

# BW2600

### **AUTOBOREWELDER**

### **BW2600 OPERATING MANUAL**



















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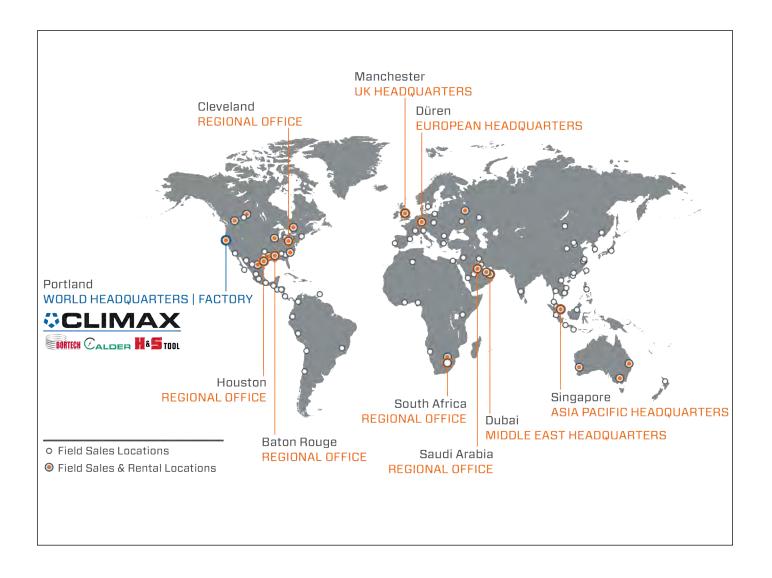
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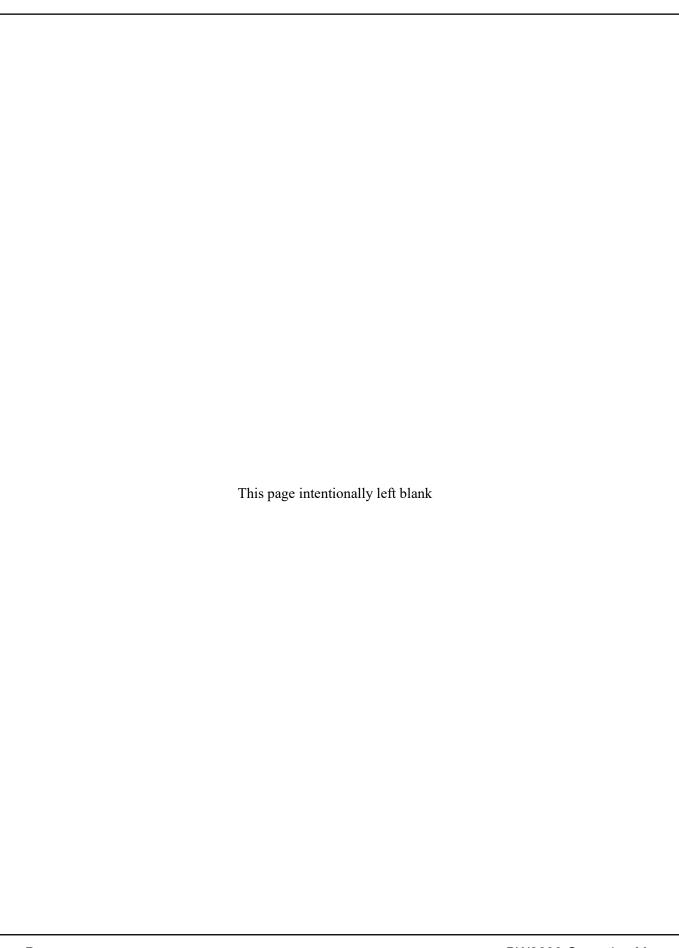
