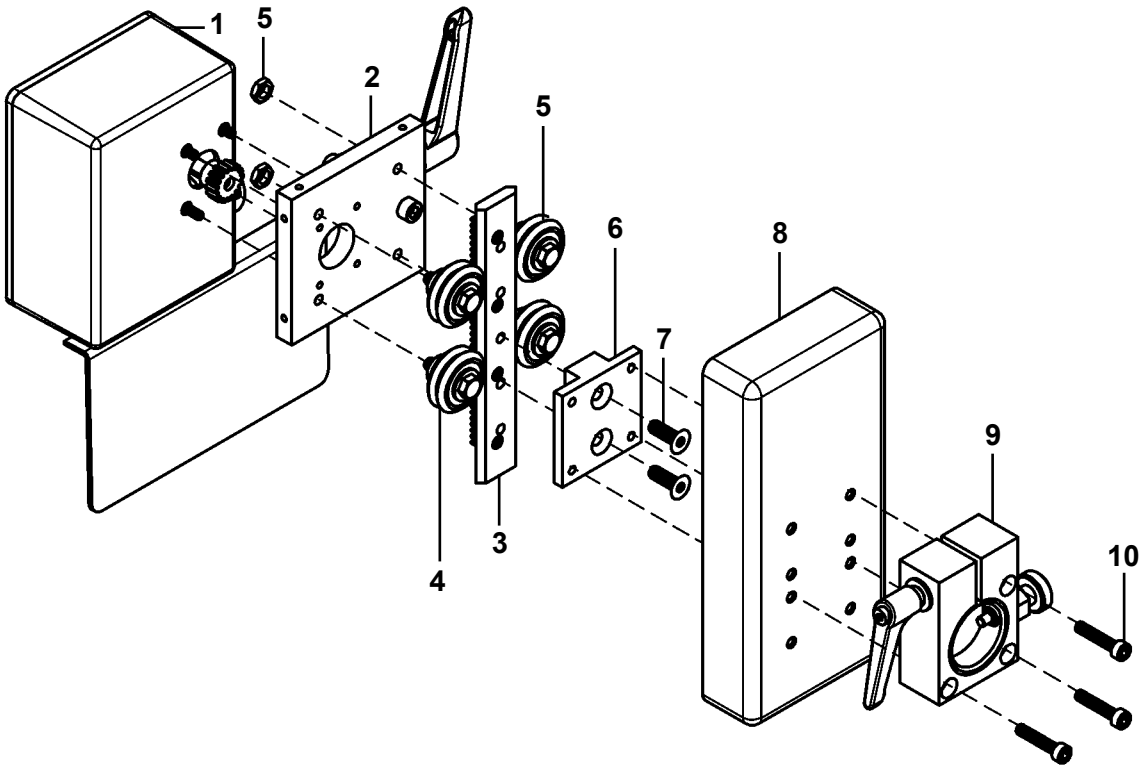
ITEM	QTY	PART NUMBER	DESCRIPTION
1	2	MET-0542-SS	Soc Hd Cap Scr M3 x 8
2	1	MET-0552-SS	Soc Hd Cap Scr M4 x 8
3	4	MET-0944-SS	Flt Hd Soc Scr M3 x 12
4	4	MET-0959-SS	Flt Hd Soc Scr M4 x 20
5	3	MET-0972-SS	Flt Hd Soc Scr M6 x 8
6	4	MET-0978-SS	Flt Hd Soc Scr M6 x 18
7	4	MET-1340-SS	M3 Hex Nut
8	2	MET-2382-SS	Hex Hd Cap Scr M8 x 25
9	4	MET-2564-SS	Soc Hd Cap M5 x 35 Partial Thr
10	1	PWS-1045	Shldr Scr, M6, 8mm Shldr Dia.
11	1	PWS-1046	2mm Square Key .75" Lg
12	1	PWS-1047	Tensioner Needle Bng, 12mm OD
13	1	PWS-1101	Acetal Insulator Block
14	1	PWS-1103	Modified Gearbox, 20:1
15	1	PWS-1104	Mxl Pulley, 18 Teeth, 9.5mm Wide
16	1	PWS-1105	Mxl Pulley, 36 Teeth, 9.5mm Wide
17	1	PWS-1106	Mxl Timing Belt, 60 Teeth
18	1	PWS-1107	Needle Bearing Spacer
19	1	PWS-1108	Motor Standoff
20	1	PWS-1110	Motor Cover
21	1	PWS-1111	4-Roll Compact Wire Feed Unit
22	1	PWS-1112	Wire Feed Mount Plate
23	1	PWS-1113	Wire Feed Output Shaft
24	1	PWS-1114	3mm Square Key .625" Lg
25	1	PWS-1119	Wire Feed Motor
26	1	PWS-1419	Quick Disconnect
27	1	WAS-0220	#8 SAE Flat
28	4	WAS-0231	#10 Internal Star Lockwasher
29	4	WAS-0230	#10 SAE Flat
30	1	PWS-1426	Output Side QDC Line Feeder
31	2	WAS-0260	3/8 Washer

PWS-1120 BUG MOTOR DRIVERS ASSEMBLY / EXPLODED VIEW / PARTS LIST



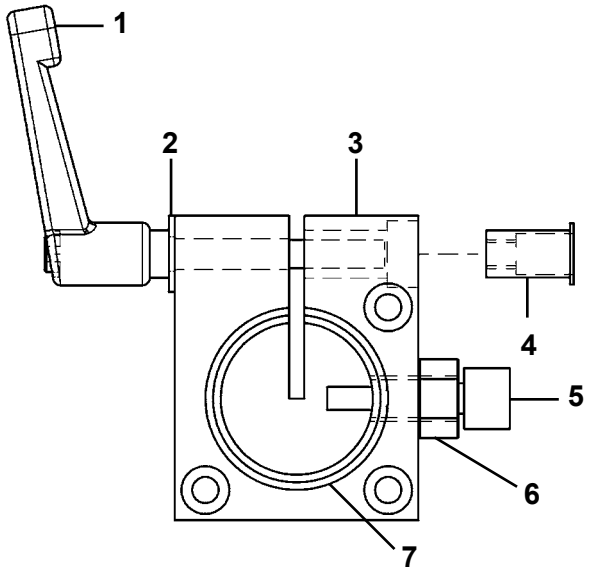
ITEM	QTY	PART NUMBER	DESCRIPTION
1	2	MET-0153-SS	Pan Hd Phil Scr M4 x 10
2	32	MET-0932-SS	Flt Hd Soc Scr M2.5 x 8
3	2	PCB-1067	Ampcard Motherboard
4	3	PCB-1220	5A Bldc Motor Driver Card
5	1	PCB-1221	10A Bldc Motor Driver Card
6	1	PWS-1121	Ampcard Heatsink / Mount
7	16	STOF-5002	M2.5 Hex Standoff F/F 20mm Lg
8	1	PWS-1191	3/4" Circle Sticker - Red
9	1	PWS-1192	3/4" Circle Sticker - Yellow
10	1	PWS-1193	3/4" Circle Sticker - Light Blue
11	1	PWS-1194	3/4" Circle Sticker - Green
12	2	WAS-5599	M4 x 3 Shoulder Washer Nylon
13	1	PWS-1123	Heat Sink Isolator
14	4	CNN-5079	Long Retainer Clip (not shown)

PWS-1200 HEIGHT CONTROL ASSEMBLY / EXPLODED VIEW / PARTS LIST



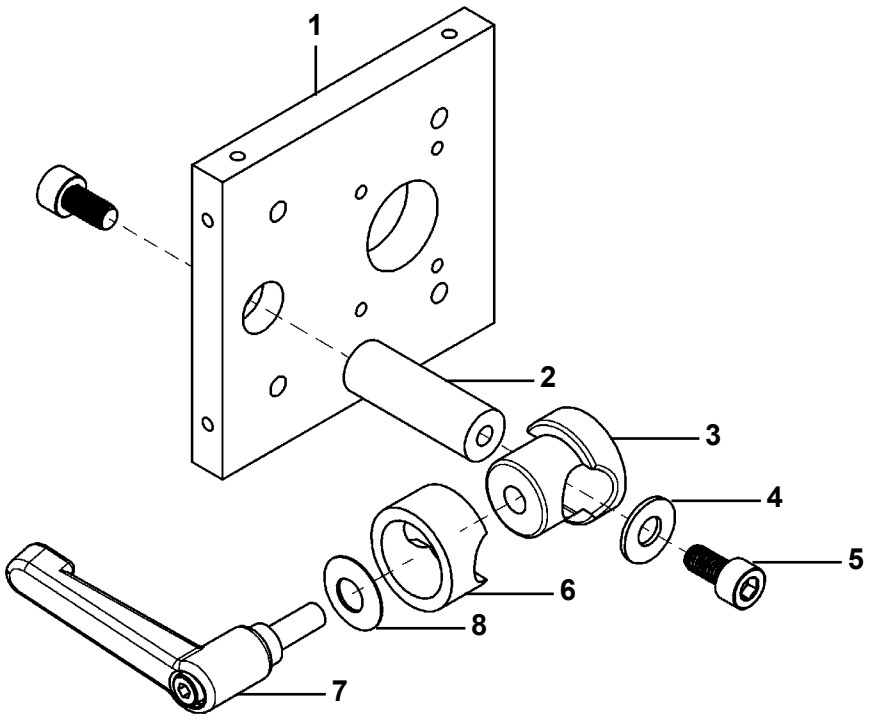
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	PWS-1160	Height Control Motor Assembly
2	1	PWS-1170	Height Control Mount Assembly
3	1	PWS-1065	Height Control Arm Assembly
4	2	PWS-1028	Fixed Wheel & Leg Assembly
5	2	PWS-1029	Adj Wheel & Leg Assembly
6	1	PWS-1073	Torch Mount Spacer
7	2	MET-0978-SS	Flt Hd Soc Scr 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

PWS-1079 TORCH MOUNTING ASSEMBLY / EXPLODED VIEW / PARTS LIST



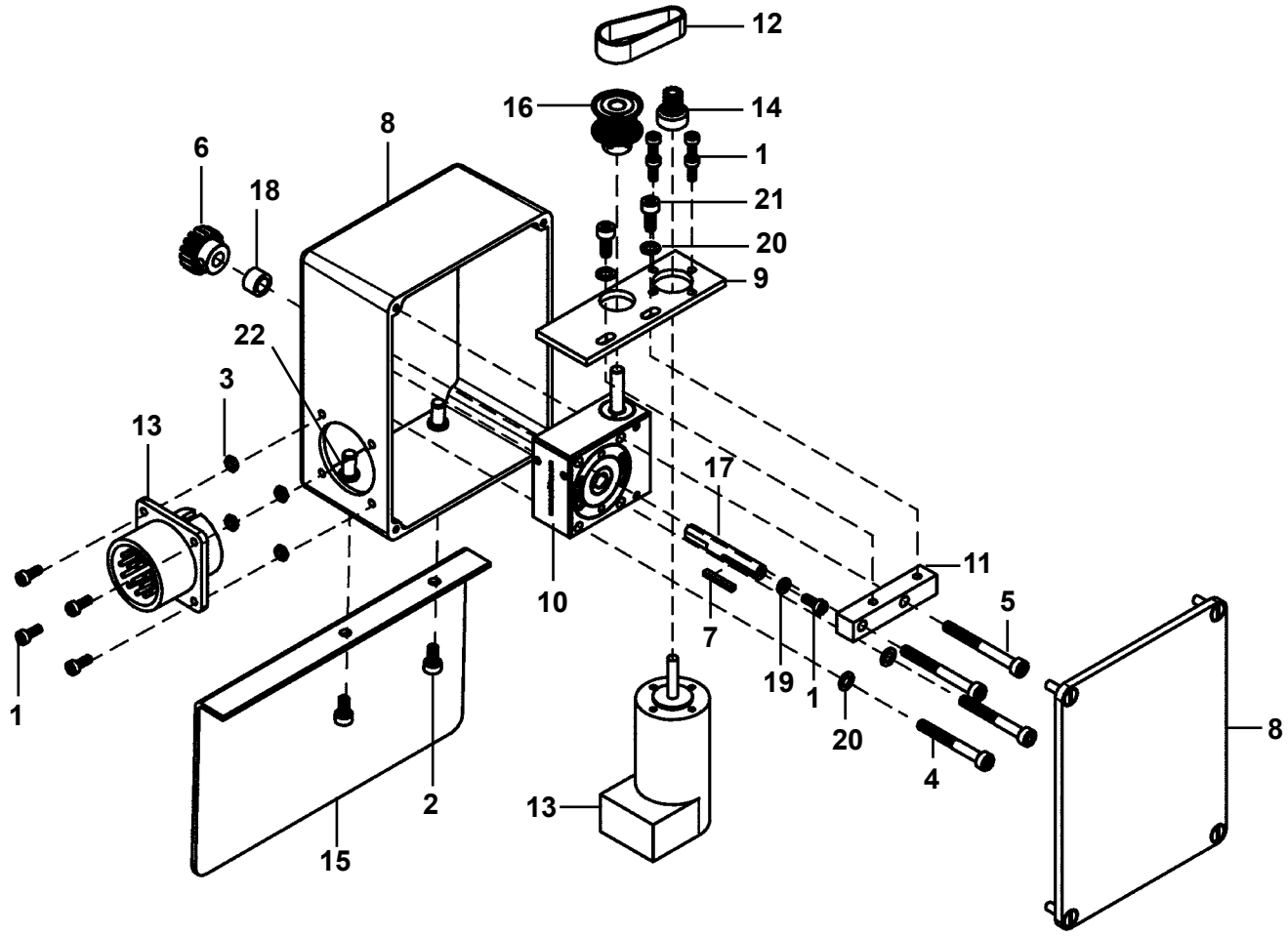
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	PWS-1077	M6 x 45 Adj Lever, SS, Black
2	1	WAS-0240	1/4 SAE Flat
3	1	PWS-1071	Insulator Block
4	1	PWS-1078	Rivet Nut M6 Threaded Insert
5	1	ARR-1106	Latch Pin
6	1	FAS-1390	Hex Nut 3/8-16
7	1	PWS-1072	Torch Mounting Collar

PWS-1170 HEIGHT CONTROL MOUNT ASSEMBLY / EXPLODED VIEW / PARTS LIST



ITEM	QTY	PART NUMBER	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

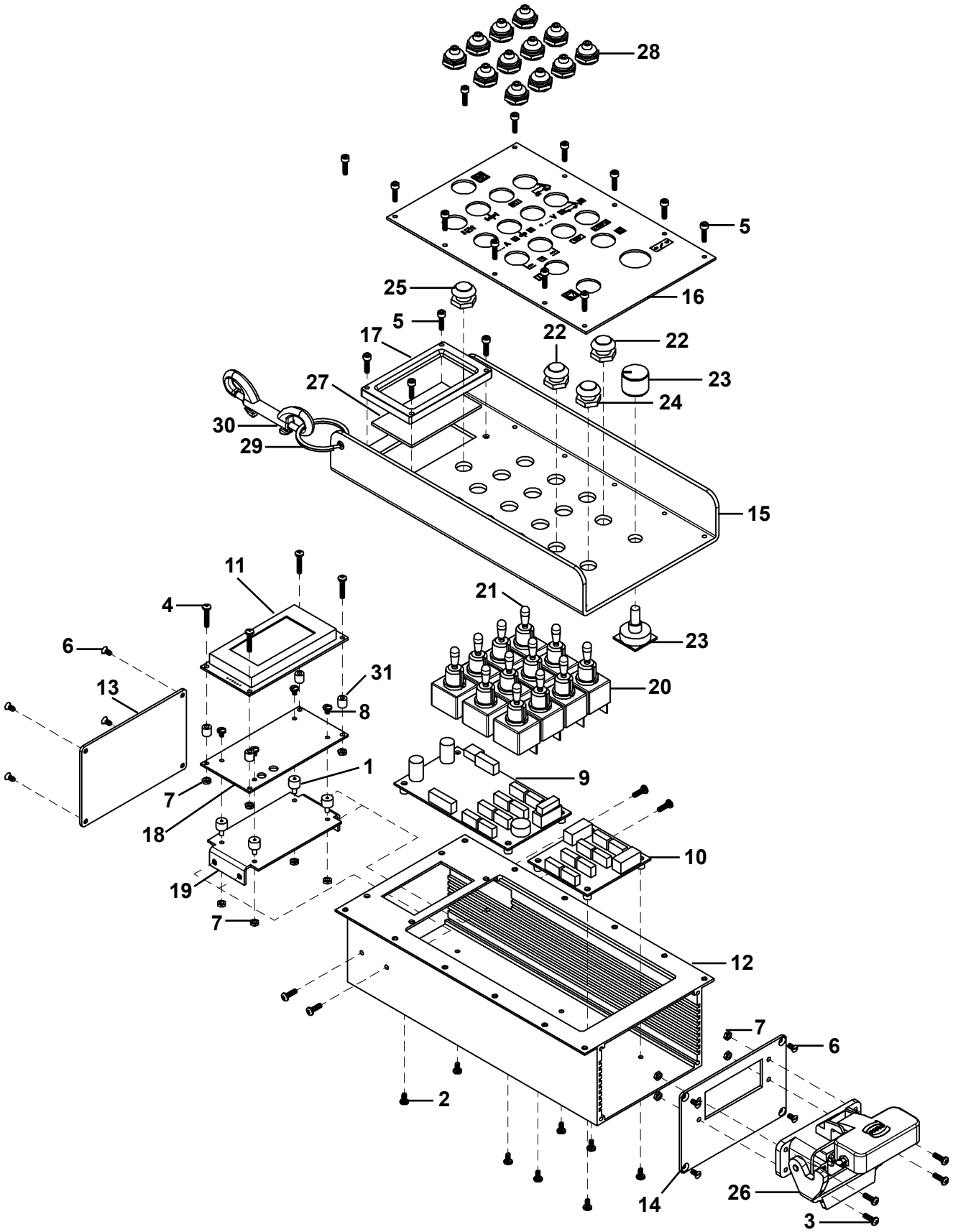
PWS-1160 HEIGHT CONTROL MOTOR & GEARBOX ASSEMBLY / EXPLODED VIEW



PWS-1160 HEIGHT CONTROL MOTOR & GEARBOX ASSEMBLY / PARTS LIST

ITEM	QTY	PART NUMBER	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
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
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	MET-0553-SS	Soc Hd Cap Scr M4 x 10
22	2	SCF-1021	Self-Clenching Blind Fastener