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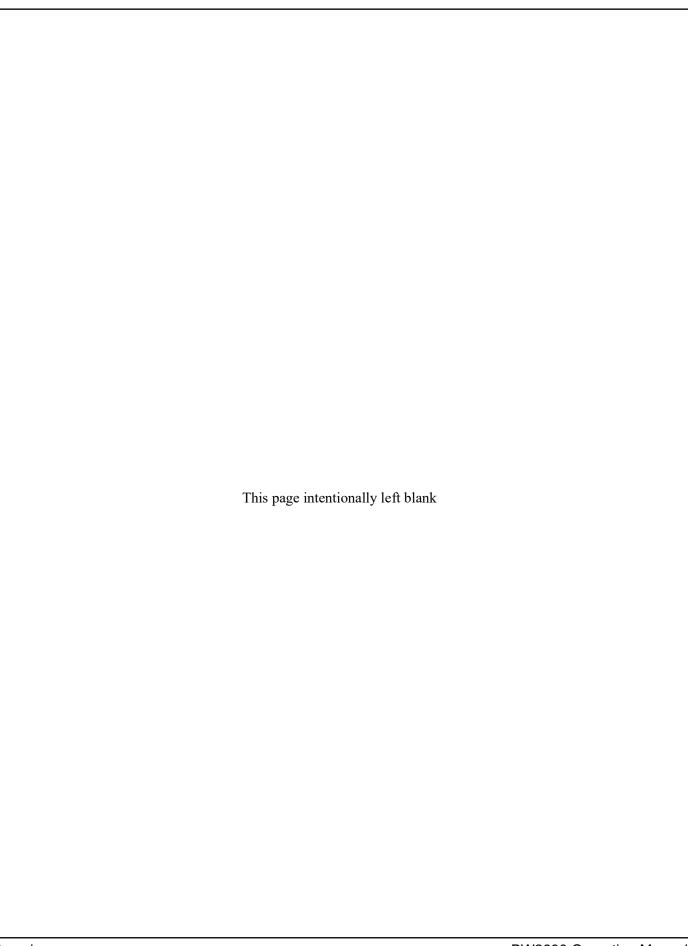
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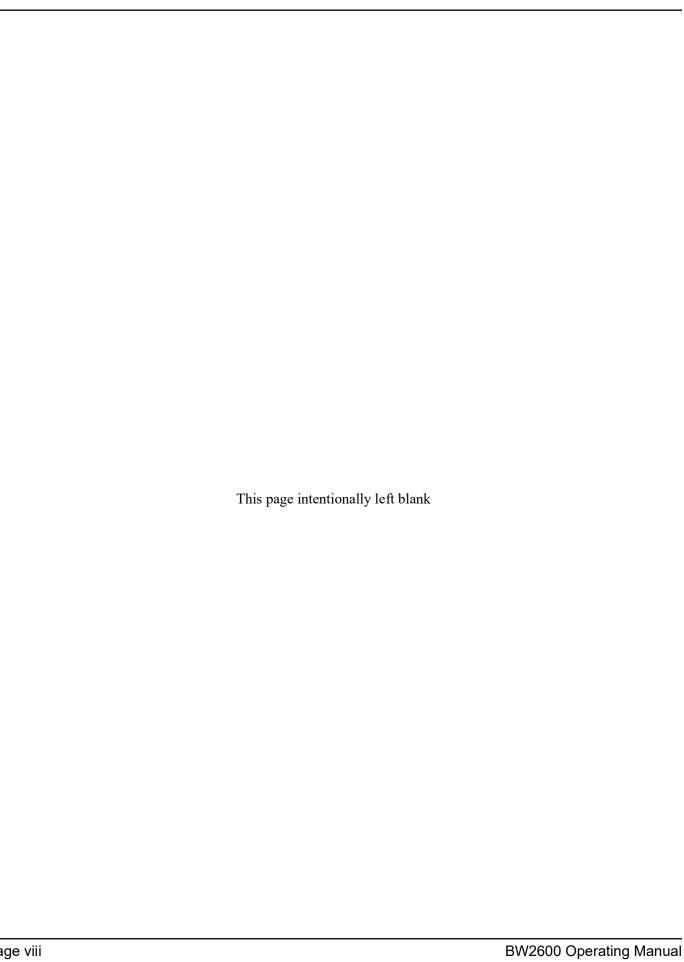
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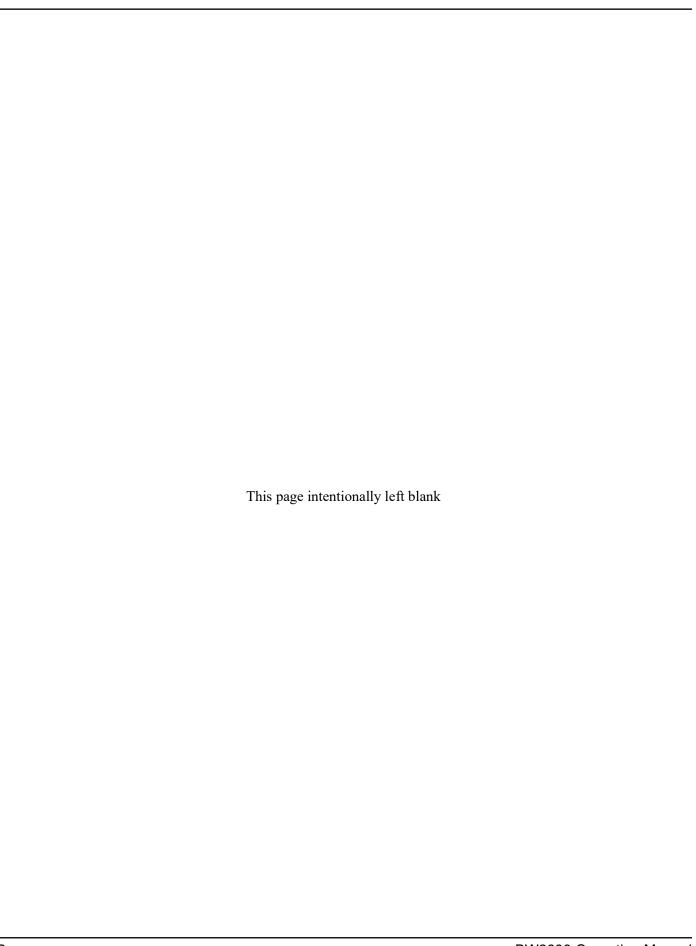
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## 1 INTRODUCTION