PWS-0200 FULL FUNCTION PENDANT / EXPLODED VIEW

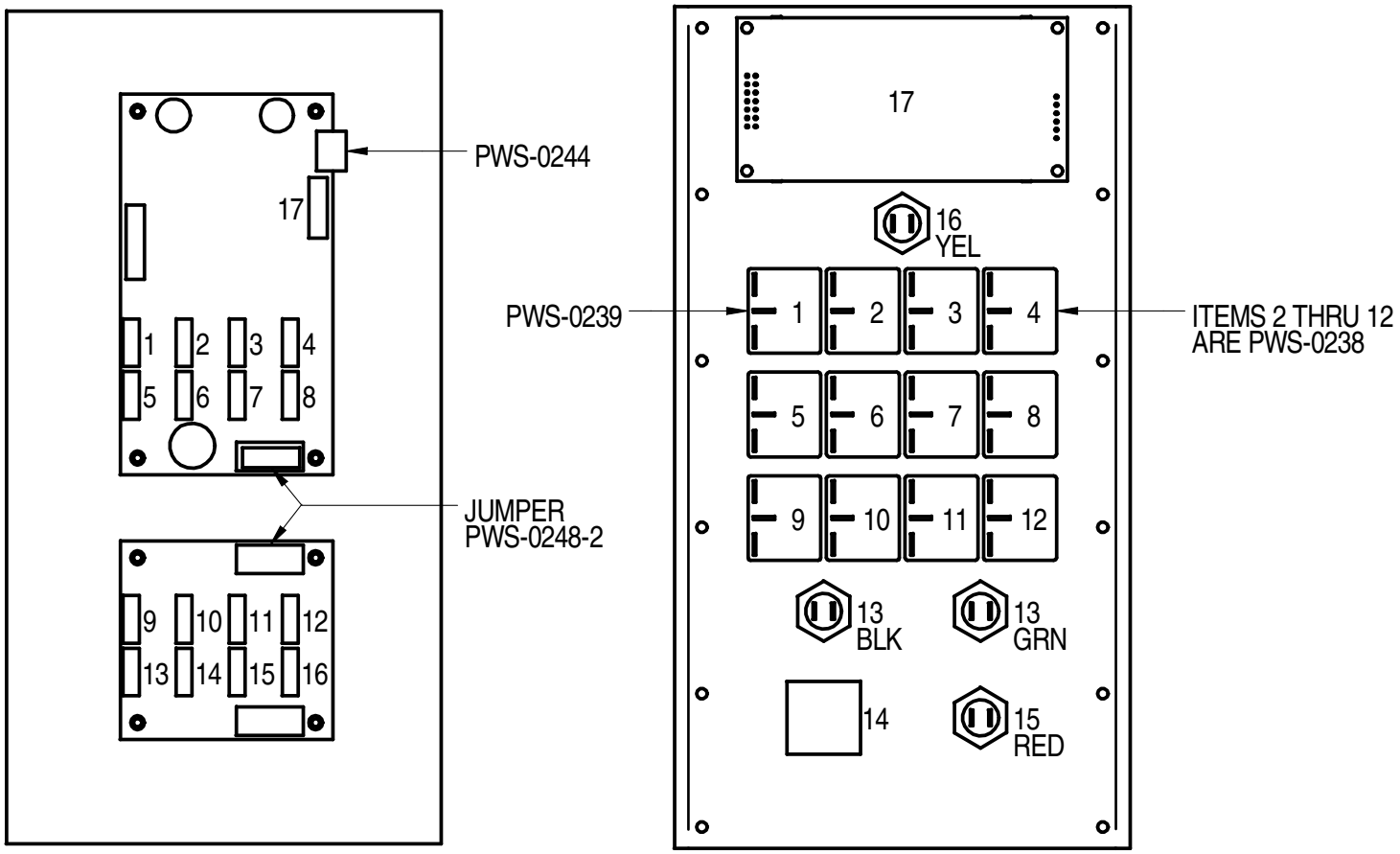


PWS-0200 FULL FUNCTION PENDANT / PARTS LIST

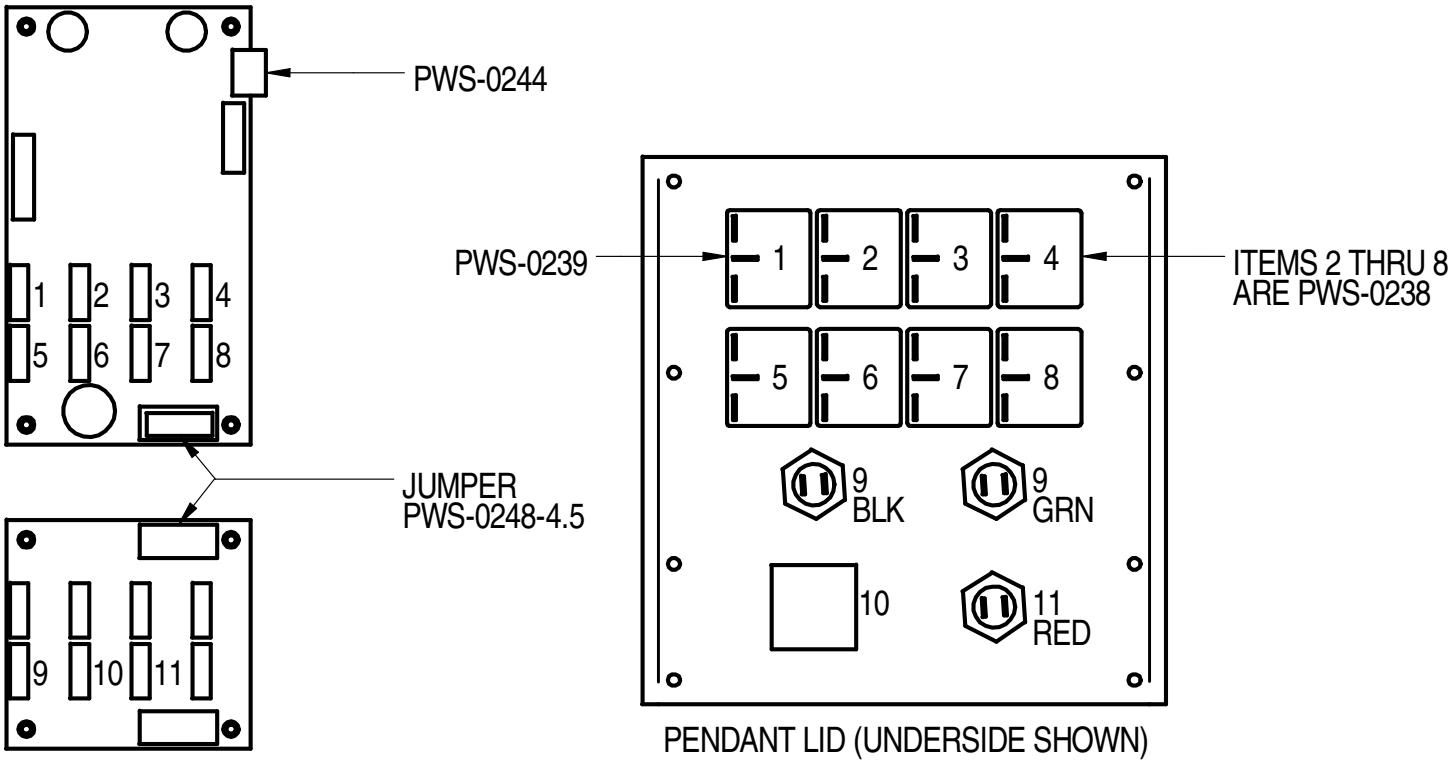
ITEM	QTY	PART NO.	DESCRIPTION
1	4	HDW-1008	Isolation Mount 3M M/F
2	8	MET-0141-SS	Pan Hd Phil Scr M3 x 6
3	8	MET-0143-SS	Pan Hd Phil M3 x 10
4	4	MET-0147-SS	Pan Hd Phil M3 x 16
5	16	MET-0543-SS	Soc Hd Cap Scr M3 x 10
6	8	MET-1043	Flt Hd Phil Scr M3 x 10
7	12	MET-1340-SS	M3 Hex Nut
8	4	MET-A0144-SS	Pan 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

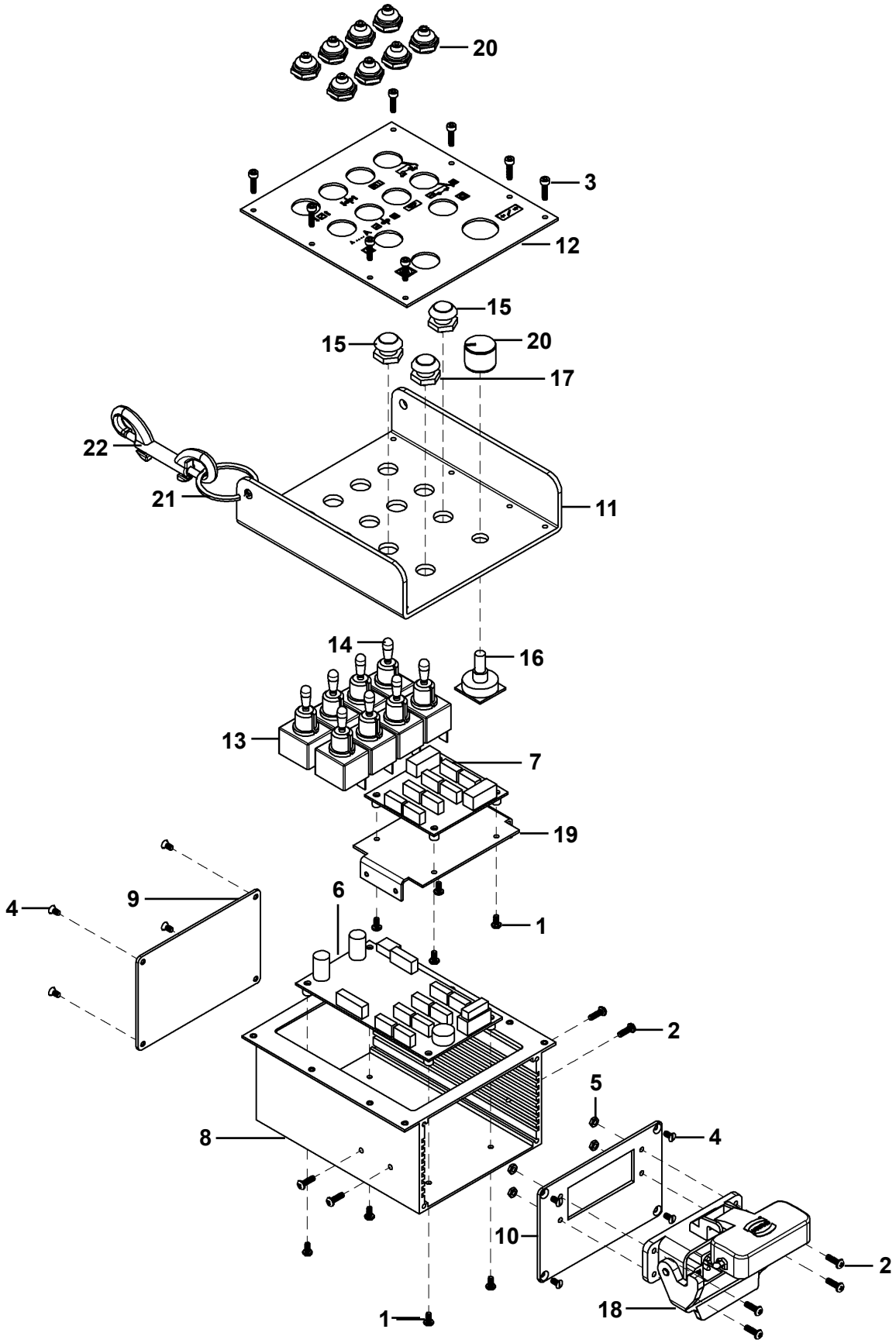
PWS-0200 FULL FUNCTION PENDANT / WIRING DIAGRAM



PWS-0201 LIMITED FUNCTION PENDANT / WIRING DIAGRAM



PWS-0201 LIMITED FUNCTION PENDANT / EXPLODED VIEW



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

PWS-0100 CONTROL BOX / EXPLODED VIEW

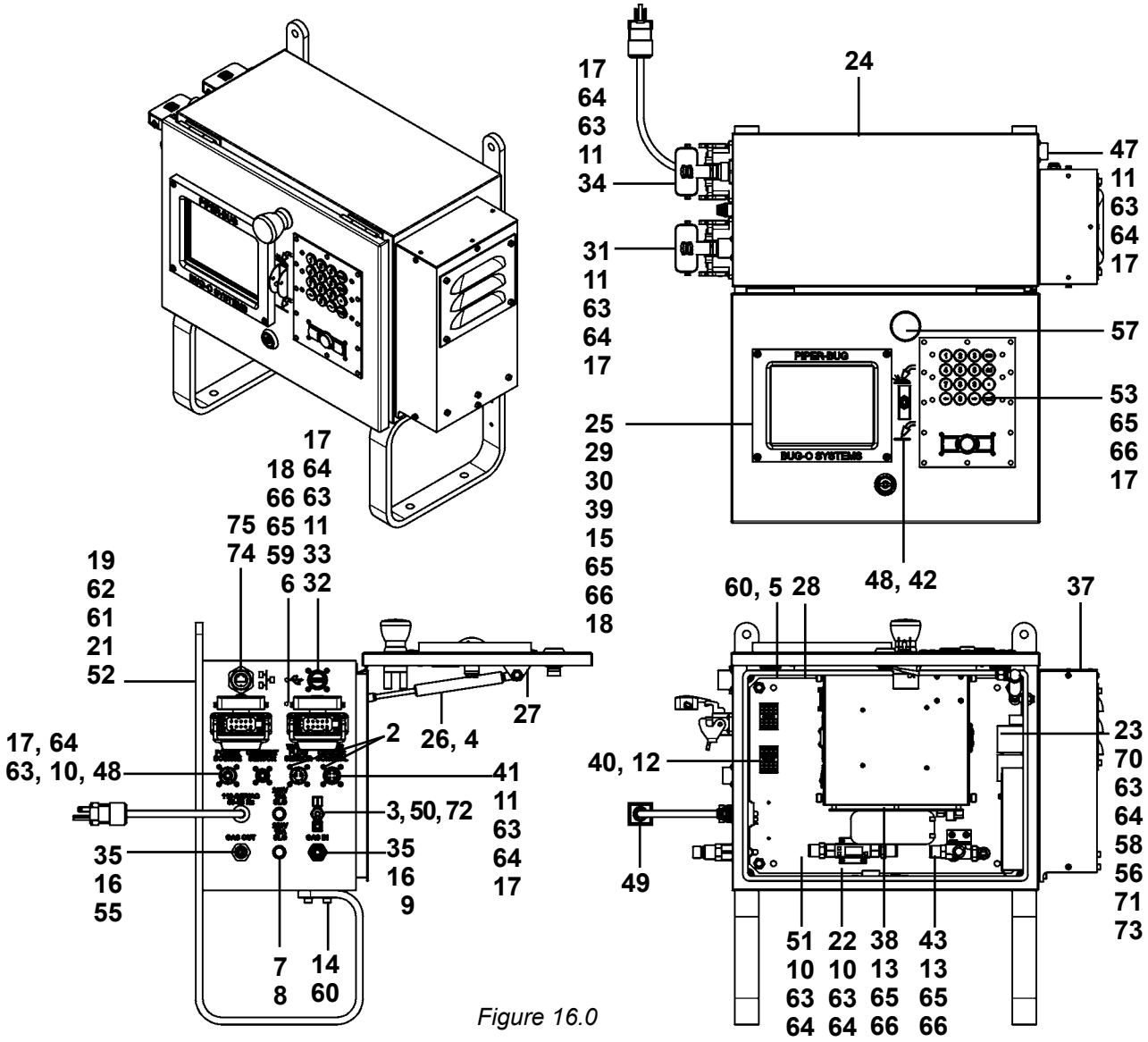


Figure 16.0

ITEM	QTY	PART NO.	DESCRIPTION
1	1	BUG-1338	Nameplate
2	2	BUG-9628	Cap & Chain Assy
3	1	PWS-0249	Boot Half Toggle 15/32
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	6	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

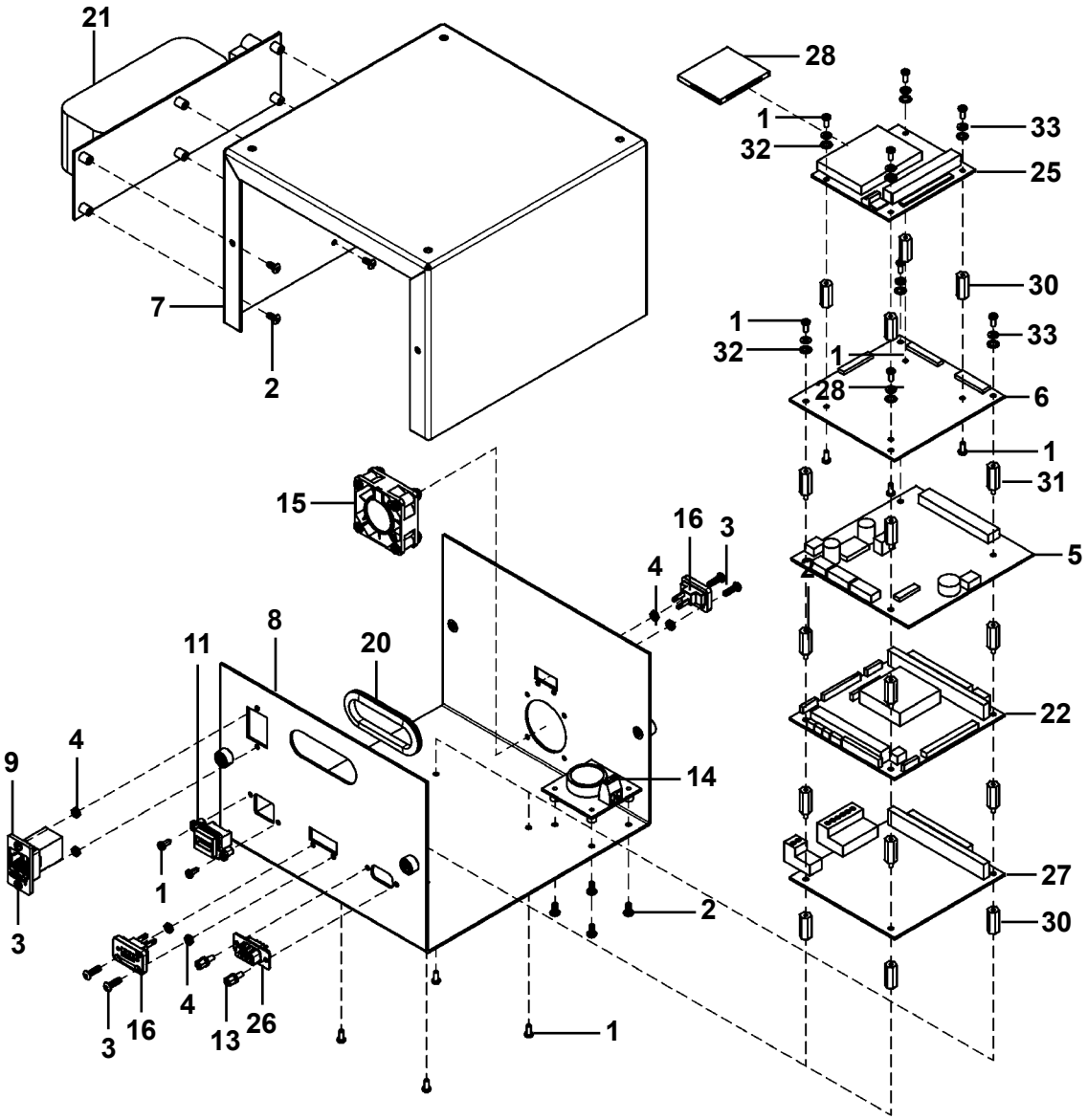
NOTE:
PWS-0100 & PWS-0100/3100 are physically the same part with software changes.

PWS-0100 CONTROL BOX / PARTS LIST

ITEM	QTY	PART NO.	DESCRIPTION
18	18	MET-1350-SS	M3 Hex Nut (Stainless Steel)
19	4	MET-1380-SS	M6 Hex Nut
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	24	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 Assy, Ground to Box
*	1	PWS-0260-LID	Ground Wire Assy, Ground to Lid

* Not Shown

PWS-0130 PC104 COMPUTER BOX ASSEMBLY / EXPLODED VIEW

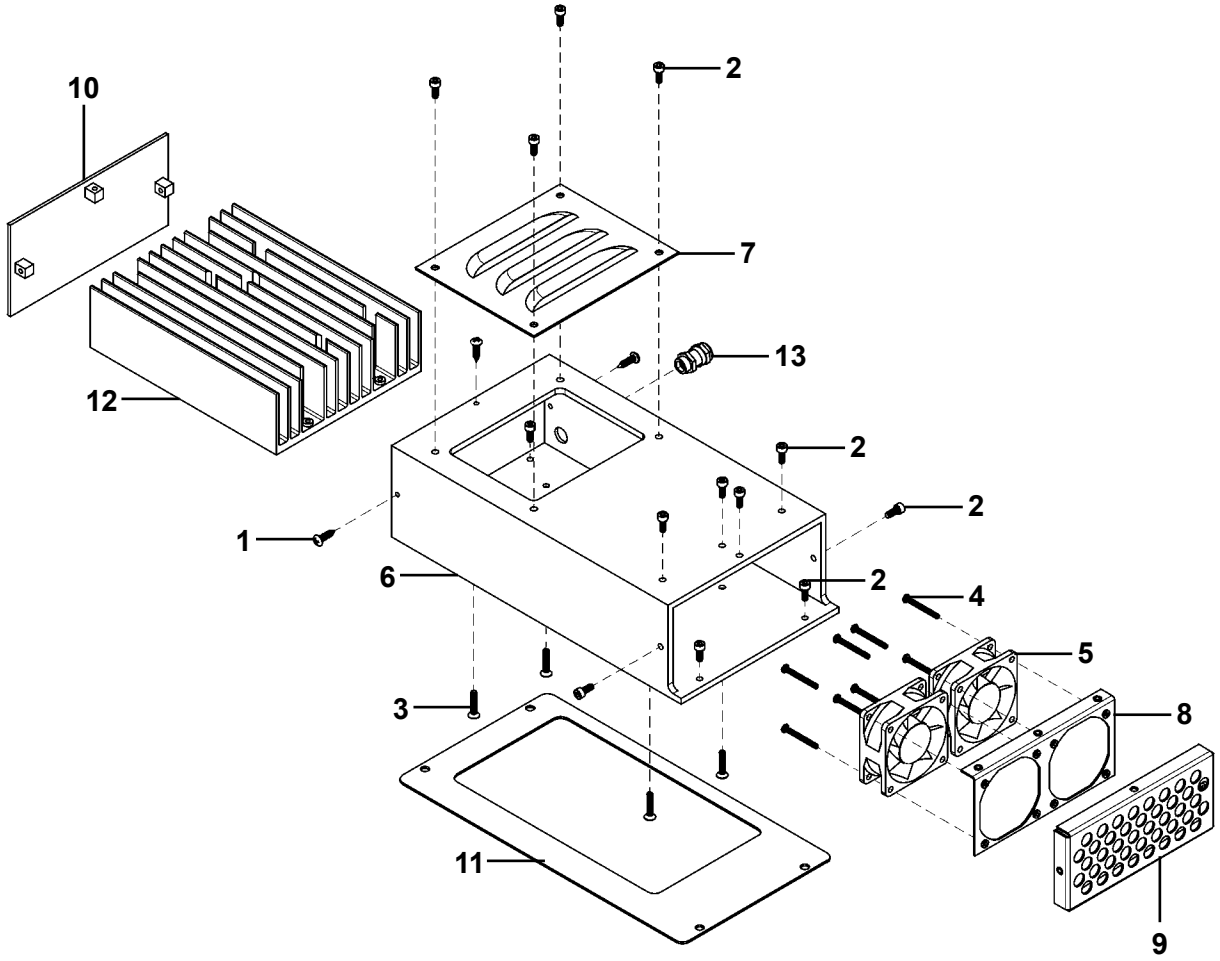


PWS-0130 PC104 COMPUTER BOX ASSEMBLY / PARTS LIST

ITEM	QTY	PART NUMBER	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
10	1	PWS-0137*	Network Cable
11	1	PWS-0138	USB Wiring Harness
12	1	PWS-0139*	USB Interconnect 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
18	1	PWS-0168*	Backlight Driver Cable
19	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
23	1	PWS-0182*	Cable Flat Flex 40 Pos.
24	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
29	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

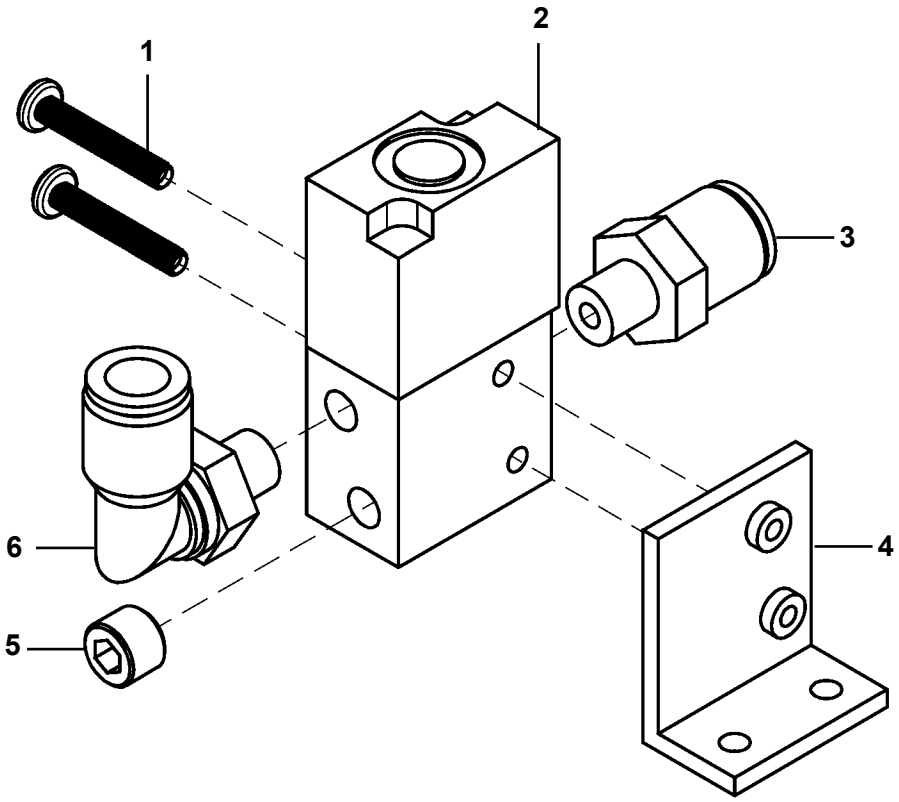
* = Not Shown

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



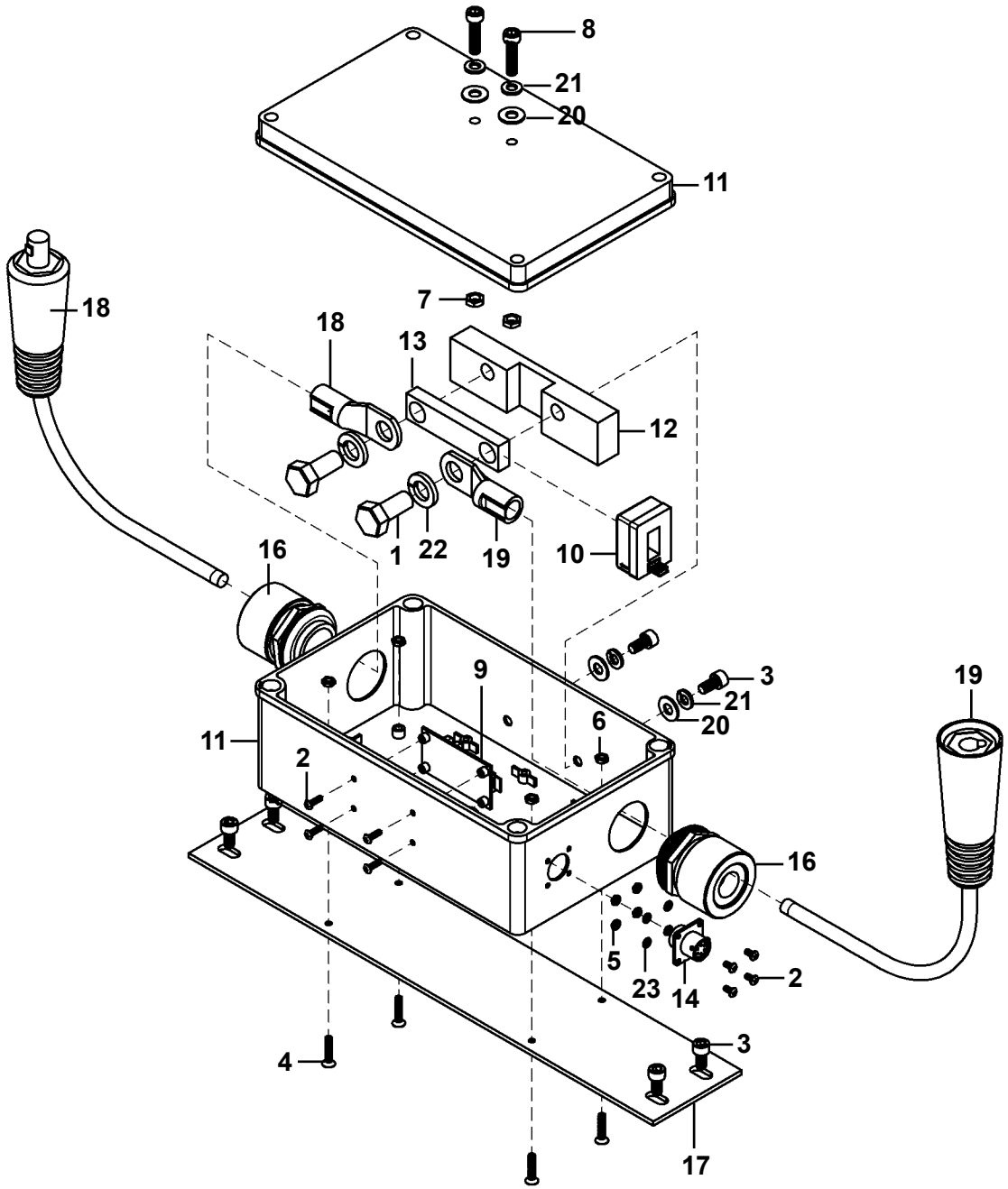
ITEM	QTY	PART NUMBER	DESCRIPTION
1	3	FAS-0114	#6-32 x 3/8" Pan Hd Black
2	14	MET-0553-SS	Soc Hd Cap Scr M4 x 10
3	4	MET-0953-SS	Flt Hd Soc Scr M4 x 10
4	8	MET-2143-SS	Pan Hd Phil M3 x 30
5	2	PWS-0113	24V DC Waterproof Fan
6	1	PWS-0121-M1	Heat Sink Enclosure
7	1	PWS-0122	Louver Plate
8	1	PWS-0123	Fan 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

PWS-0150 SOLENOID VALVE ASSEMBLY / EXPLODED VIEW / PARTS LIST



ITEM	QTY	PART NUMBER	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.

PWS-0300 CURRENT SENSOR ASSEMBLY / EXPLODED VIEW

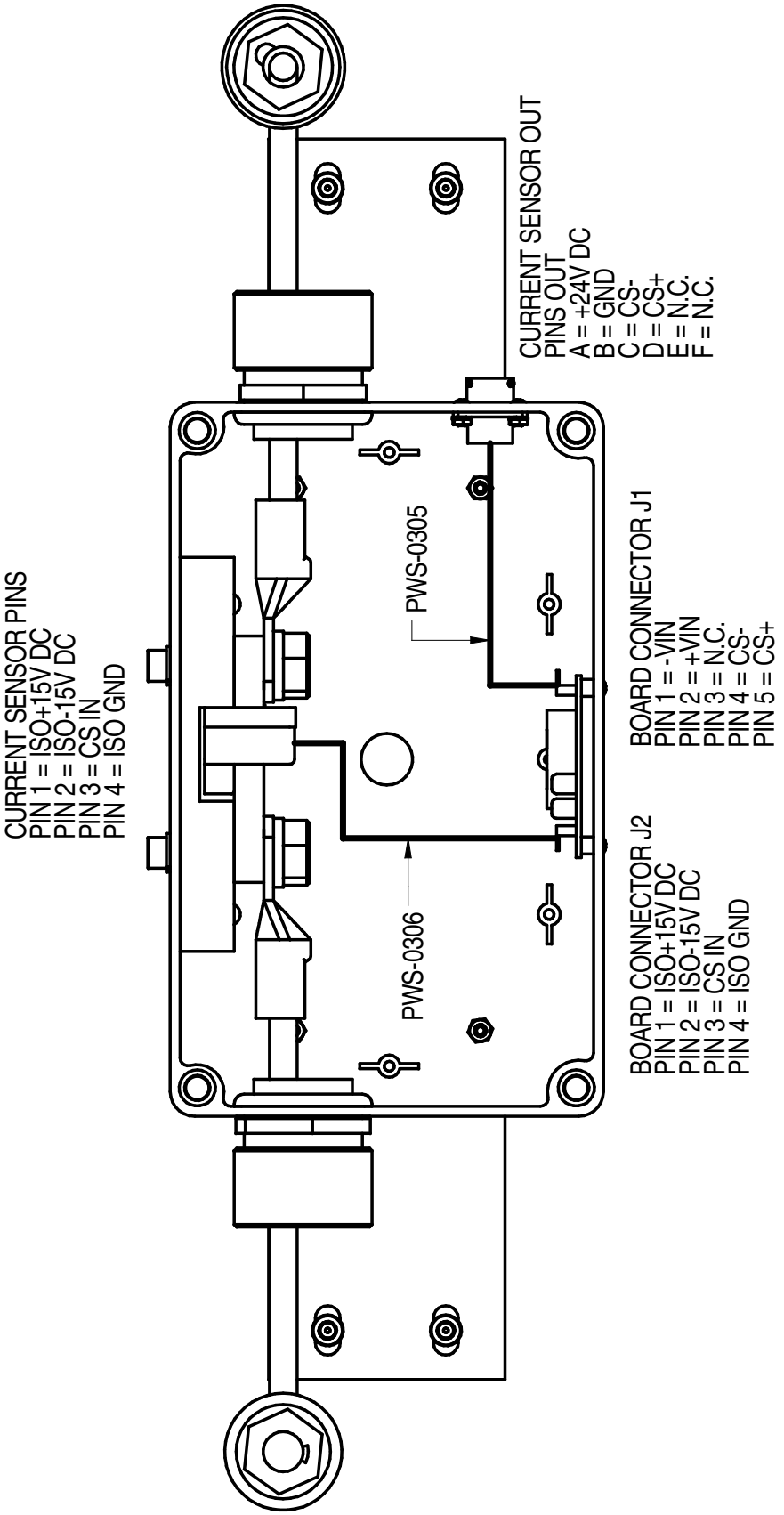


PWS-0300 CURRENT SENSOR ASSEMBLY / PARTS LIST

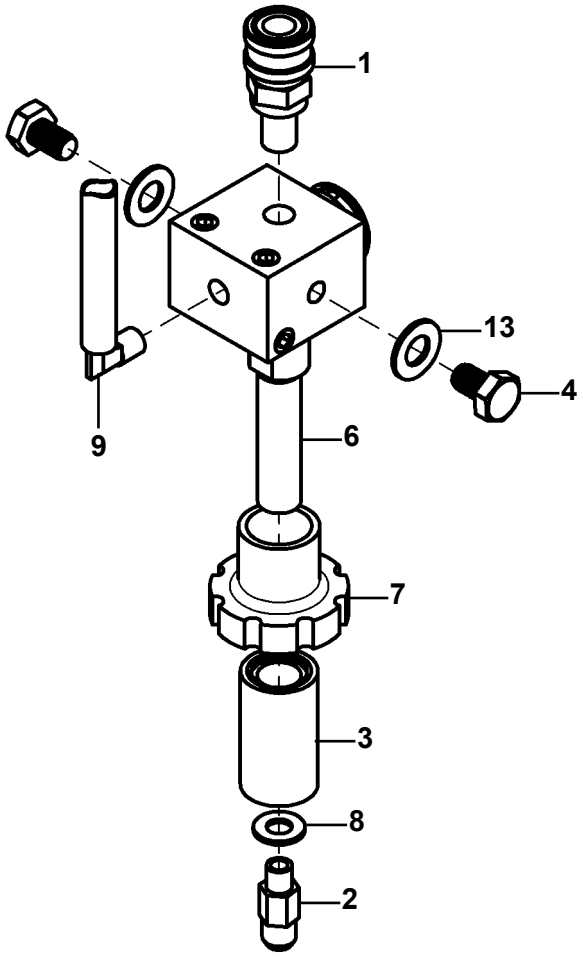
ITEM	QTY	PART NUMBER	DESCRIPTION
1	2	FAS-0309	Hex Hd Cap Scr 1/2-13 x 1"
2	8	MET-0143-SS	Pan Hd Phil Scr M3 x 10
3	6	MET-0574-SS	Soc Hd Cap Scr M6 x 12
4	4	MET-0959-SS	Flt Hd Soc Scr M4 x 20
5	4	MET-1340-SS	M3 Hex Nut
6	4	MET-1350-SS	M4 Hex Nut
7	2	MET-1370-SS	M6 Hex Nut
8	2	MET-2572-SS	Soc Hd Cap Scr M6 x 25
9	1	PCB-1218	Power Supply Module
10	1	PWS-0301	400A Current Sensor
11	1	PWS-0302	9" x 5.5" Plastic Enclosure
12	1	PWS-0303	Insulator Block
13	1	PWS-0304	Brass Current Bar
14	1	PWS-0305	Main Current Sense Harness
15	1	PWS-0306*	Sensor Harness
16	2	PWS-0307	1" Cord Grip .63" to .75" Cable
17	1	PWS-0308	Current Sensor Mount Plate
18	1	PWS-0311-10	Male Current Sensor Cable
19	1	PWS-0312-1.5	Female Current Sensor Cable
20	4	WAS-0240	1/4 SAE Flat
21	4	WAS-0243	1/4" Split Lock Washer
22	2	WAS-0281	1/2" Split Lock Washer
23	4	WAS-5541-SS	M3 Lock Washer

* = Not Shown

PWS-0300 TROUBLESHOOTING DIAGRAM



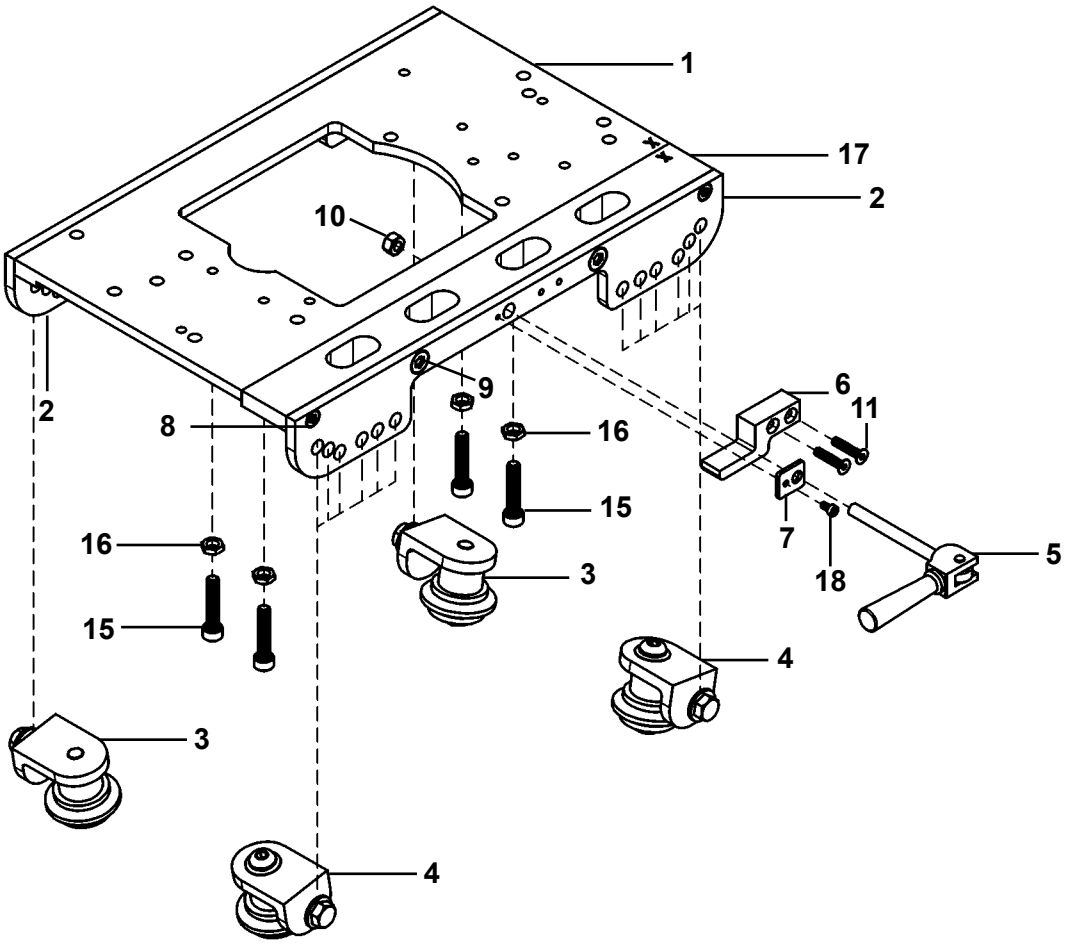
PWS-1400 TORCH ASSEMBLY / EXPLODED VIEW / PARTS LIST



ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	CWO-1817	Bulk Head Connector QCB
2	1	CWO-8008	54A Gas Diffuser
3	1	CWO-8035	35CT Nozzle Insulator
4	2	MET-0397	Hex Hd Cap Scr M10 x 16
5	1	PWS-1432*	Set Scr. for Gas Diffuser
6	1	PWS-1450	Torch Block Assembly
7	1	PWS-1453	Phenolic Torch Lock Nut
8	1	PWS-1454	Internal Nozzle Spatter Guard
9	1	PWS-1457-2.5	30" Shielding Gas Hose Assy
10	1	PWS-1467*	Conduit, 24" Long
11	1	PWS-1468*	Oval Steel Spring Torch Liner
12	2.5'	PWS-1469-P*	1-1/2" ID Flexgard VCO Sleeve
13	2	WAS-0270	7/16" Flat Washer Zinc Plated
14	4	PWS-1488-12*	12" Velcro Strip

* = Not Shown

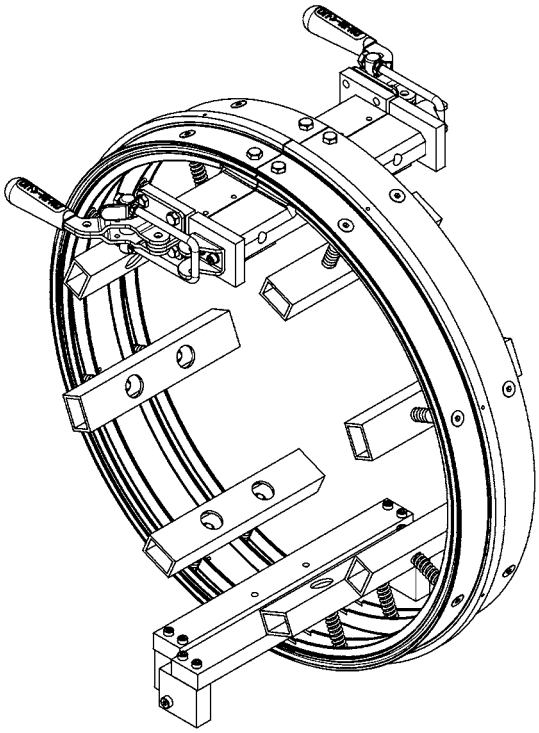
ACCESSORIES / PWS-5960 PIPER BRR CARRIAGE / EXPLODED VIEW / PARTS LIST



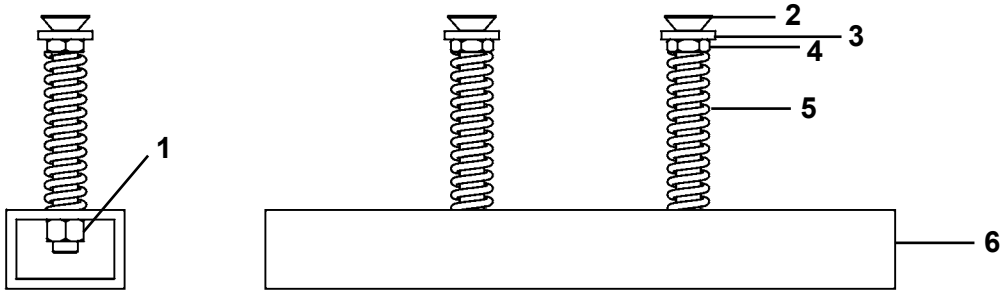
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	PWS-5961	Carriage Left Plate
2	2	PWS-5964	Carriage Side Plate
3	2	BUG-5918	Fixed Angle Leg w/ Wheel
4	2	BUG-5920	Adjustable Angle Leg w/ Wheel
5	1	BUG-5967	Cam Handle Assembly
6	1	BUG-5962	Cam Stop Block
7	1	PWS-5966	Cam Handle Washer
8	4	FAS-0935	Screw, Flat Head 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
12	1	BUG-1979	Label (Not Shown)
13	2	BUG-5911	Spring (Not Shown)
14	2	BUG-5912	Dowel Pin 18/8, Stainless (Not Shown)
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