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#### 1.1 How to use this manual

This manual describes the setup, operation, maintenance, storage, shipping, and decommissioning of the BW2600 bore welding machine.

### NOTICE

For maximum safety and performance, read this entire manual before attempting to set up or operate the machine.

The first page of each chapter includes a list of the chapter contents to help you locate specific information.

The appendices contain supplemental product information to aid in setup, operation, and maintenance tasks.

#### 1.2 SAFETY ALERTS

Pay careful attention to the safety alerts in this manual. Safety alerts call your attention to dangerous situations that you may encounter when operating this machine. This manual uses the following types of safety alerts:<sup>1</sup>



indicates a dangerous situation that, if not avoided, **WILL** result in death or serious injury.

<sup>1.</sup> For more information on safety alerts, see ANSI/NEMA Z535.6-2011, Product safety Information in Product Manuals, Instructions, and Other Collateral Materials.



indicates a dangerous situation that, if not avoided, **COULD** result in death or serious injury.

### **A CAUTION**

indicates a dangerous situation that, if not avoided, could result in minor or moderate injury.

## NOTICE

indicates a dangerous situation that, if not avoided, could result in property damage, equipment failure, or undesirable work results.

#### 1.3 GENERAL SAFETY PRECAUTIONS

CLIMAX leads the way in promoting the safe use of portable machine tools. Safety is a joint effort. You must do your part by:

- Being aware of your work environment
- Closely following the operating procedures and safety precautions contained in this manual
- Closely following your employer's safety guidelines

When operating or working around the machine, observe the safety precautions below.

- **Training** Before operating this or any machine tool, you should receive instruction from a qualified trainer. Contact CLIMAX for machine-specific training information.
- **Risk assessment** Working with and around this machine poses risks to your safety. Conduct a risk assessment (Section 1.5 and Section 1.5 on page 4) of each job site before setting up and operating this machine.
- **Intended use** Use this machine in accordance with the instructions and precautions in this manual. Do not use this machine for any purpose other than its intended use as described in this manual.
- **Personal protective equipment –** Always wear appropriate personal protective gear when operating this or any other machine tool. Wear flame-resistant clothing with long sleeves and legs when operating the machine, as hot flying spatter from the workpiece may burn bare skin. This machine produces radiation in the visible and ultraviolet spectrum range called arc rays. Always wear welding PPE for eyes and exposed skin when observing or working around the machine during operation.



**Work area** – Keep the work area around the machine clear of clutter. Restrain cords and hoses connected to the machine. Keep other cords and hoses away from the work area.

**Danger zone** – The danger zone of this machine is inside the bore during welding operations. The main danger of this machine is from the arc flash, and is mainly visual in nature. All persons in the area of the machine need to have proper shielding from the radiation produced while welding.

**Moving parts –** Many CLIMAX machines have numerous exposed moving parts and interfaces that can cause severe impact, pinching, cutting, and other injuries.

During machine operation:

- Keep hands and tools away from moving parts.
- Wear proper PPE for welding and always maintain a clear working area to prevent tripping hazards.

**Hot surfaces** – During operation, torches and extensions will get hot enough to cause severe burns. Pay attention to hot-surface warning labels and avoid contact with bare skin until the machine has cooled.

#### 1.4 MACHINE-SPECIFIC SAFETY PRECAUTIONS

## NOTICE

If welding and boring operations are conducted simultaneously, take care when choosing the location and quality of the weld ground conductor. Poor electrical grounding may result in irreparable damage to the equipment.

**Hazardous environments –** Do not operate the machine in environments where explosive materials, toxic chemicals, or radiation may be present. Do not expose the machine to rain or wet conditions.

**Welding hazards –** This machine produces radiation in the visible and ultraviolet spectrum range. Always wear welding PPE for eyes and exposed skin when observing or working around the machine during operation. For more information on welding hazards and safety precautions, refer to ANSI 749.1, *Safety in Welding and Cutting*.

**Sound level –** This machine produces potentially harmful sound levels. Always wear hearing protection when operating the machine or working around it.

During testing, the machine produced the following sound levels.<sup>1</sup>

TABLE 1-1. SOUND LEVELS

The declared sound power level is:	59.7 dBA
The declared operator sound pressure level is:	58.0 dBA
The declared bystander sound pressure level is:	56.4 dBA

#### **Hoses, pendants, and electrical cables –** Follow these rules:

- Do not abuse the pendant cable as this can damage the cable and pendant.
- Never use the cord for carrying, pulling, or unplugging.
- Remove any and all kinks before straightening the cable.
- Keep cords and hoses away from heat, oil, sharp edges, and moving parts.
- Plugs must match the outlet. Never modify the plugs in any way. Do not use an adapter plug with grounded power tools.
- Always examine hoses and cables for damage before use.

**Adjustments and maintenance –** Stop the machine and lock out all power sources before performing any adjustment, lubrication, or maintenance.

**Controls** – The machine controls are designed to withstand the rigors of normal use.

The on/off switches are clearly visible and identifiable. When you leave the machine, disconnect all power sources to the machine.

#### 1.5 RISK ASSESSMENT AND HAZARD MITIGATION

Welding tools are specifically designed to perform precise metal-joining and overlay operations. Some welding tools are used in controlled environments such as factories and repair shops; however, portable welding tools are used in a wide variety of conditions. A portable welding tool typically attaches directly to the workpiece itself, or to an adjacent structure. The design intent is that the portable welding tool and the structure to which it is attached become one complete machine during the welding processes.

To achieve the intended results and to promote safety, the operator must understand and follow the design intent, setup, and operation practices that are unique to portable welding tools. Hazards include the potential for operator injury, as well as the potential for damage to the workpiece and to the welding equipment itself.