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

BRR-3250-_

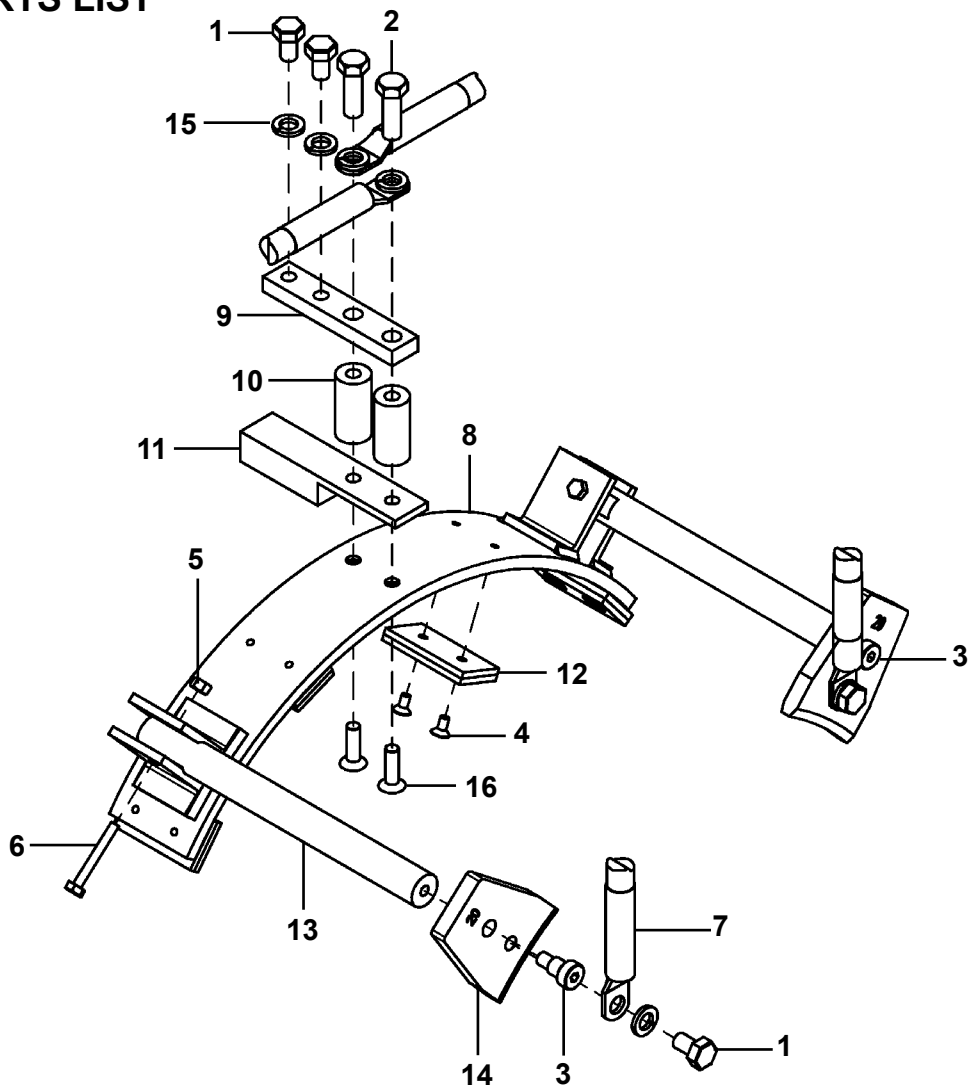


BRR-3255 BRR FOOT ASSEMBLY



ITEM	QTY	PART NUMBER	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

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



ITEM	QTY	PART NUMBER	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"

* = Not Shown

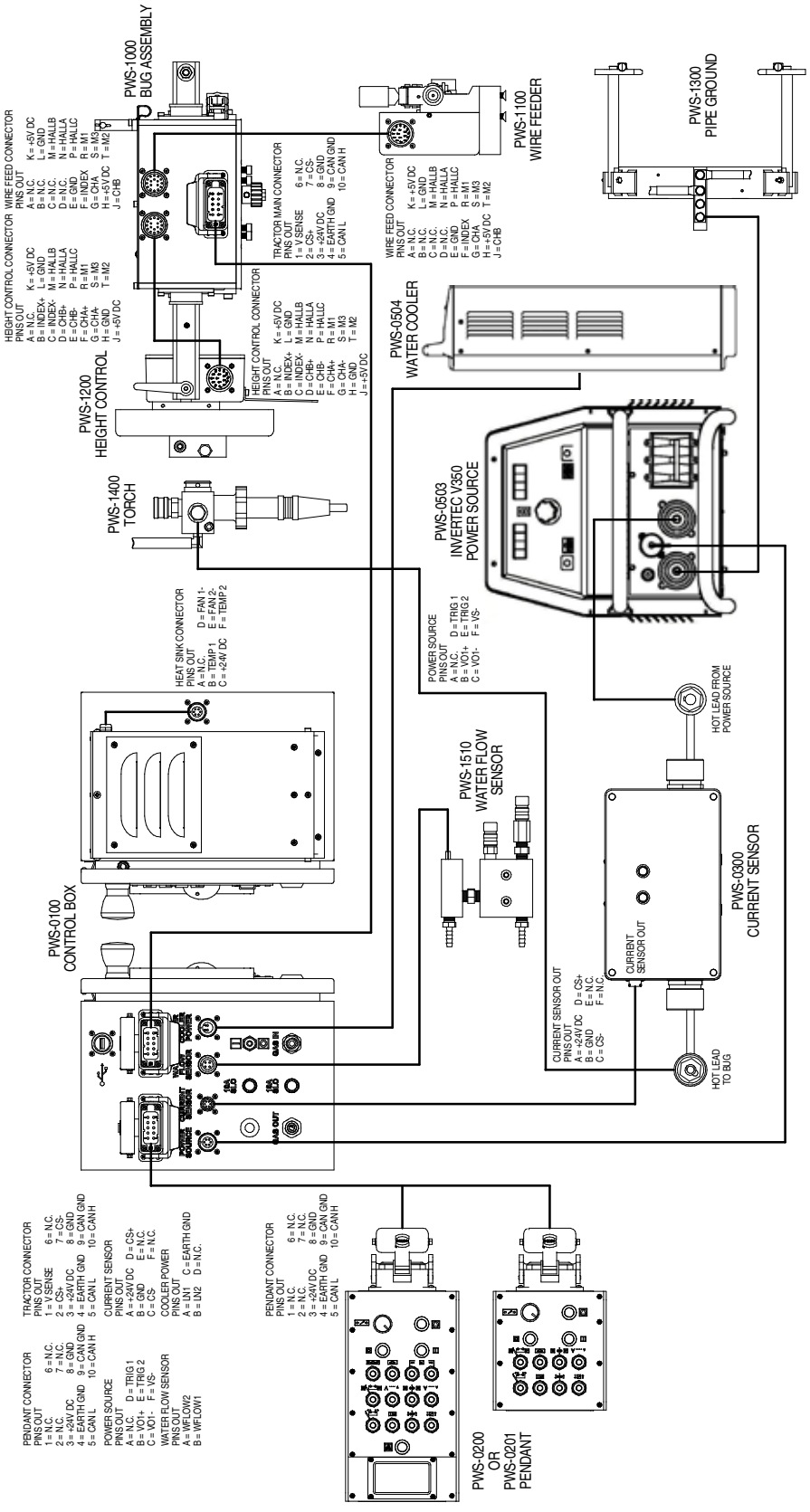
PWS-1600 WIRE KITS

PN	QTY	PN	DESCRIPTION
PWS-1600-1.0K16T			**1.0MM WIRE KIT W/ 16MM NOZZLE**
	50	PWS-1434-1.0	.035" CONTACT TIP – TAPERED
	5	PWS-1436	5/8" OD TORCH NOZZLE
	2	PWS-1118-1.0	1.0MM (.035") V-KNURLED FEED ROLL
	5	CWO-8008	54A GAS DIFFUSER
	5	PWS-1432	LINER LOCK SET SCREW
	10	PWS-1454	BRASS WASHER, 3/4" OD, 3/8" ID, 1/16"THCK
	2	CWO-8035	35CT NOZZLE INSULATOR
	1	PWS-1467	CONDUIT 24" (610MM) LONG
PWS-1600-1.0K19S			**1.0MM WIRE KIT W/ 19MM NOZZLE**
	50	PWS-1433-1.0	.035" CONTACT TIP
	5	PWS-1437	3/4" OD TORCH NOZZLE
	2	PWS-1118-1.0	1.0MM (.035") V-KNURLED FEED ROLL
	5	CWO-8008	54A GAS DIFFUSER
	5	PWS-1432	LINER LOCK SET SCREW
	10	PWS-1454	BRASS WASHER, 3/4"OD, 3/8" ID, 1/16" THCK
	2	CWO-8035	35CT NOZZLE INSULATOR
	1	PWS-1467	CONDUIT 24" (610MM) LONG
PWS-1600-1.2K16T			**1.2MM WIRE KIT W/ 16MM NOZZLE**
	50	PWS-1434-1.2	.045" CONTACT TIP – TAPERED
	5	PWS-1436	5/8" OD TORCH NOZZLE
	2	PWS-1118-1.2	1.2MM (.045") V-KNURLED FEED ROLL
	5	CWO-8008	54A GAS DIFFUSER
	5	PWS-1432	LINER LOCK SET SCREW
	10	PWS-1454	BRASS WASHER, 3/4"OD, 3/8" ID, 1/16" THCK
	2	CWO-8035	35CT NOZZLE INSULATOR
	1	PWS-1467	CONDUIT 24" (610MM) LONG
PWS-1600-1.2K19S			**1.2MM WIRE KIT W/ 19MM NOZZLE**
	50	PWS-1433-1.2	.045" CONTACT TIP
	5	PWS-1437	3/4" OD TORCH NOZZLE
	2	PWS-1118-1.2	1.2MM (.045") V-KNURLED FEED ROLL
	5	CWO-8008	54A GAS DIFFUSER
	5	PWS-1432	LINER LOCK SET SCREW
	10	PWS-1454	BRASS WASHER, 3/4"OD, 3/8" ID, 1/16" THCK
	2	CWO-8035	35CT NOZZLE INSULATOR
	1	PWS-1467	CONDUIT 24" (610MM) LONG
PWS-1600-1.4K16T			**1.4MM WIRE KIT W/ 16MM NOZZLE**
	50	PWS-1434-1.4	.052" CONTACT TIP - TAPERED
	5	PWS-1436	5/8" OD TORCH NOZZLE
	2	PWS-1118-1.4	1.4MM (.052") V-KNURLED FEED ROLL
	5	CWO-8008	54A GAS DIFFUSER
	5	PWS-1432	LINER LOCK SET SCREW
	10	PWS-1454	BRASS WASHER, 3/4" OD, 3/8" ID, 1/16" THCK
	2	CWO-8035	35CT NOZZLE INSULATOR
	1	PWS-1467	CONDUIT 24" (610MM) LONG

PWS-1600 WIRE KITS, CONT'D.

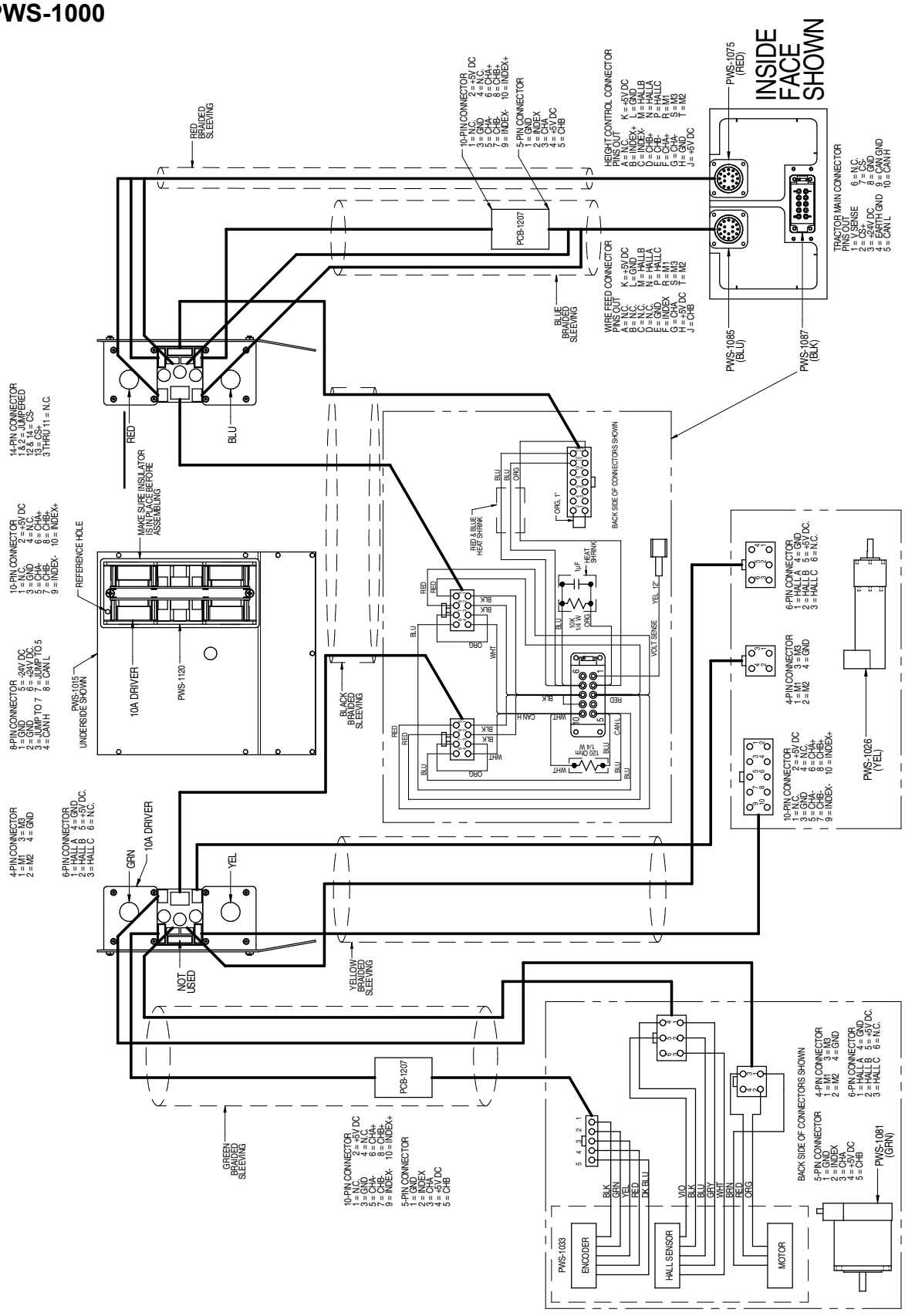
PWS-1600-1.4K19S			**1.4MM WIRE KIT W/ 19MM NOZZLE**
	50	PWS-1433-1.4	.052" CONTACT TIP
	5	PWS-1437	3/4" OD TORCH NOZZLE
	2	PWS-1118-1.4	1.4MM (.052") V-KNURLED FEED ROLL
	5	CWO-8008	54A GAS DIFFUSER
	5	PWS-1432	LINER LOCK SET SCREW
	10	PWS-1454	BRASS WASHER, 3/4" OD, 3/8" ID, 1/16" THCK
	2	CWO-8035	35CT NOZZLE INSULATOR
	1	PWS-1467	CONDUIT 24" (610MM) LONG
PWS-1600-1.6K16T			**1.6MM WIRE KIT W/ 16MM NOZZLE**
	50	PWS-1434-1.6	1/16" CONTACT TIP - TAPERED
	5	PWS-1436	5/8" OD TORCH NOZZLE
	2	PWS-1118-1.6	1.6MM (1/16") V-KNURLED FEED ROLL
	5	CWO-8008	54A GAS DIFFUSER
	5	PWS-1432	LINER LOCK SET SCREW
	10	PWS-1454	BRASS WASHER, 3/4" OD, 3/8" ID, 1/16" THCK
	2	CWO-8035	35CT NOZZLE INSULATOR
	1	PWS-1467	CONDUIT 24" (610MM) LONG
PWS-1600-1.6K19S			**1.6MM WIRE KIT W/ 19MM NOZZLE**
	50	PWS-1433-1.6	1/16" CONTACT TIP
	5	PWS-1437	3/4" OD TORCH NOZZLE
	2	PWS-1118-1.6	1.6MM (1/16") V-KNURLED FEED ROLL
	5	CWO-8008	54A GAS DIFFUSER
	5	PWS-1432	LINER LOCK SET SCREW
	10	PWS-1454	BRASS WASHER, 3/4" OD, 3/8" ID, 1/16" THCK
	2	CWO-8035	35CT NOZZLE INSULATOR
	1	PWS-1467	CONDUIT 24" (610MM) LONG

WIRING DIAGRAMS / PIPER CONNECTION



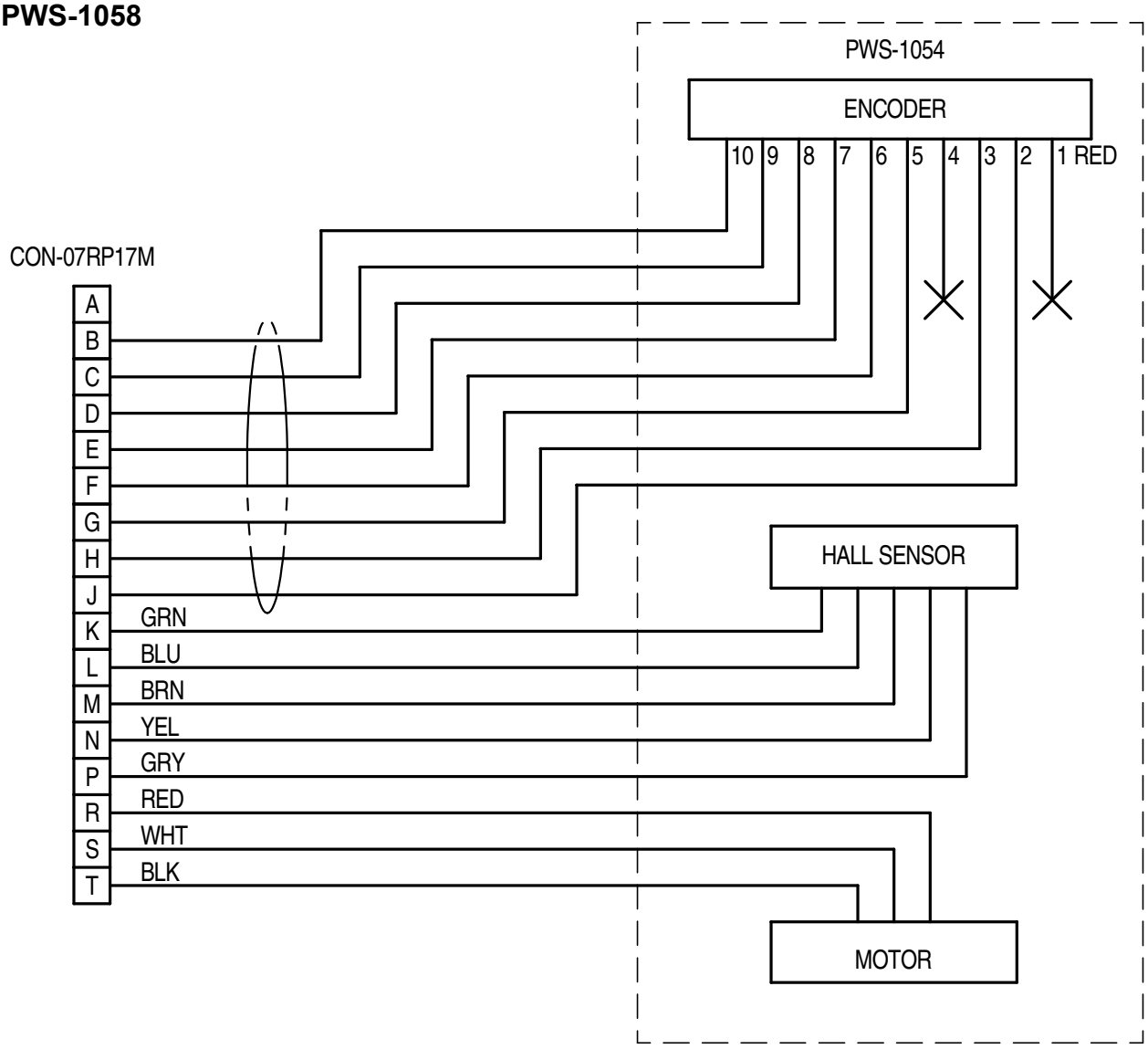
WIRING DIAGRAMS / TRACTOR

PWS-1000



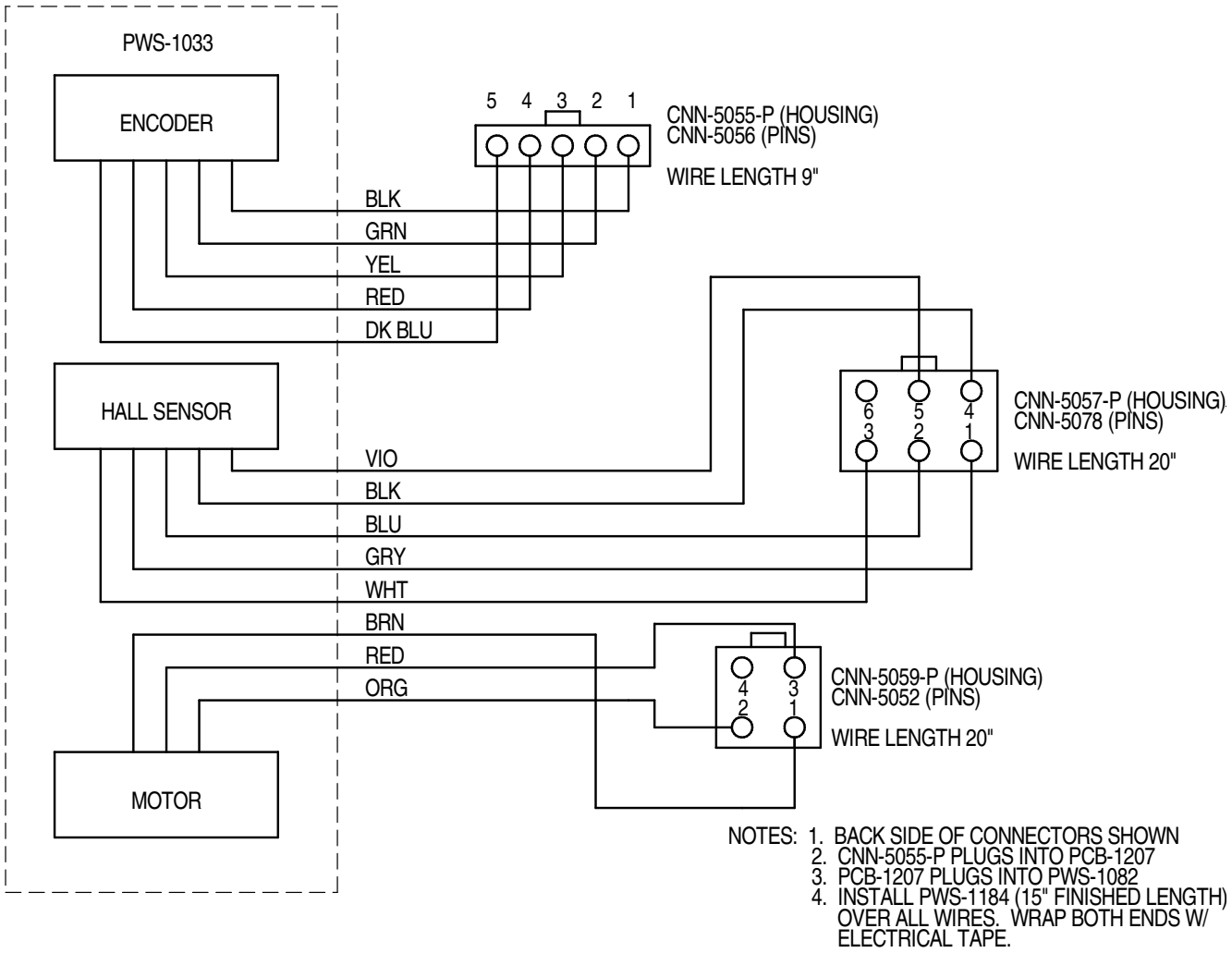
WIRING DIAGRAMS / TRACTOR / MOTOR

PWS-1058



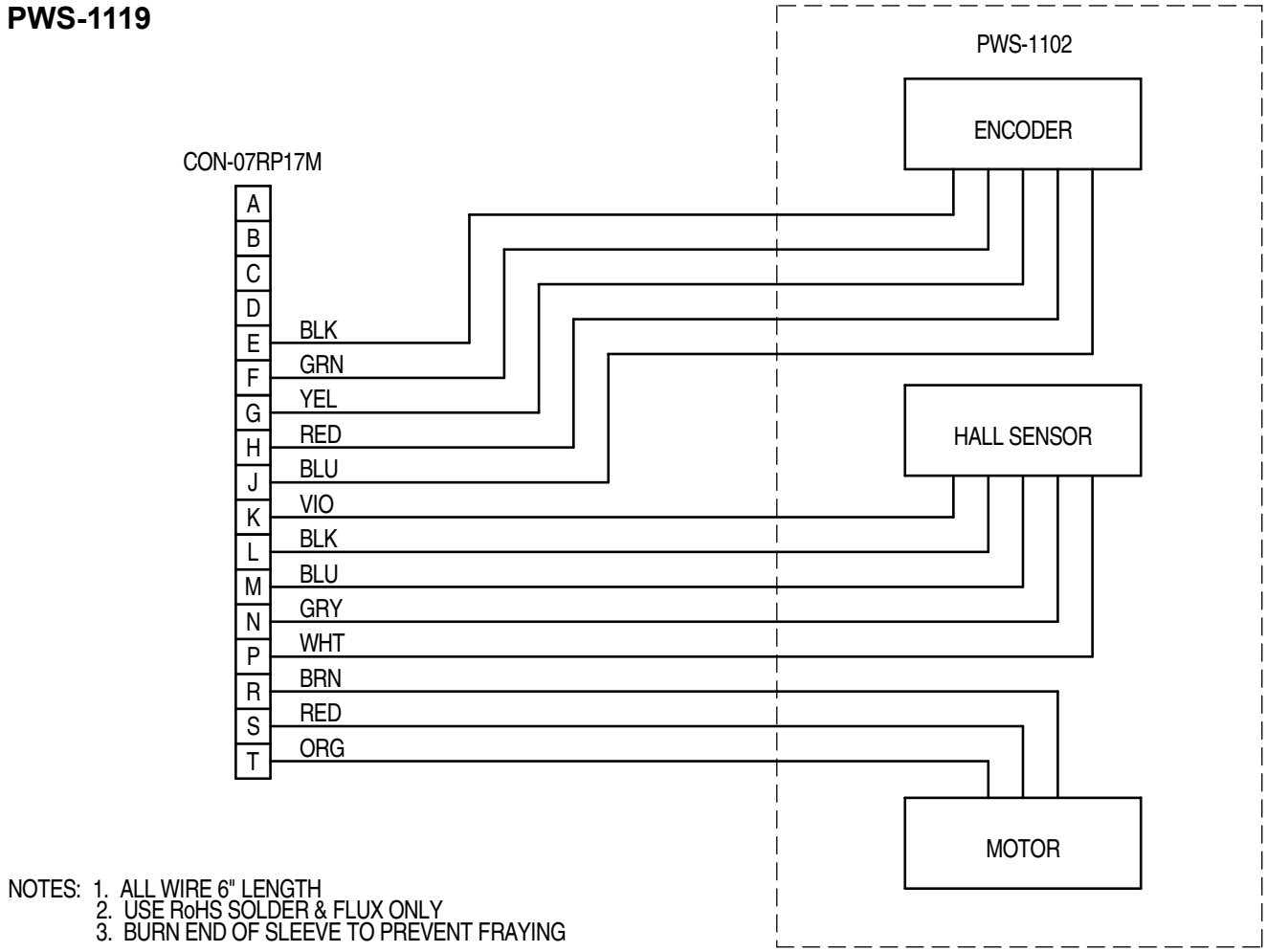
WIRING DIAGRAMS / TRACTOR / MOTOR, CONT'D.

PWS-1081



WIRING DIAGRAMS / TRACTOR / MOTOR, CONT'D.

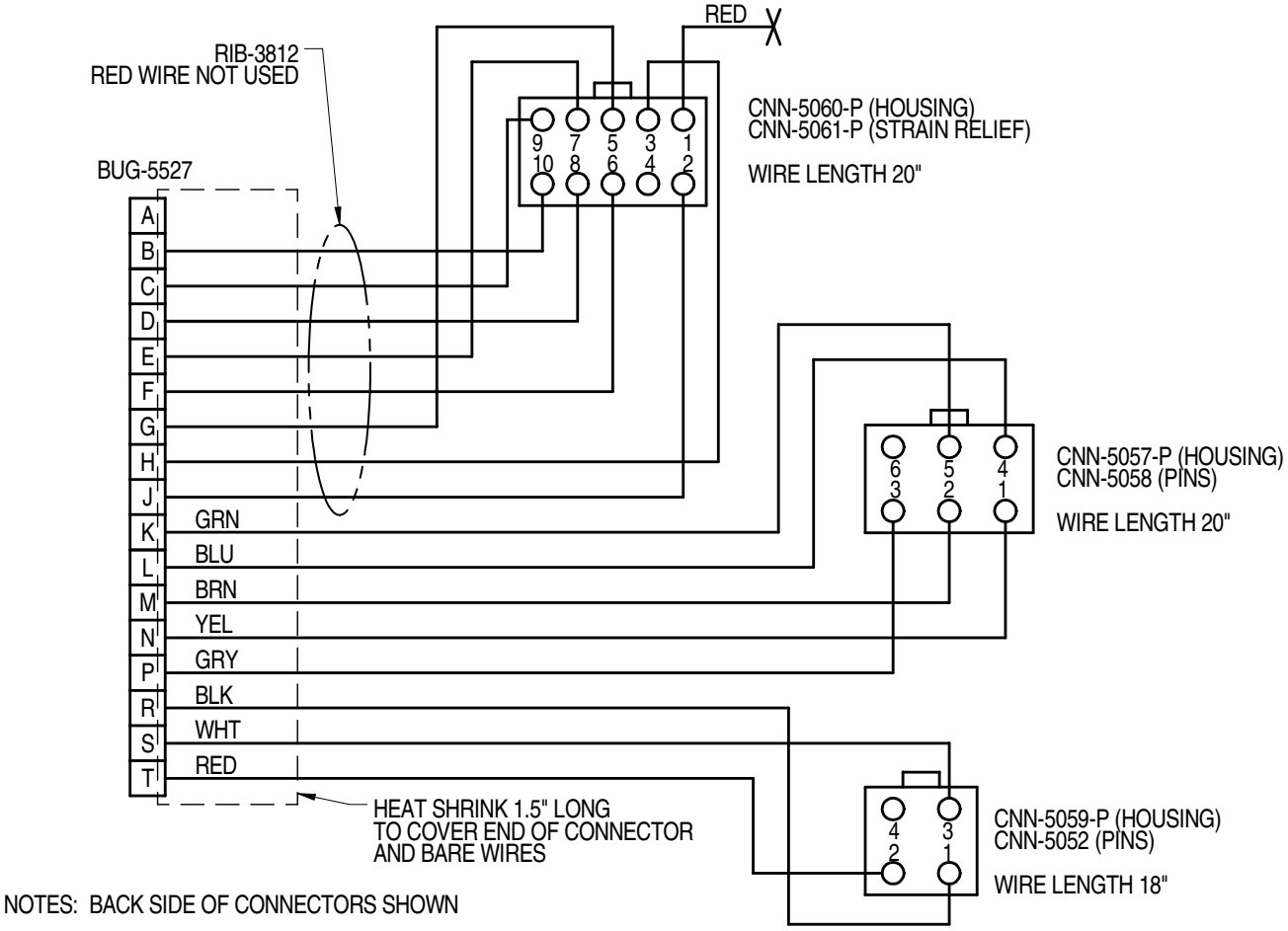
PWS-1119



NOTES: 1. ALL WIRE 6" LENGTH
2. USE RoHS SOLDER & FLUX ONLY
3. BURN END OF SLEEVE TO PREVENT FRAYING

WIRING DIAGRAMS / TRACTOR / WIRING HARNESSES

PWS-1075

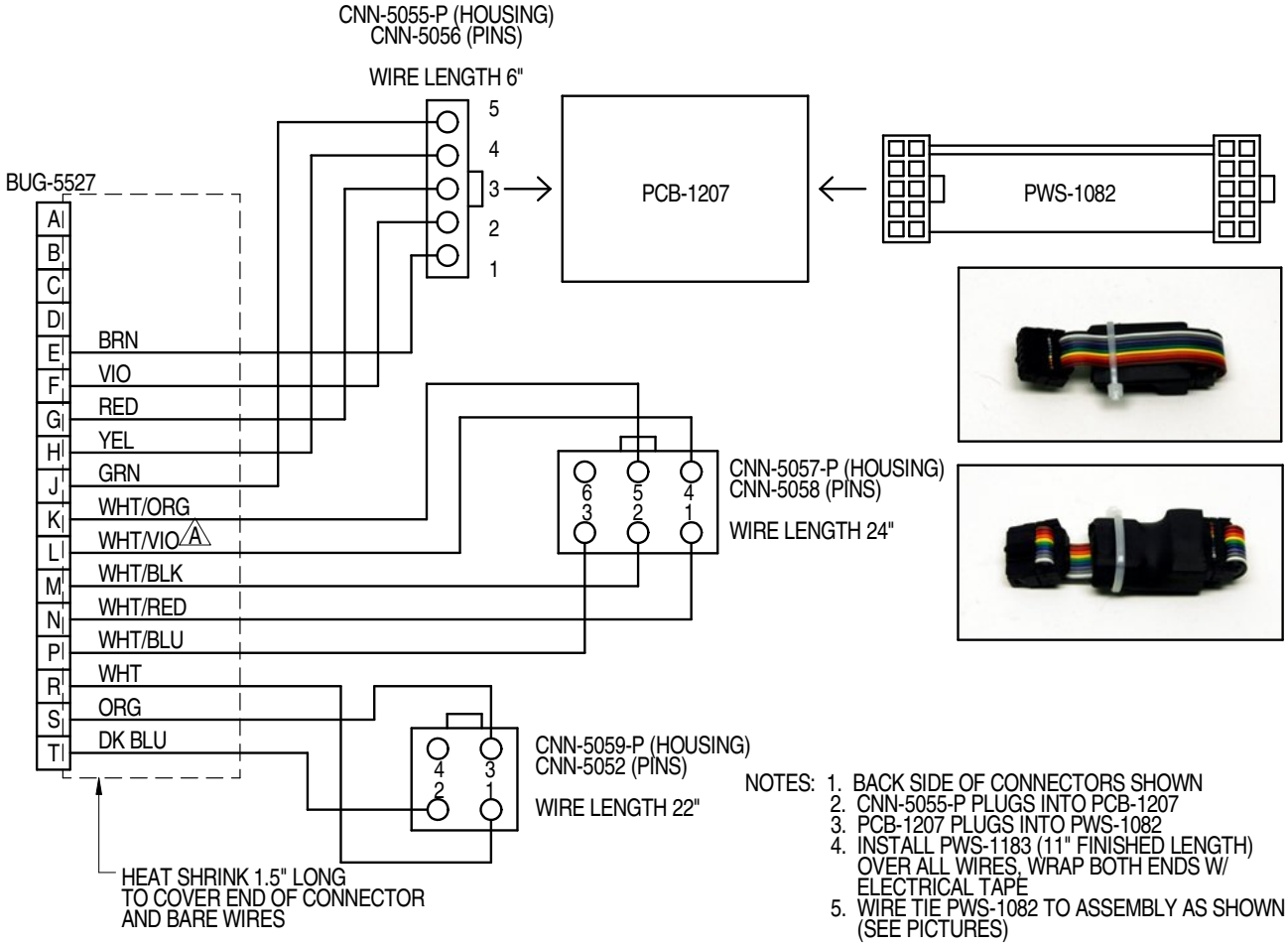


NOTES: BACK SIDE OF CONNECTORS SHOWN

INSTALL PWS-1181 (13" FINISHED LENGTH) OVER ALL WIRES. WRAP BOTH ENDS W/ ELECTRICAL TAPE.

WIRING DIAGRAMS / TRACTOR / WIRING HARNESSES, CONT'D.

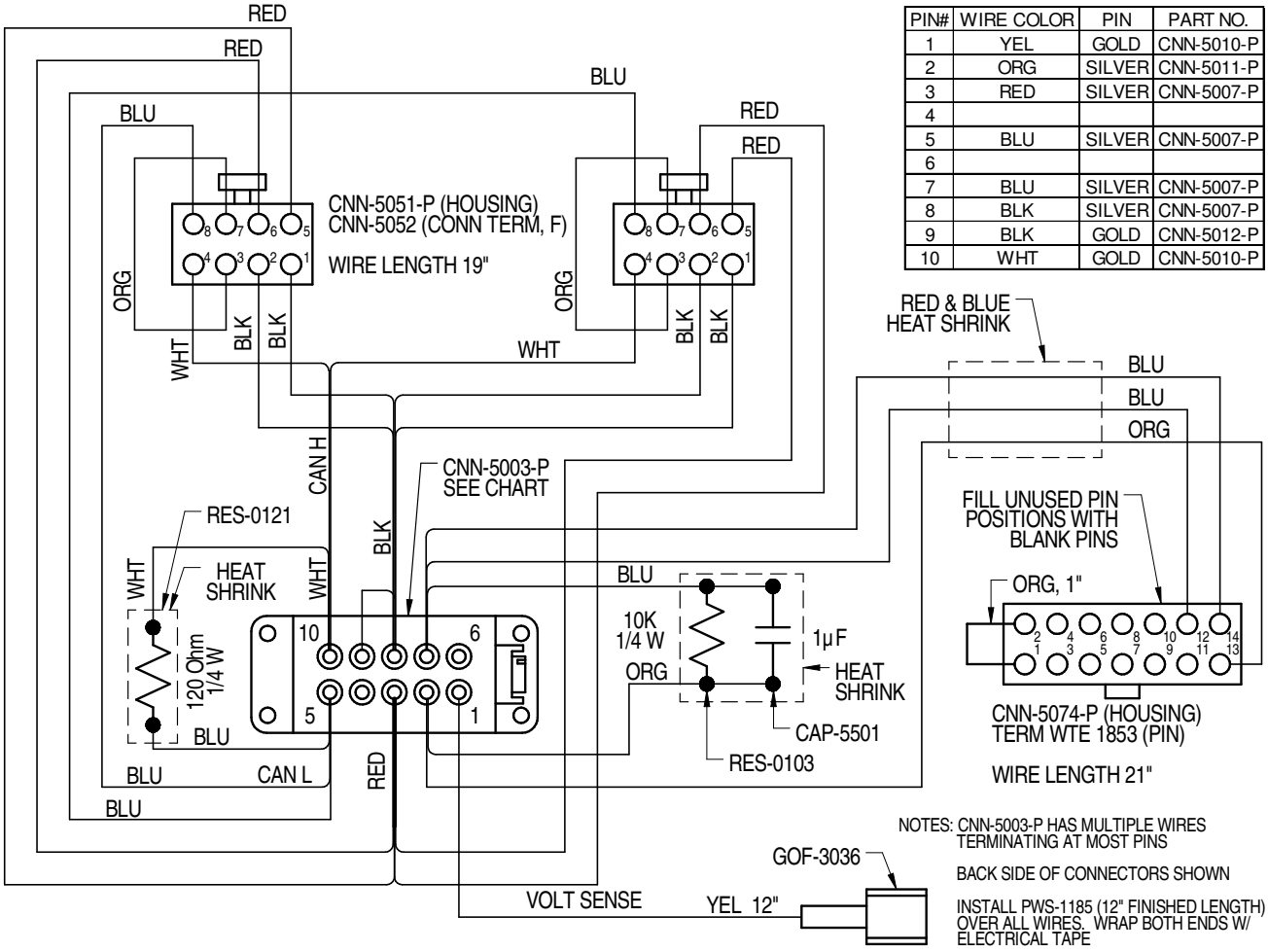
PWS-1085



NOTES:
1. BACK SIDE OF CONNECTORS SHOWN
2. CNN-5055-P PLUGS INTO PCB-1207
3. PCB-1207 PLUGS INTO PWS-1082
4. INSTALL PWS-1183 (11" FINISHED LENGTH) OVER ALL WIRES, WRAP BOTH ENDS W/ ELECTRICAL TAPE
5. WIRE TIE PWS-1082 TO ASSEMBLY AS SHOWN (SEE PICTURES)

WIRING DIAGRAMS / TRACTOR / WIRING HARNESSES, CONT'D.

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			
5	BLU	SILVER	CNN-5007-P
6			
7	BLU	SILVER	CNN-5007-P
8	BLK	SILVER	CNN-5007-P
9	BLK	GOLD	CNN-5012-P
10	WHT	GOLD	CNN-5010-P

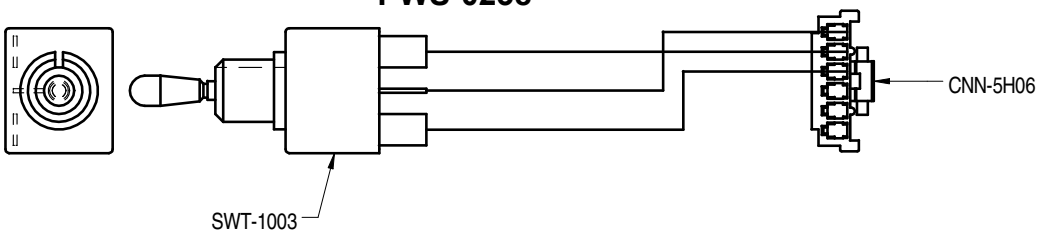
NOTES: CNN-5003-P HAS MULTIPLE WIRES TERMINATING AT MOST PINS

BACK SIDE OF CONNECTORS SHOWN

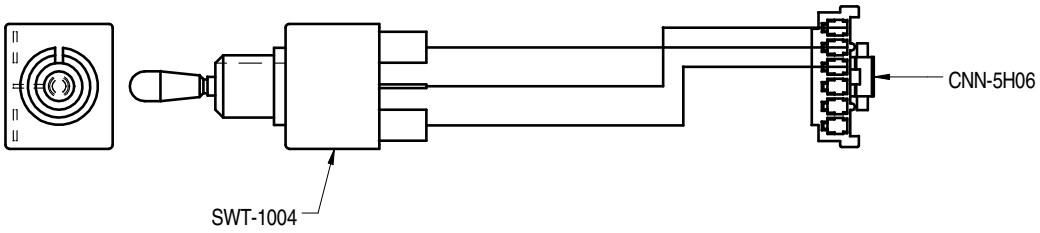
INSTALL PWS-1185 (12" FINISHED LENGTH) OVER ALL WIRES. WRAP BOTH ENDS W/ ELECTRICAL TAPE