Precautions are required to avoid injury from burns, electric shock, vision damage, inhalation of poisonous gases and fumes, and exposure to intense ultraviolet radia-

<sup>1.</sup> Machine sound testing was conducted in accordance with European Harmonized Standards EN ISO 3744:2010 and EN 11201:2010.



tion. When welding is performed on motorized equipment, precaution is required to minimize the risk of fuel ignition or electrical damage to vehicle instrumentation. Power sources must be evaluated for proper voltage and current rating. To avoid damaging generators, weld power supplies, and welding equipment, power cabling must be maintained and replaced as required.

The operator must perform an overall review and on-site risk assessment of the intended application. Due to the unique nature of welding tool applications, identifying one or more hazards that must be addressed is typical. When performing the on-site risk assessment, it is important to consider the portable welding tool and the workpiece as a whole.

#### 1.6 RISK ASSESSMENT CHECKLIST

The following checklist is not intended to be an all inclusive list of things to watch out for when setting up and operating this Portable Machine Tool. However these checklists are typical of the types of risks the assembler and operator should be considering. Use these checklists as part of your risk assessment:

TABLE 1-2. RISK ASSESSMENT CHECKLIST BEFORE SET-UP

Before Set-up
I took note of all the warning labels on the machine.
I removed or mitigated all identified risks (such as tripping, entanglement, or falling objects).
I considered the need for personnel safety including shielding from arc rays.
I read the Machine Assembly instructions (Section 3).
I took inventory of all the items required but not supplied (Section 2.4).
I considered how this machine operates and identified the best placement for the controls, cabling, and the operator.
I have assessed for additional risks unique to this application of the Portable Welding tool.

TABLE 1-3. RISK ASSESSMENT CHECKLIST AFTER SET-UP

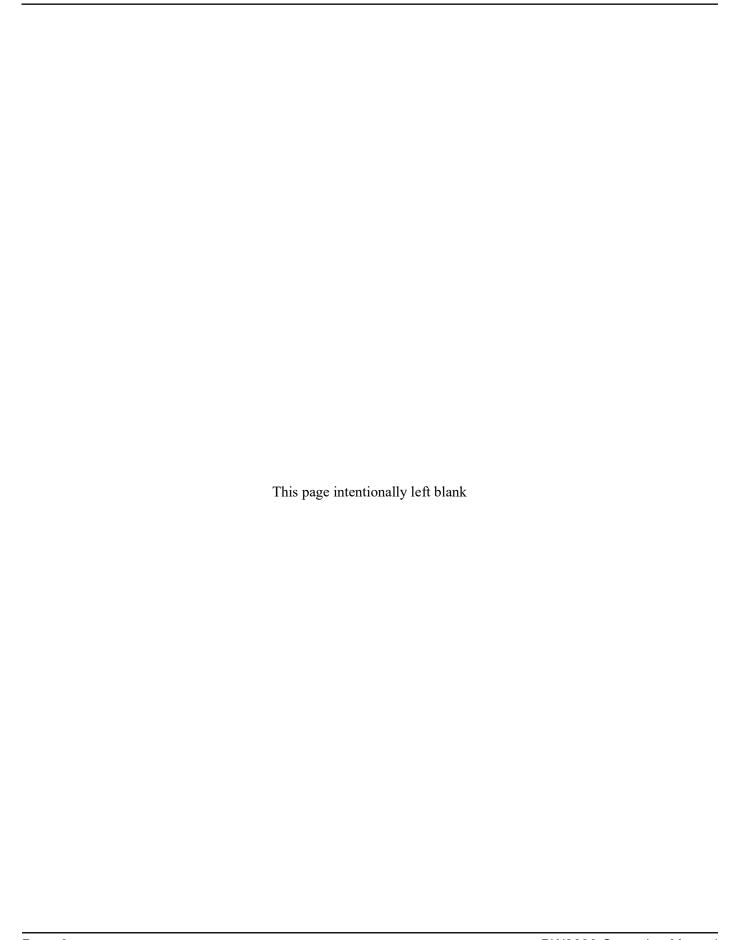
After Set-up
I checked that the machine is safely installed (according to Section 3) and the potential fall path is clear. If the machine is installed at an elevated position, I checked that the machine is safeguarded against falling.
I planned for containment of any weld spatter produced by the machine.
I followed the required Maintenance Intervals (Section 5.2).
I checked that all affected personnel have the recommended personal protective equipment, as well as any equipment required by the site or other regulations.
I checked that all affected personnel understand the danger zone and are clear of it or UV guarding is present.
I examined the area surrounding the workpiece for flammable materials and removed them if possible. I have an appropriate fire extinguisher nearby.
I have a fire extinguisher nearby.
I have assessed for additional risks unique to this application of the Portable Machine tool.

### 1.7 LABELS

Table 1-4 shows the labels that should be on your machine. If any are defaced or missing, contact CLIMAX immediately for replacements.