WIRING DIAGRAMS / PENDANT WIRING

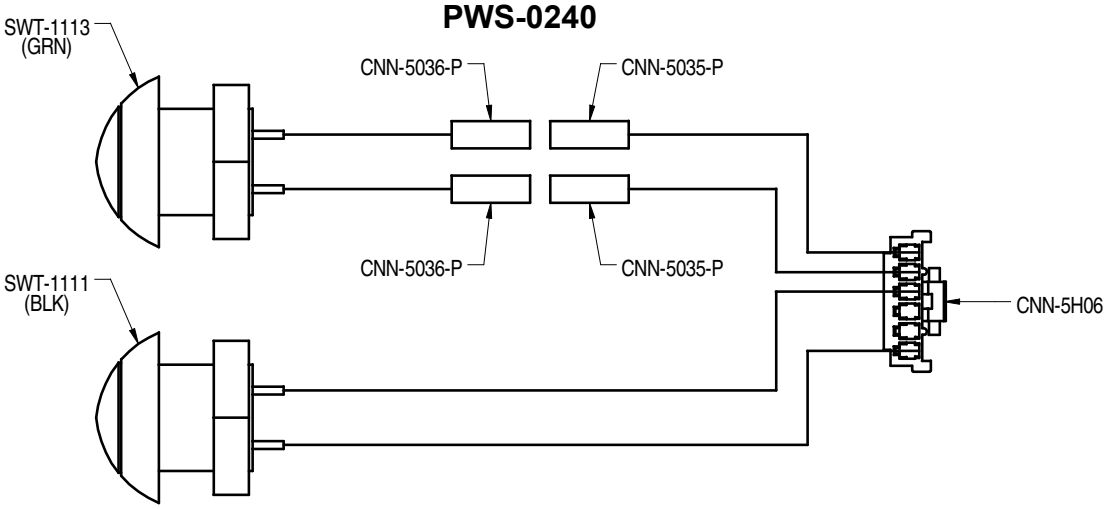
PWS-0238



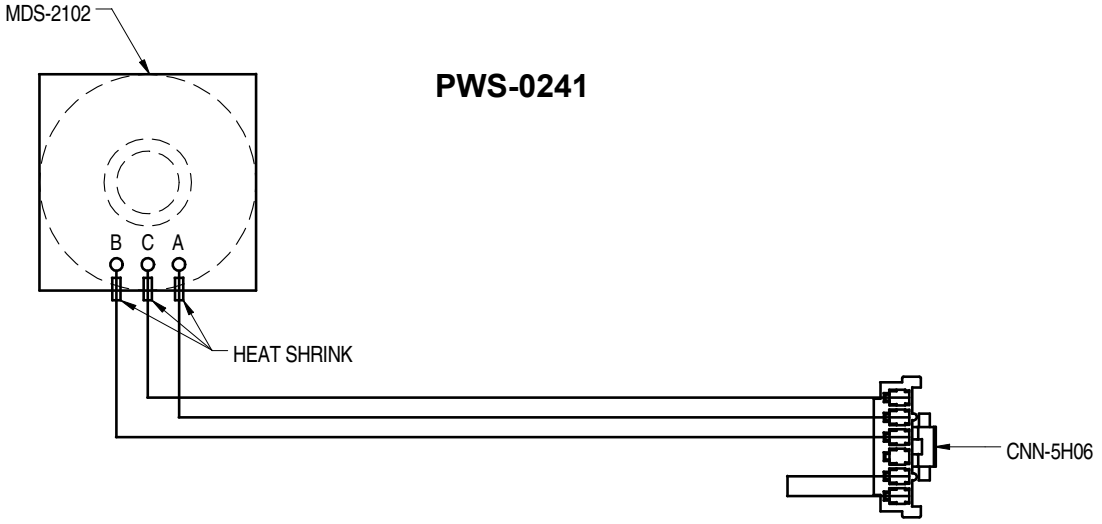
PWS-0239



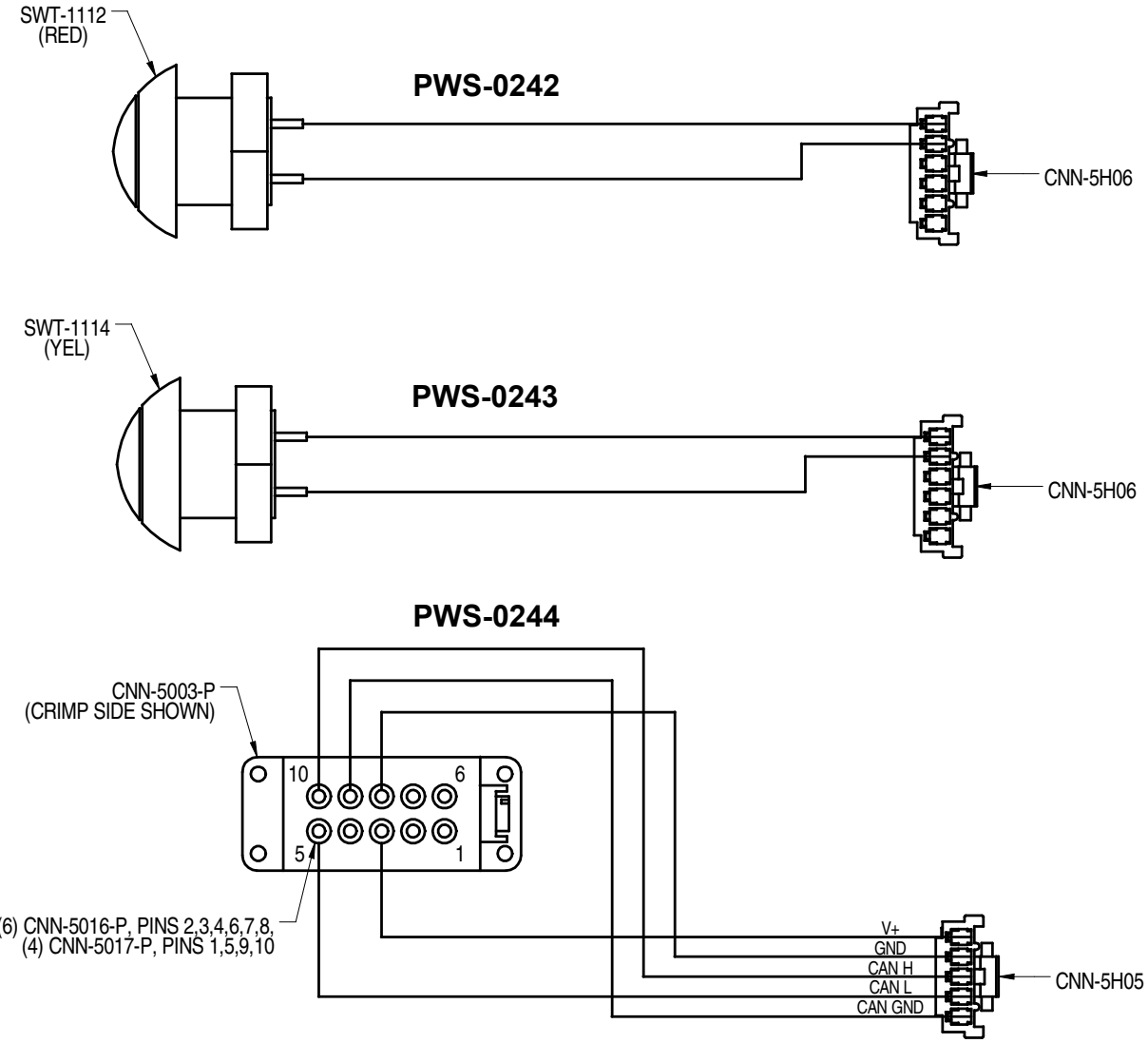
PWS-0240



PWS-0241

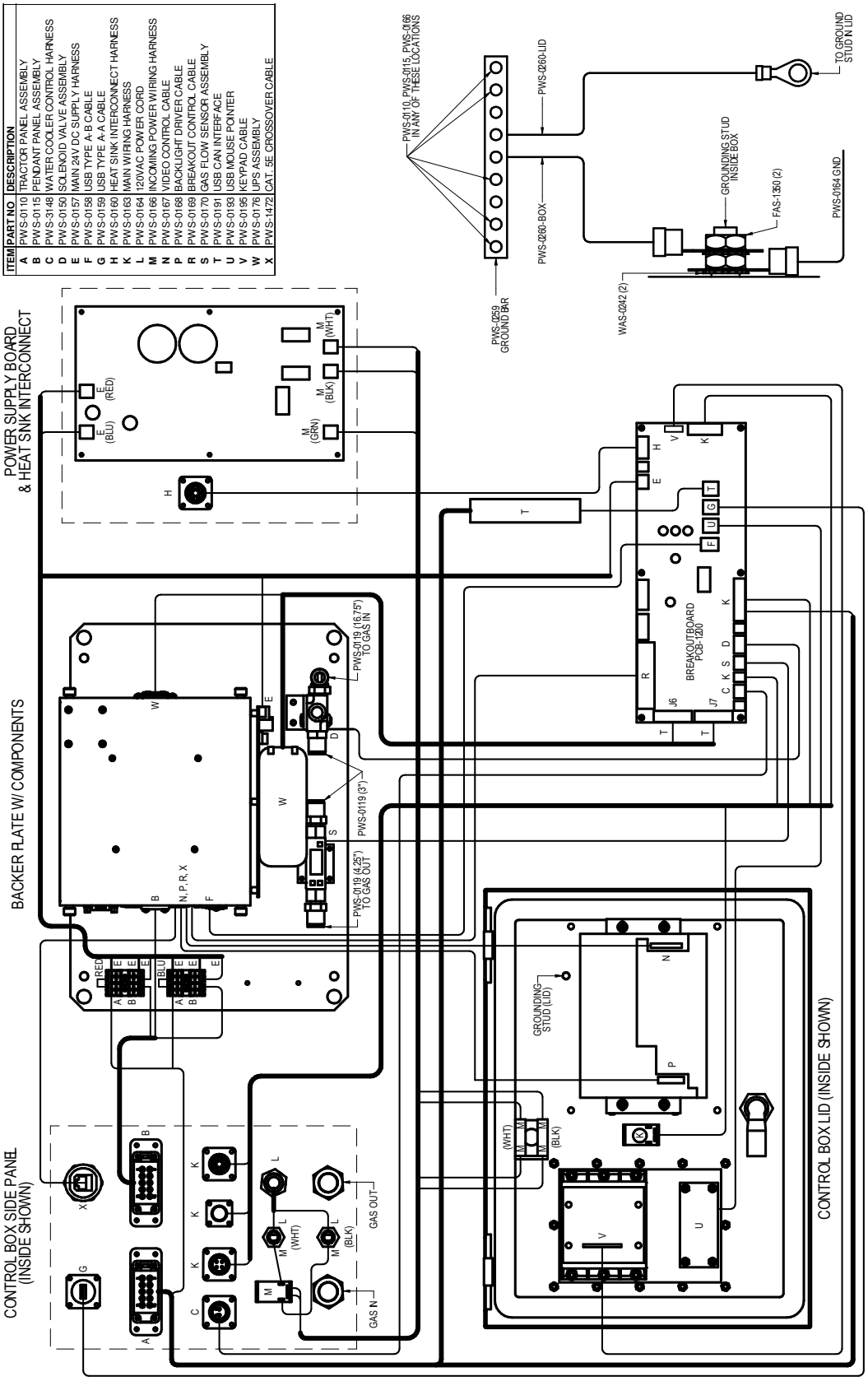


WIRING DIAGRAMS / PENDANT WIRING, CONT'D.



WIRING DIAGRAMS / CONTROL BOX

PWS-0100/3100



WIRING DIAGRAMS / CONTROL BOX / WIRING HARNESSES

PWS-0157

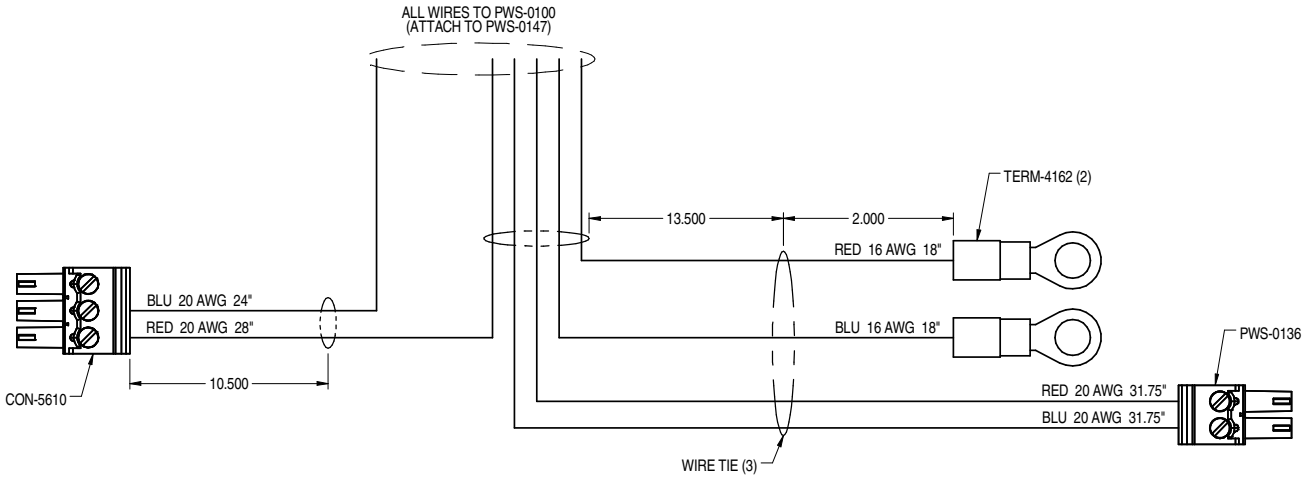
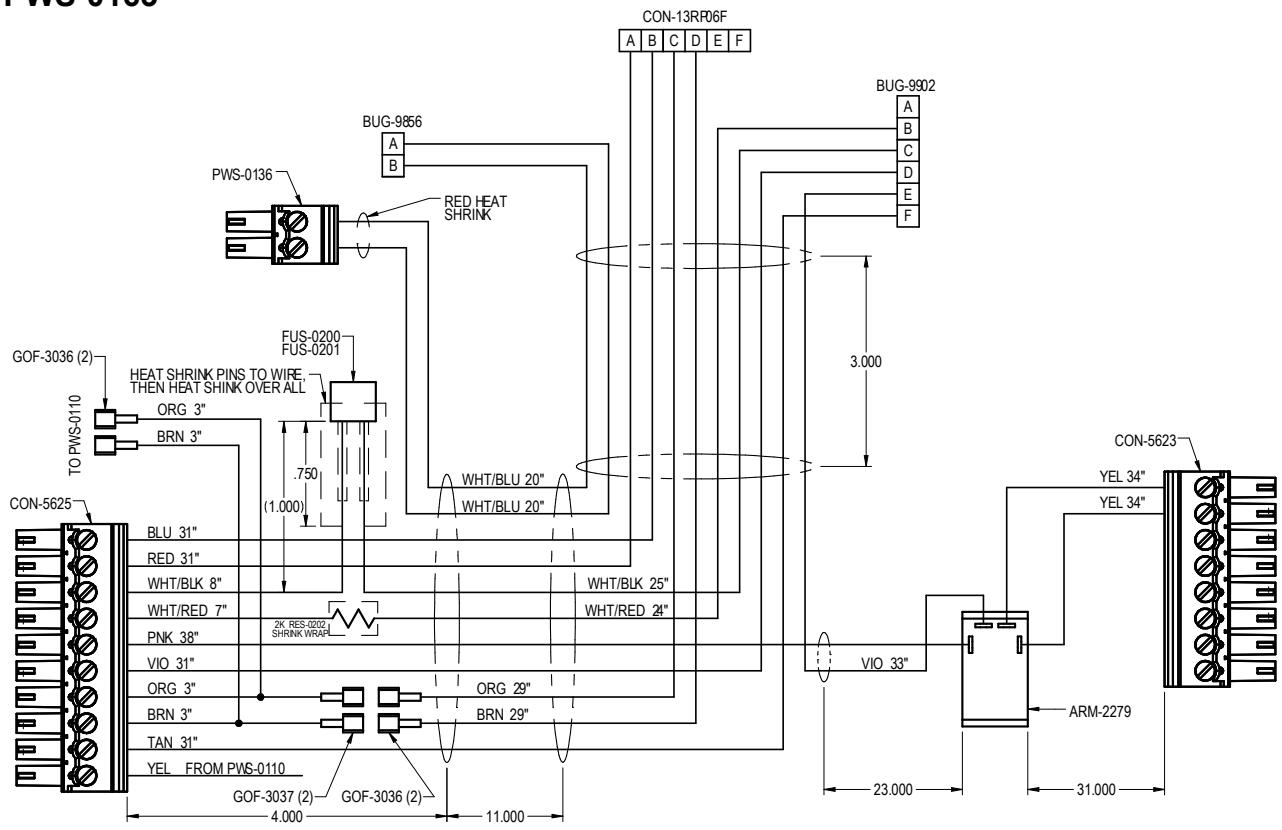


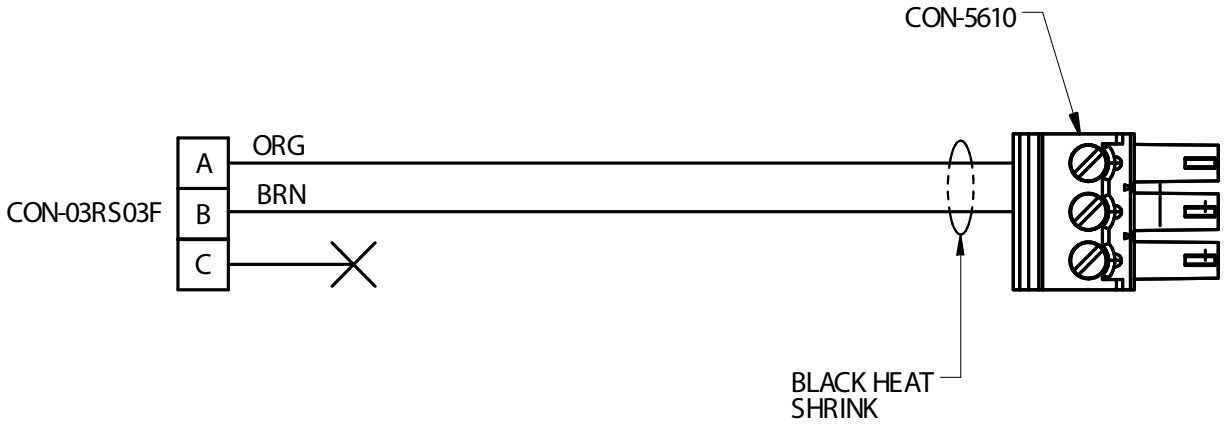
Figure 18.13

PWS-0163

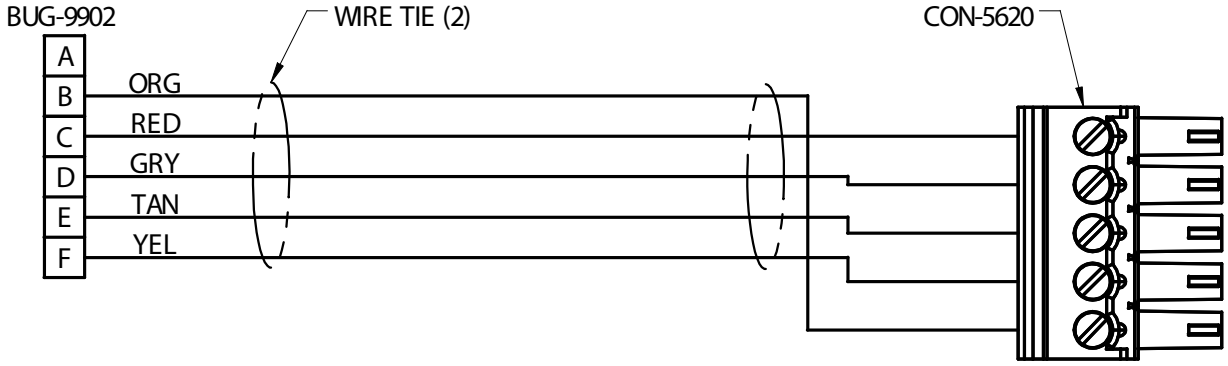


WIRING DIAGRAMS / CONTROL BOX / WIRING HARNESSES, CONT'D.