TABLE 1-4. LABELS

I ABLE 1-4. LABELS			
Partanti MacAring & Wester & Control of the Control	P/N 29154 Serial number plate	CAUTION  TO AVOID ELECTRIC SHOCK THE POWER CORD. PROTECTIVE GROUNDING CONDUCTOR MUST BE CONNECTED TO GROUND. NO OPERATOR SERVICABLE PARTS INSUITO. DO NO HERVOYE COVERS. REFER SERVICING TO QUALIFED PERSONAL	P/N 37576 Warning label: electrical shock danger
	P/N 46902 Warning label: hot surface	The state of the s	P/N 59044 Read the owner's manual
WARNING  INCLUDED THE LIAB. PRINCE DESIGN OF DROPE  AND	P/N 63504 Warning label: fumes and gases, electric shock, arc rays, and fire		P/N 86036  Warning label: hand crush danger, and a pinch point with moving parts; keep your hands clear
BORTECH AUTO BORE WELDER MODEL BW2600 CHRISSORIDIA COR	P/N 86158 BW2600 label	PN 106481	P/N 106481 Run position label
.06 = = 0 .18 = = 4 in mm	P/N 90627 Step indicator label		





## **2 OVERVIEW**

#### IN THIS CHAPTER:

2.1 FEATURES AND COMPONENTS
2.1.1 FEATURES
2.1.2 STOCK COMPONENTS
2.1 ACCESSORIES
2.2 Controls
2.3 MACHINE SPECIFICATIONS
2.4 ITEMS REQUIRED BUT NOT SUPPLIED

Bore welders are highly configurable with many options and accessories. This manual covers the use and operation of all standalone options. The machine configuration purchased may not contain all of the options and accessories in this manual. If a specific machine application requires additional options or accessories, please contact CLIMAX for assistance.

#### 2.1 FEATURES AND COMPONENTS

The BW2600 is a feature-rich bore welder based on the BW1000 architecture and provides some BW3000 features. The BW2600 can weld bores between the range of 0.87–12" (22–305 mm) with the full range of torches.

The BW2600 provides circular and axial motion required to accomplish continuous bore buildup. This bore welding machine is equipped with a mechanically-actuated, infinitely-variable axial step feed and variable rotation speed. The BW2600 power swivel coupling allows for the passage of weld current, shielding gas, and welding wire.

The control for rotation speed is on the rear control panel, and the axial feed knob is on the side of the machine (see Figure 2-1 on page 10 and Figure 2-2 on page 11).

Principle features include:

- Skip or fill (described in page 11)
- Variable mechanical step (described on page 11)
- Feed engage/disengage (described on page 12)
- Wire feed control (also known as trigger control; described on page 13)
- Reversible rotation (described on page 13)
- Axial adjustment (described on page 11)



FIGURE 2-1. BW2600 CONTROLS AND COMPONENTS

TABLEAU 2-1. CONTROL AND COMPONENT IDENTIFICATION

Number	Component
1	Axial feed knob
2	Drag brake adjustment
3	Axial feed engagement lever
4	Axial feed lever position label
5	Step amount indicator
6	Step adjustment knob



#### 2.1.1 Features

#### Skip or fill

This feature allows automated SKIP or FILL welding up to 180° within any radial location in the bore.

### **NOTICE**

Wire feeders with burnback control are necessary to use this feature.

TABLE 2-2. SKIP OR FILL CONTROL IDENTIFI-CATION

Number	Component
1	Skip on/off
2	Fill or skip selector
3	Weld stop/start

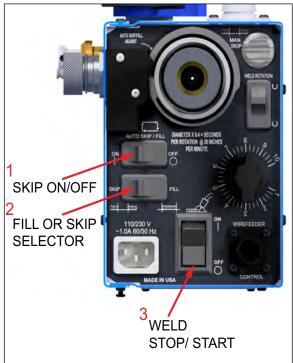


FIGURE 2-2. BW2600 SKIP OR FILL CONTROLS

The SKIP feature de-energizes

the welding where the cam detent is set by the operator, typically when avoiding key ways.

The FILL feature provides welding in the cam detent opening. It is typically used for buildup in worn areas.

See Section 4.6 on page 59 for how to set the detent for the SKIP or FILL feature.

#### Variable mechanical step

Variable mechanical step: an infinitely variable mechanical step ranging 0.05–0.175" (1.27–4.5 mm).

The amount of step may be varied according to the size of the weld bead. The step adjustment knob adjusts the step size, as shown in Figure 2-1.

The approximate step size is shown by the step amount indicator. Manually rotate the spindle until the indicator reaches the highest value, then turn the step adjustment knob (clockwise to reduce the feed rate, or counter-clockwise to increase the feed amount).

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#### Feed engage/disengage

The BW2600 only feeds by retracting the spindle.

Rotating the axial feed engagement lever clockwise disengages the feed and allows free movement of the spindle.

Rotating the axial feed engagement lever counter-clockwise engages the feed.

### **NOTICE**

The step indicator (see Figure 2-3) also shows the start and the peak of each feed actuation. The feed is at its peak when the indicator shows zero. The



FIGURE 2-3. STEP AMOUNT INDICATOR

feed is just starting when it begins to move from its maximum indication.

#### Axial adjustment of the spindle

The axial feed knob provides fine control of axial placement of the spindle at any time when the feed is engaged or disengaged.

#### Feed drag brake adjustment

The drag brake has been factory adjusted. It prevents the spindle from re-extending when the BW2600 is mounted in the vertical position with the torch down. It also prevents the spindle from over-traveling when the machine is oriented vertically with the torch up. Take these actions to restore the proper drag brake setting:

If the feed is intermittent or less than the step indicator amount, loosen the drag brake slightly until the feed matches the step indicator amount.

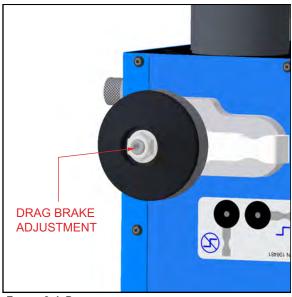


FIGURE 2-4. DRAG BRAKE ADJUSTMENT



If the spindle re-extends between each feed step (torch down) then gradually tighten the drag brake adjustment until re-extending stops.