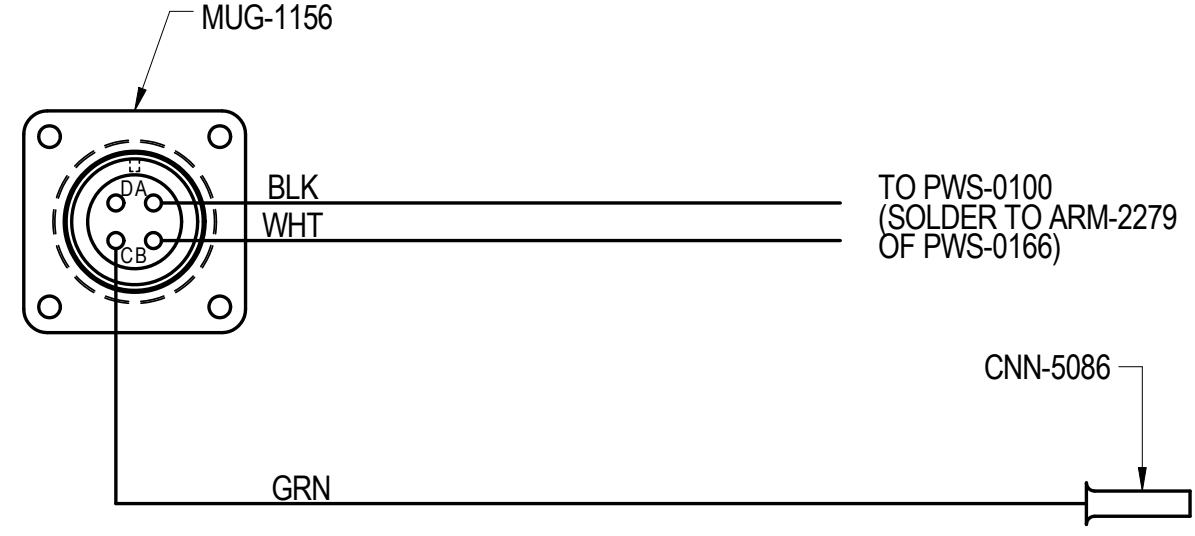
PWS-3148



PWS-0160

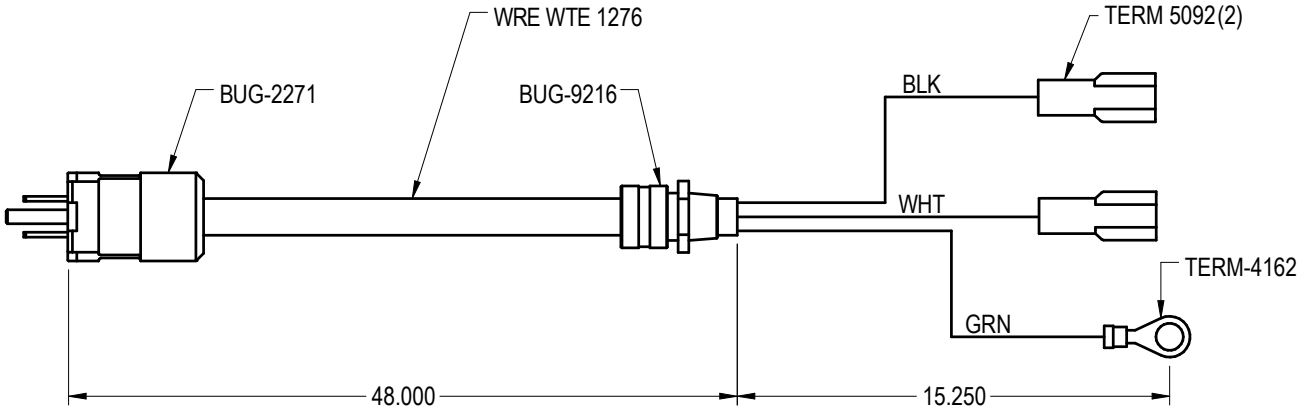


PWS-0162

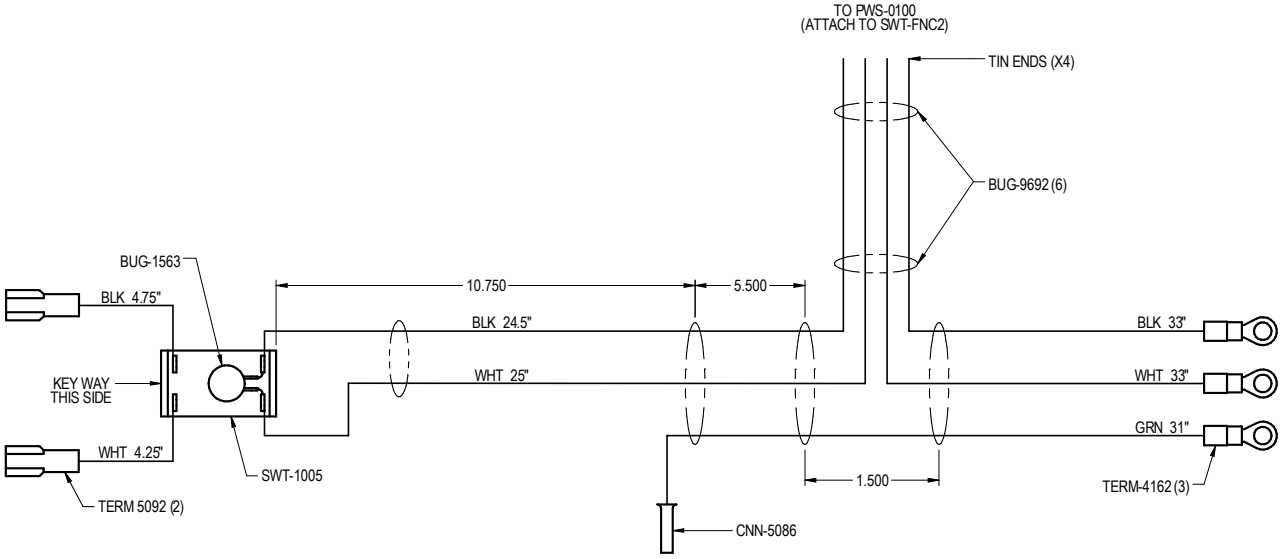


WIRING DIAGRAMS / CONTROL BOX / WIRING HARNESSES, CONT'D.

PWS-0164

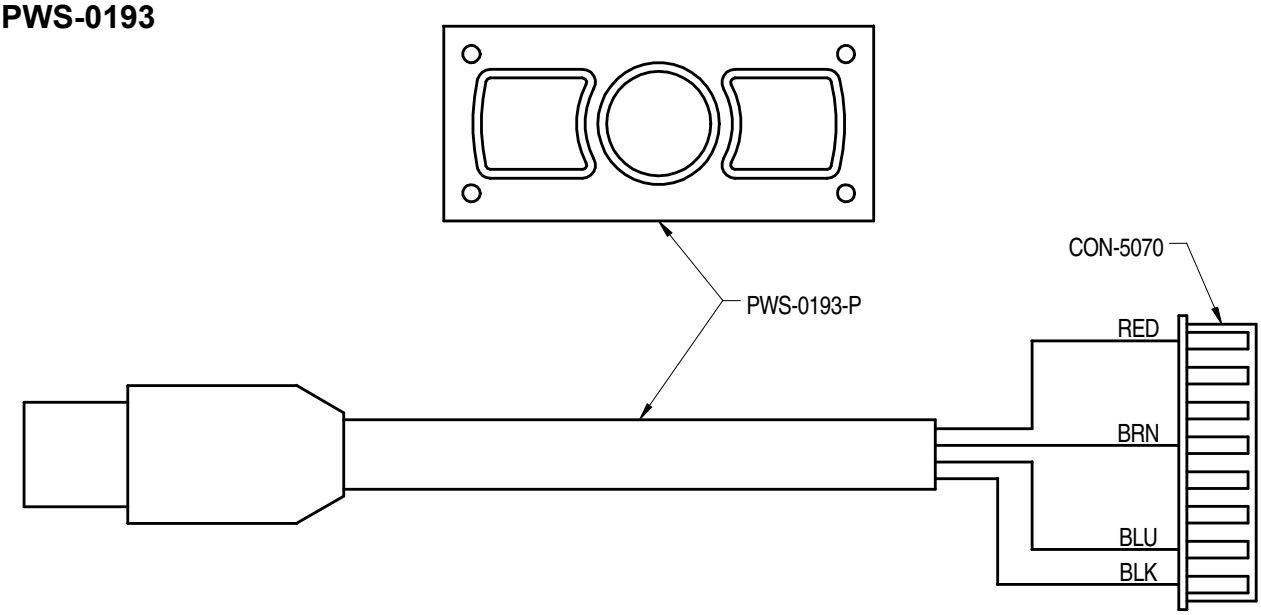


PWS-0166

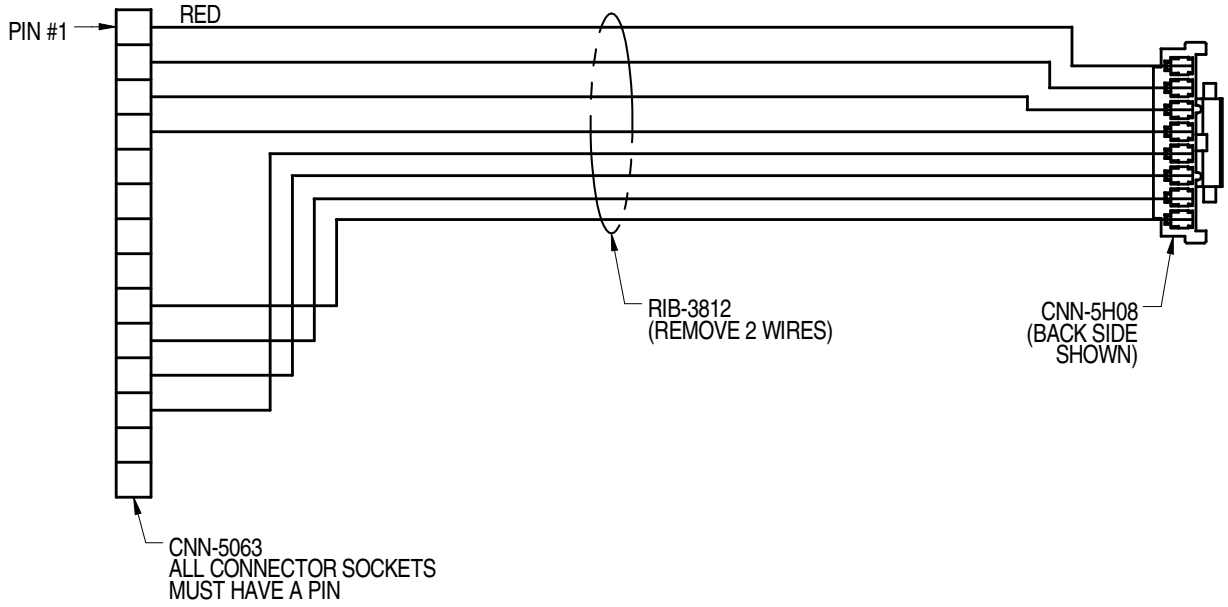


WIRING DIAGRAMS / CONTROL BOX / WIRING HARNESSES, CONT'D.

PWS-0193

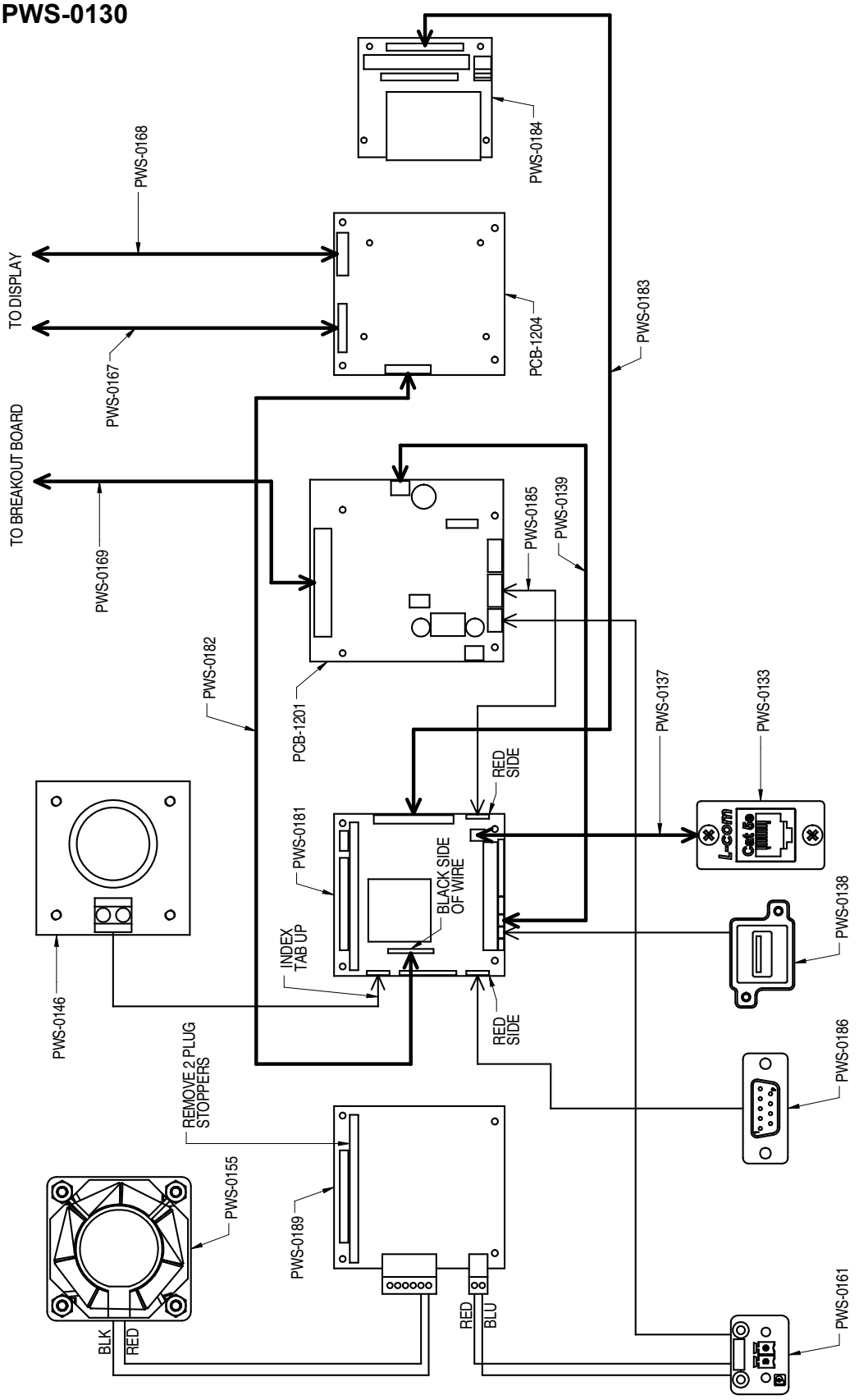


PWS-0195



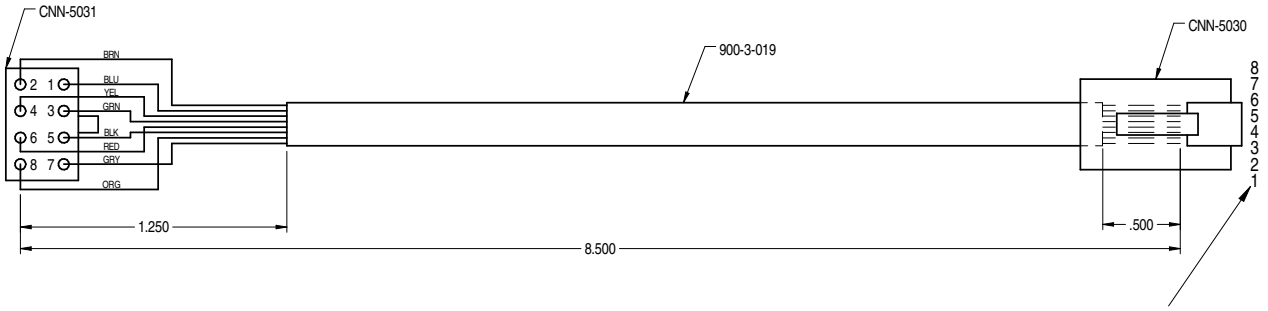
WIRING DIAGRAMS / CONTROL BOX / PWS-0130 WIRING DIAGRAM

PWS-0130



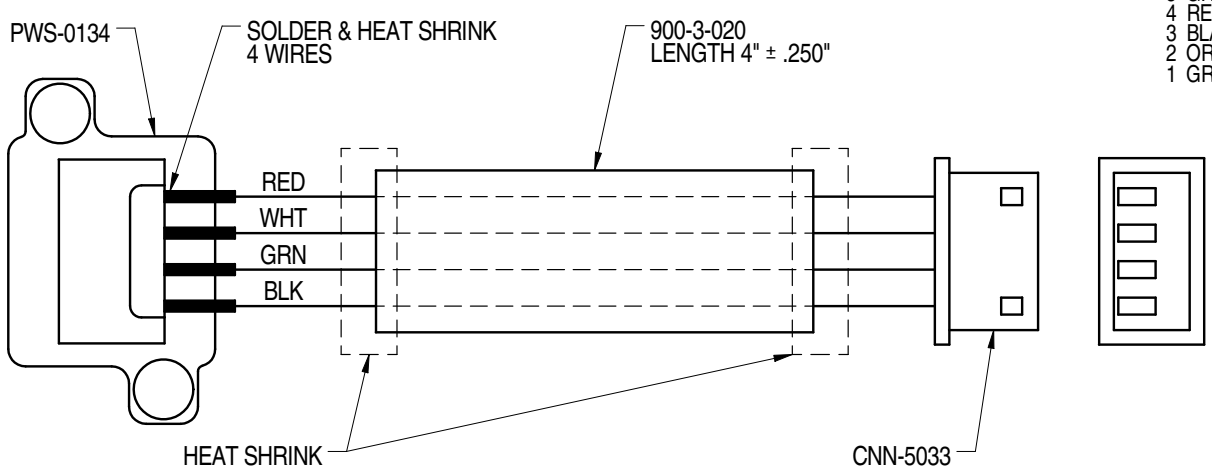
WIRING DIAGRAMS / CONTROL BOX / PWS-0130 / WIRING HARNESSES

PWS-0137



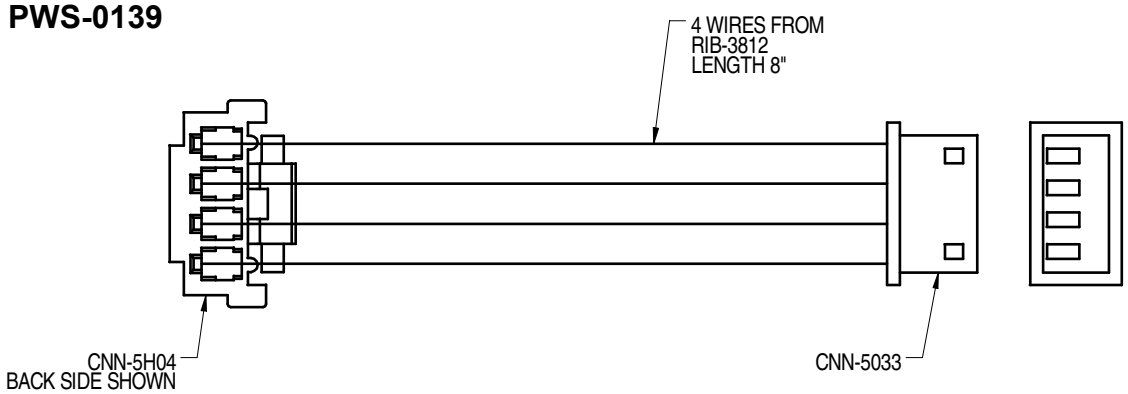
WIRE COLORS:
8 BROWN
7 BLUE
6 YELLOW
5 GREEN
4 RED
3 BLACK
2 ORANGE
1 GRAY

PWS-0138



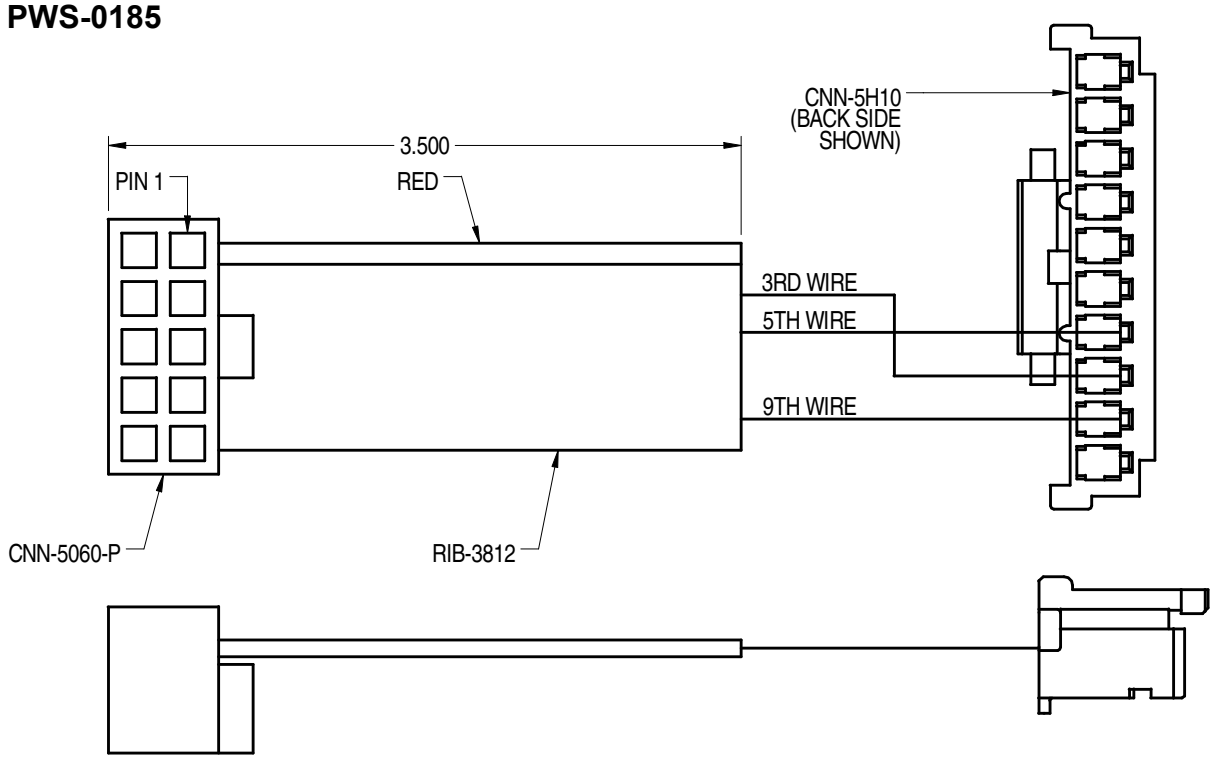
NOTES: 1. REMOVE CABLE SHEATH 1" FROM END OF WIRE BOTH SIDES
2. KEEP WHITE & GREEN WIRES TWISTED AS MUCH AS POSSIBLE

PWS-0139



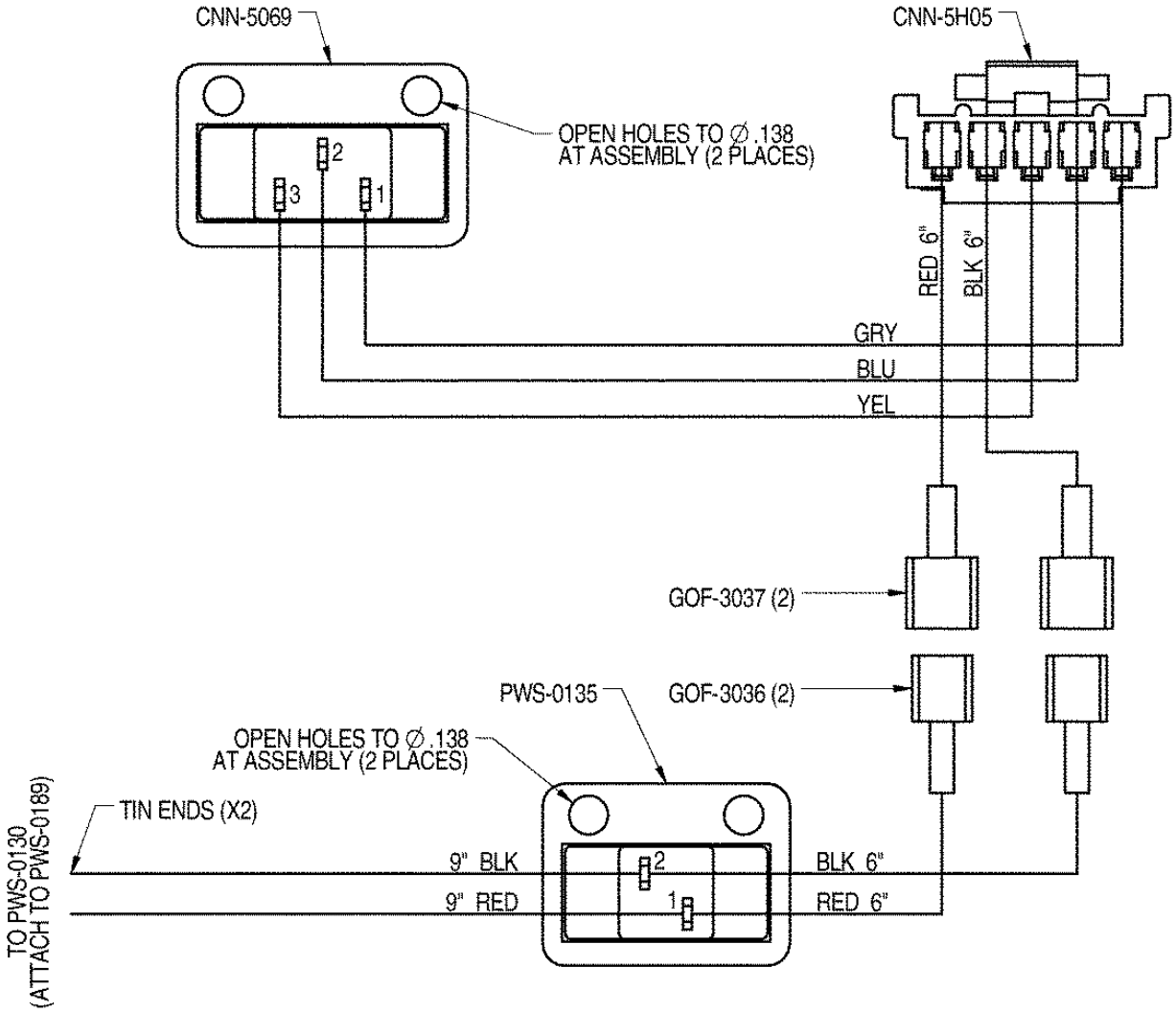
WIRING DIAGRAMS / CONTROL BOX / PWS-0130 / WIRING HARNESSES, CONT'D.

PWS-0185



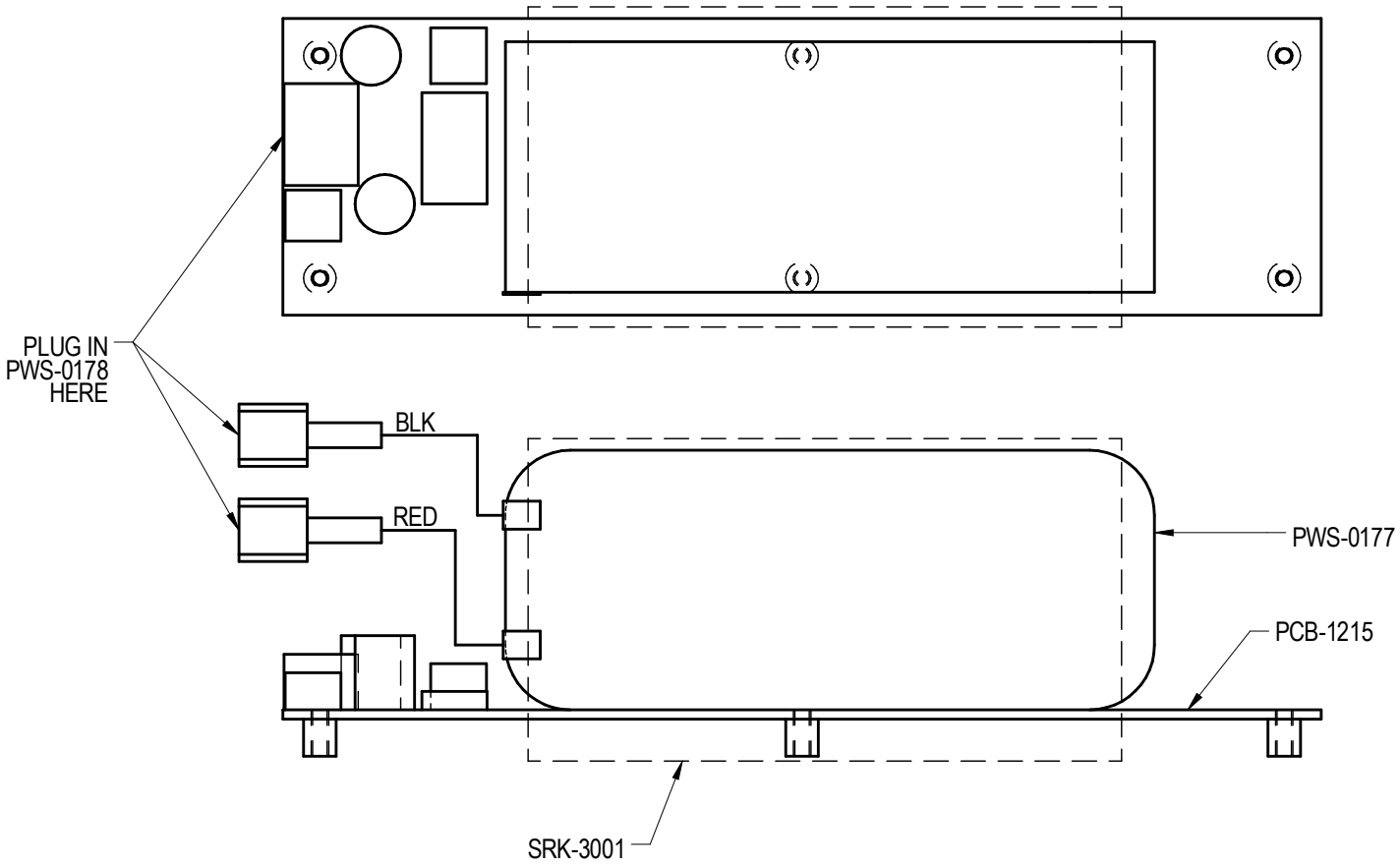
WIRING DIAGRAMS / CONTROL BOX / PWS-0130 / WIRING HARNESSES, CONT'D.

PWS-0161

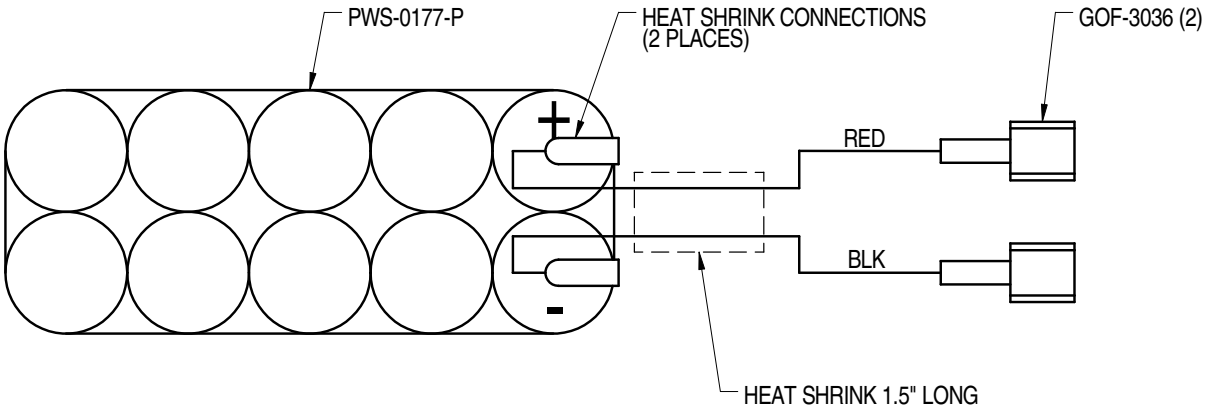


WIRING DIAGRAMS / CONTROL BOX / PWS-0130 / WIRING HARNESSES, CONT'D.

PWS-0176

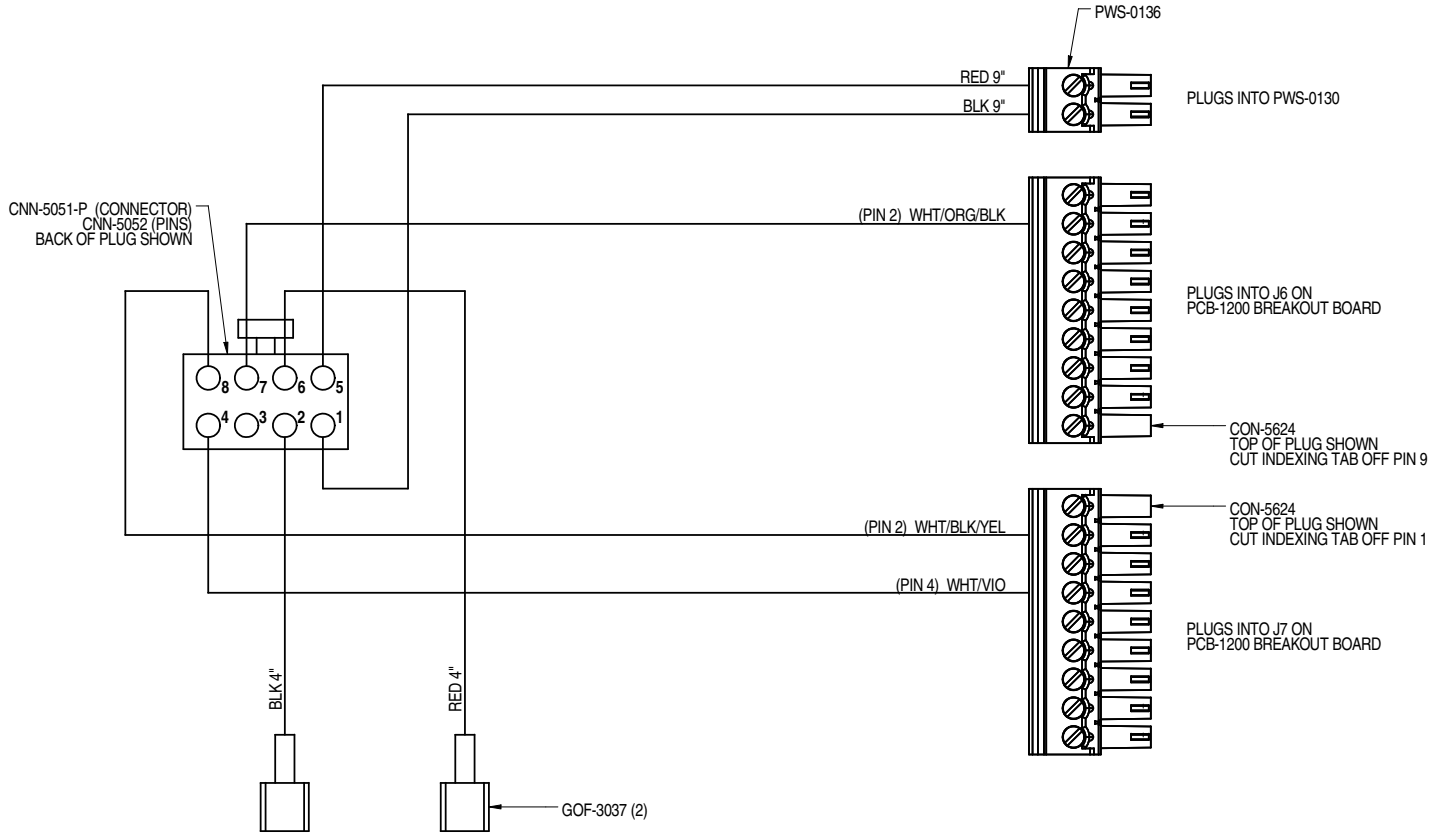


PWS-0177



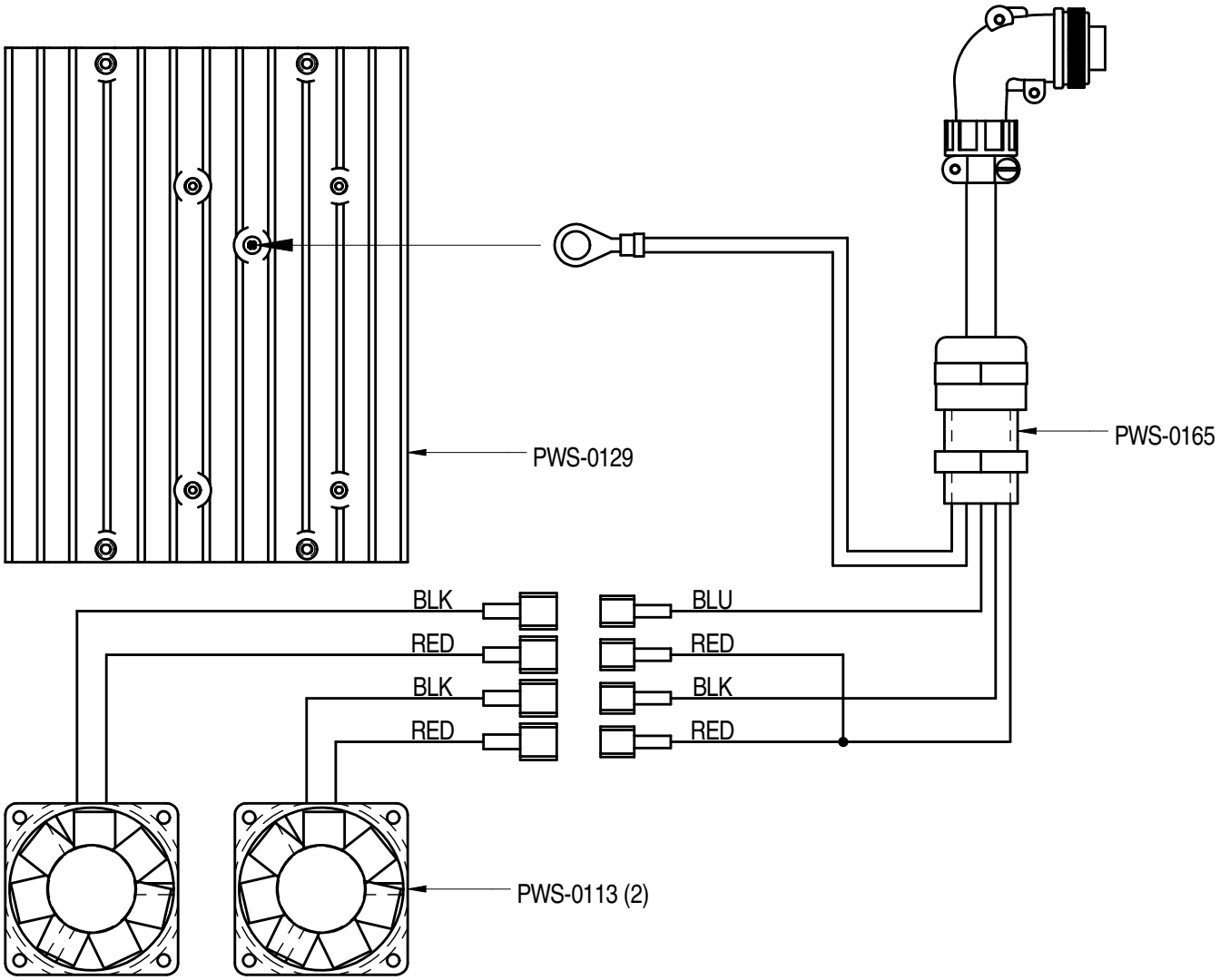
WIRING DIAGRAMS / CONTROL BOX / PWS-0130 / WIRING HARNESSES, CONT'D.

PWS-0178



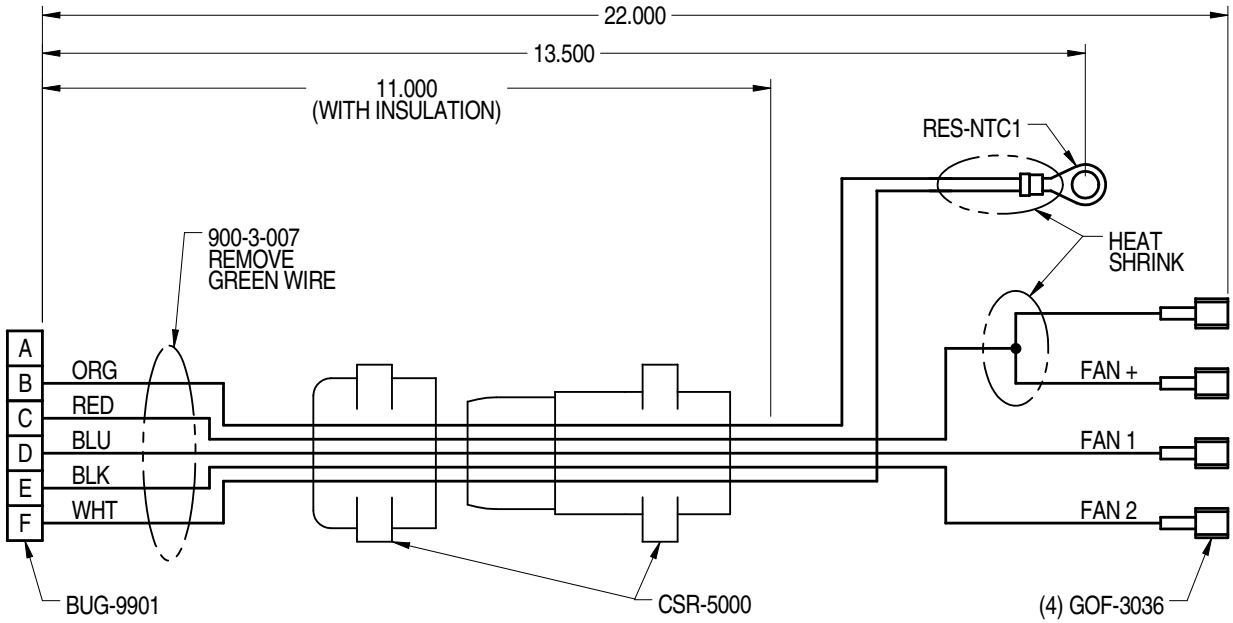
WIRING DIAGRAMS / CONTROL BOX / PWS-0130 / WIRING HARNESSES, CONT'D.

PWS-0120

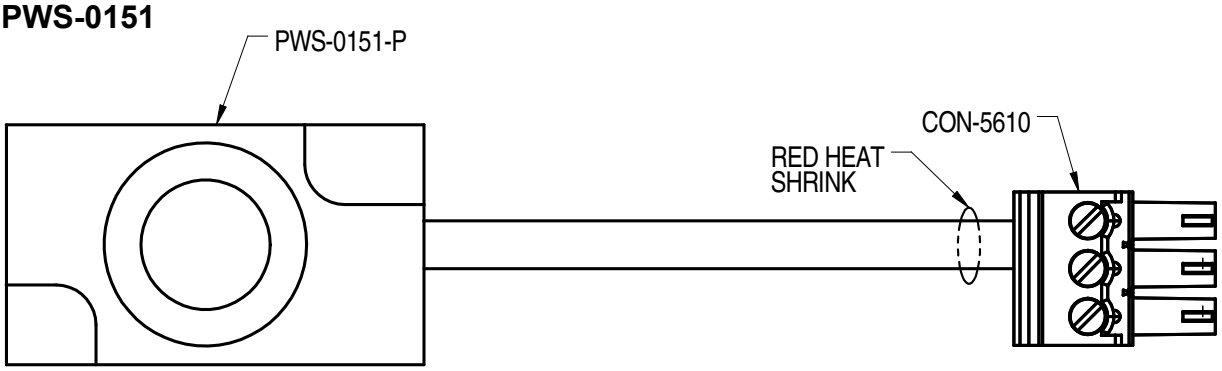


WIRING DIAGRAMS / CONTROL BOX / PWS-0130 / WIRING HARNESSES, CONT'D.

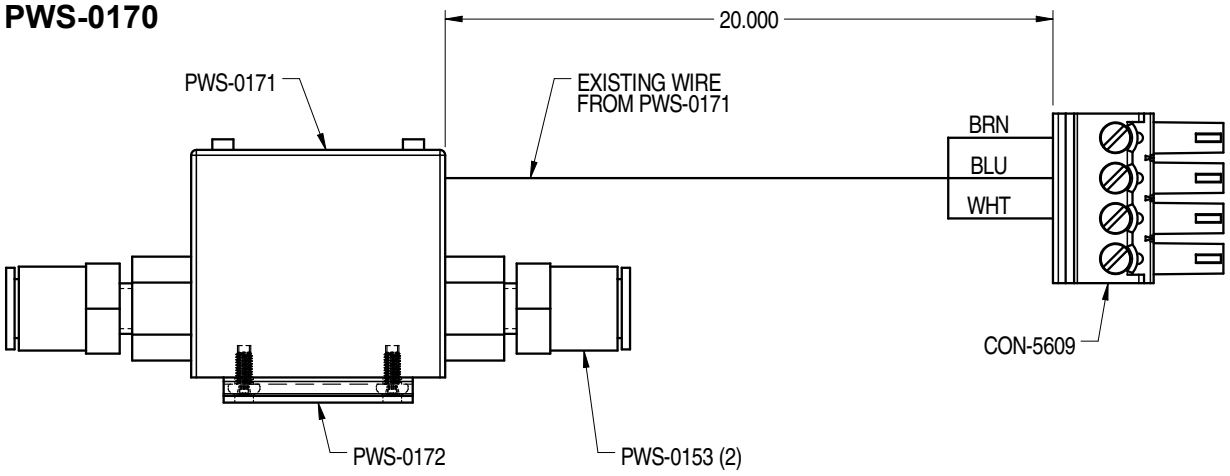
PWS-0165



PWS-0151



PWS-0170



WARRANTY

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.