If the spindle over feeds with the torch up, then gradually tighten the drag brake adjustment until re-extending stops.

#### Reversible rotation

The reversible rotation direction easily allows for simplified, higher-quality multiple pass buildup when the bore welder is in the horizontal axis. See the rotation direction selector in Figure 2-5.

TABLE 2-3. CONTROL FEATURE IDENTIFICATION

Number	Component
1	Arc interrupt
2	Rotation direction selector
3	Rotation speed knob
4	Wire feed contactor control port
5	Power input
6	Remote operator pendant port

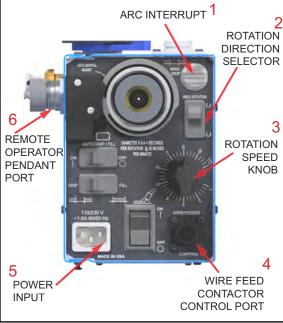


FIGURE 2-5. BW2600 CONTROL FEATURES

#### Interface with customer's existing MIG wire feed system

CLIMAX manufactures many interface kits for use with worldwide suppliers of MIG welding units. The customer's wire feed system connects to the BW2600 at the wire feed contactor control port, as seen in Figure 2-5.

#### Wire feed control

The wire feed contactor control port (shown in Figure 2-5) initiates the welding process via the wire feed control cable when the weld switch is turned on.

### NOTICE

Power does not need to be applied to the machine for the wire feeder to be activated. The weld on/off switch will close the contactor, providing weld current, whether AC mains are connected or not.

#### 2.1.2 Stock components

#### Conduit assembly

The conduit assembly provides passage of welding current, welding wire, and shielding gas to the BW2600. It includes a wire feed control cable for actuation of the trigger circuit contactor.

Compatible conduits for the BW2600 include the following:

- Conduit & Switch Assembly – Euro Connection (P/N 85435)
- Conduit & Switch Assembly – Miller (P/N 85476)
- Conduit & Switch Assembly Tweco (P/N 85534)
- Conduit & Switch Assembly Lincoln (P/N 85536)
- Conduit & Switch Assembly Lincoln PowerMig (P/N 85527)
- Conduit & Switch Assembly Lincoln Tweco Style with 5-pin Amphenol (P/N 86046)



FIGURE 2-6. CONDUIT ASSEMBLY (MILLER EXAMPLE SHOWN)

## 2 BW2600 RADIAL MOUNT (P/N 85771)



FIGURE 2-7. BW2600 RADIAL MOUNT

The radial mount was designed for use between the mounting rod and the bore welder, extending the distance between them to 3.98" (101 mm). This mount is the correct distance for most boring bar interfaces designed for the BW3000.

The BW2600 is a center-mount system, enabling infinite rotational placement of the bore welder for clearance in tight spaces. The BW2600 radial mount also provides the means to use the adjustable base and the BW3000 radial mounts.



#### Swivel head assembly (P/N 35603)

Designed for use with multiple torch heads, this ball-and-seat device performs the following functions:

- Provides a fine diameter adjustment for torches
- Acts as a conductive path for weld current
- Passage for shielding gas
- Passage for welding wire

Angle changes of the 7/16–20 stem of up to 10 degrees off-center may be accommodated.

The swivel head has a locking nut on the brass stem that can be loosened to remove the torch.

Upon re-installation, the torch nozzle should point in the direction of the arc that the brass stem prescribes (that is, the swivel travel).

TABLE 2-4. SWIVEL AND TORCH IDENTIFICATION

Number	Component
1	Swivel assembly
2	Jam nut
3	Torch

## JAM NUT 2 SWIVEL **ASSEMBLY TORCH**

FIGURE 2-9. SWIVEL ASSEMBLY AND TORCH

FIGURE 2-8. SWIVEL HEAD ASSEMBLY

#### Standard torch sizes

Torch sizes #1 and #2 are standard equipment.



FIGURE 2-10. TORCH SIZES #1 AND #2

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#### Extension assemblies

The extension assemblies facilitate remote placement of the swivel head and torches for extended reach in the following positions:

- 3" (76 mm) with P/N 29038
- 6" (152 mm) with P/N 29039
- 12" (305 mm) with P/N 29040

#### Mounting rod (P/N 30773)

Use the mounting rod to mount the BW2600 to the adjustable base or boring bar interface.

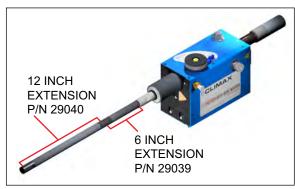


FIGURE 2-11. 12" AND 6" EXTENSIONS



FIGURE 2-12. DETAIL OF MOUNTING ROD P/N 30773

#### Carrying case (P/N 85731)

The carrying case is provided for the protection and storage of the bore welder.

#### Quick change torch

Torches may be changed easily with the torch connection system, allowing for fast changes between torch sizes. The torch extensions have a captive liner for rapid setup without impeding liner installation.

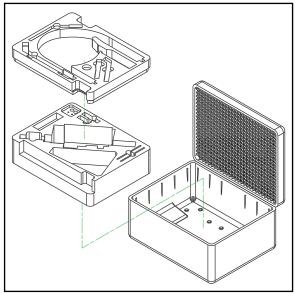


FIGURE 2-13. DETAIL OF BW2600 CARRYING CASE



#### 2.1 ACCESSORIES

Accessories are not included with the basic BW2600 but are available for purchase. Contact CLIMAX for more information.

## Torch assemblies #00 and #0 (P/N 39725 and P/N 39726)

When welding holes with a diameter smaller than 2.7" (68.6 mm), use torch assemblies #00 and #0.

The base model BW2600 ships with torch sizes #1 and #2 (for holes 2.7–12" [68.6–305 mm]).



FIGURE 2-14. TORCH SIZES #00 AND #0

## Standard torch adapter kit (P/N 36750)

The standard torch adapter (shown in Figure 2-15) is for the #00 torch (P/N 29063) and the #0 torch (P/N 28448), enabling bore-welding range capability down to 0.87" (22 mm) diameter.



FIGURE 2-15. STANDARD TORCH ADAPTER KIT (SHOWN WITH SWIVEL INSTALLED)

## Remote operator pendant (P/N 85341)

The remote operator pendant allows for control of the BW2600 while in close proximity to the weld process.

The pendant allows the operator to control a limited number of bore welder functions. See Section 2.2 on page 21 for information about the remote operator pendant controls.



FIGURE 2-16. REMOTE OPERATOR PENDANT

#### Face torch

There are two face torches: compact and standard.

The compact face torch (P/N 48013) is used when the bore welder is interfacing with the BB5000 Boring Bar. A minimum of 6" (152 mm) swing in 6" (152 mm) axial clearance is necessary to use the compact face torch.



FIGURE 2-17. COMPACT FACE TORCH (P/N 48013)



The standard face torch (P/N 28186) is used with the adjustable base.

Both face torches have a range of 1–20" (25–508 mm).



FIGURE 2-18. STANDARD FACE TORCH (P/N 28186)

#### Adjustable base (P/N 29037)

The adjustable base provides support, leveling, and centering adjustments for the BW2600. This is generally required when a boring bar interface is not available.

The nonmagnetic base provides safe attachment and can be used on a variety of uneven surfaces.

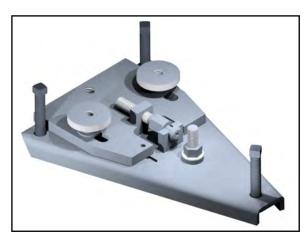


FIGURE 2-19. BW2600 ADJUSTABLE BASE



#### BW3000 radial mounts (P/N 23208, 35006)

The BW3000 5" and 10" (127 and 254 mm) radial mounts (shown in Figure 2-20) are used in conjunction with the adjustable base option only. They provide support, articulation, and add distance from the mounting rod to the bore welder spindle for larger jobs. It is commonly used with the standard face torch, trammel torch, and adjustable base.



FIGURE 2-20. BW2600 RADIAL MOUNT

#### Mounting rod extender (P/N 67090)

The mounting rod extender (shown in Figure 2-21) increases the distance between the bore welder and the work piece by 9" (229 mm). It is commonly used with the standard face torch, trammel torch, and adjustable base. It would not be used with the boring bar interface.

#### 18-inch extension (P/N 29065)

Extensions allow the torch and swivel mechanism to be installed farther away from the BW2600, providing greater reach. When reaching over 39" (991 mm), consider the use of the torch extension support kit (P/N 40877).



FIGURE 2-21. MOUNTING ROD EXTENDER

#### Torch extension support kit (P/N *40877*)

The torch extension support kit is used for extensions that need more rigidity and an extension reach greater than 36" (914 mm). For more detail, see Section 3.4.3 on page 49.



FIGURE 2-22. BW2600 TORCH EXTENSION SUPPORT



## 2.2 CONTROLS

SKIP FILL

DIAMETER X 9.4 = SECONDS

SKIP / FILL

PER ROTATION

ON

ON

OFF

OFF

ON

WELD ROTATION

WELD ROTATION

WELD ROTATION

ON

ON

OFF

OFF

OFF

ON

WIREFEEDER

CONTROL

This section explains control locations and functions.

FIGURE 2-23. BW2600 FRONT PANEL CONTROLS

TABLE 2-5. BW2600 FRONT PANEL CONTROLS

Item	Control	Action	Purpose	Notes
1	Main On/Off	Starts rotation and trig- gers the wire feeder system.	Starts and stops the bore welding process.	Contactor control with power switch is still operative when the AC mains are not connected.
2	Wirefeeder Control Port	Provides a connection point for dry contacts, controlling the wire feeder.	Necessary to provide synchronized "trigger" control to the feeder system.	Always check that the Main On/ Off switch is off before connecting the wire feeder (must be burn- back-enabled).
3	Rotation Speed Dial	Adjusts the spindle rotation speed.	Varies travel speed for different bore sizes and applications.	See Section 4.4.1 on page 53 for setting and checking rotation speed. Disabled when pendant is connected.

TABLE 2-5. BW2600 FRONT PANEL CONTROLS

Item	Control	Action	Purpose	Notes
4	Weld Rotation	Controls the rotation direction.	Used for horizontal axis, multi-pass welding.	Never reverse direction while the machine is rotating.
5	Manual Skip	When in weld mode, this button stops the wire feed while spindle rotation continues.	Allows manual skip of small grease holes and cross-pin holes; aids during uneven stop-start sections.	Disabled when the pendant is connected.
6	6   Correct   to skip or fill, anywhere   (fill) or outside the cam detent   provide mechanical s	The BW2600 must rotate fully to provide mechanical step, or else skip/fill is not applicable.		
7	Skip/Fill On/ Off	Enables or disables skip and fill function.	Disables the switch from reading the cams.	Useful for situations where cams are preset, but the operator needs to disable or enable during welding.
8	Skip/Fill Switch	Selects Skip or Fill.	Designates no weld (Skip) or weld-only area (Fill).	Fill is for correcting moderately oblong bores.  Skip is for skipping a key way or split line.
9	AC Mains Receptacle	AC power inlet for the BW2600. 110/230 VAC 1 amp, 50/60 Hz.	To power the motor drive and circuitry of the BW2600.	NA



FIGURE 2-24. REMOTE PENDANT CONTROLLER

TABLE 2-6. REMOTE PENDANT CONTROLS

Item	Control	Action	Purpose	Notes
10	Rotation Jog / Man- ual Skip	When <u>not</u> in weld mode: provides Rotation Jog control.  When <u>in</u> weld mode: stops the wire feed while spindle rotation continues.	Rotation Jog helps verify centering during setup. Manual Skip allows manual skip of small grease holes and cross-pin holes, or aids during uneven stop-start sections.	To use the pendant, turn on the panel Main On/Off switch.
11	Rotation Speed	Adjusts the rotation speed of the BW2600 spindle.	Varies the travel speed for different bore sizes and applications.	When using the pendant, the panel Rotation Speed control is locked out.



TABLE 2-6. REMOTE PENDANT CONTROLS (CONTINUED)

Item	Control	Action	Purpose	Notes
12	Weld Start	Starts rotation and triggers the wire feeder system to weld.	Starts the bore welding process.	To use the pendant, turn on the panel Main On/Off switch.
13	Weld Stop	Stops rotation and the wire feeder system.	Stops the bore welding process.	After removing the remote control, you must cycle the Main On/Off switch to restore control to the machine panel.

# 2.3 MACHINE SPECIFICATIONS

Figure 2-25 shows the bore welder dimensions in inches.

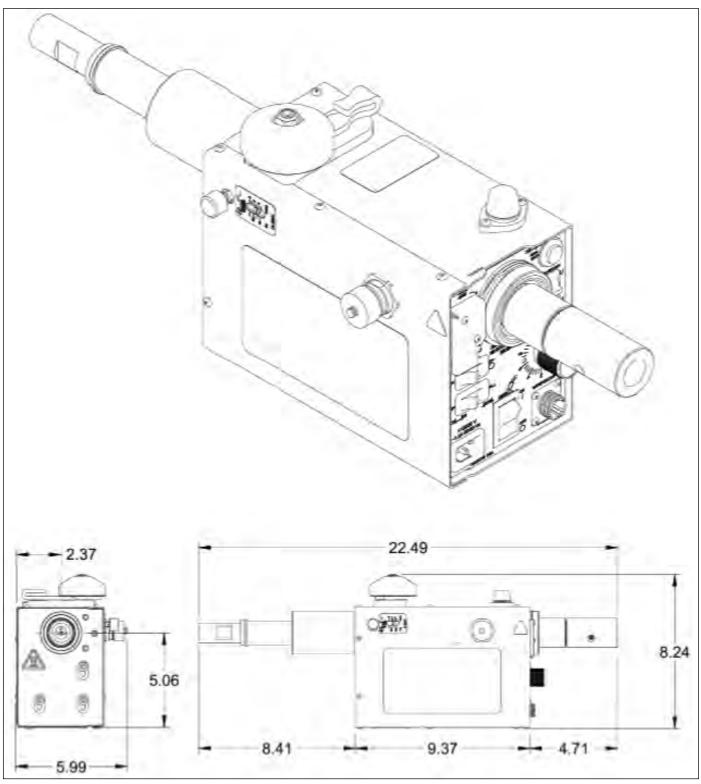


FIGURE 2-25. BW2600 DIMENSIONS



Machine specifications for the BW2600 are listed in Table 2-7.

TABLE 2-7. BW2600 SPECIFICATIONS

Welding process:	metal inert gas (MIG)
Wire diameter range:	0.030-0.045" (0.8-1.2 mm)
Unsupported torch extension:	36" (914 mm)
Stroke length:	9" (229 mm)
Mechanical step range:	0.05–0.175" (1.3–4.45 mm) per revolution
Maximum continuous welding current:	175 amps
BW2600 power:	120v or 220v 50/60Hz VAC
Contactor control:	provided via on-board relays and remote operator pendant
Typical voltage operating range (short arc/.035 wire):	17–19 volts
Component weight:	17 lbs (7.7 kg)

Table 2-8 shows buildup diameter ranges at 20 in/min 0.88–10" (22.35–254 mm).

TABLE 2-8. BUILDUP DIAMETERS PER SWIVEL HEAD

Swivel head	Part number	Size	Notes
Head # 1 Swivel	39725	2.7-8.2" (68.6-208.3 mm)	Included as stock
Head # 2 Swivel	39726	8–12" (203–305 mm)	BW2600 torches

Table 2-9 shows optional torch size diameter ranges at 20 in/min 0.88-24" (22–610 mm).

TABLE 2-9. OPTIONAL TORCH DIAMETER RANGES

Torch type	Part number	Diameter	Notes
#00 Torch	29063	0.88–1.8" (22–46 mm)	Included in the small bore kit
#0 Torch	28448	1.7–3" (46–76 mm)	
#1 Torch	29064	2.75–5.5" (70–139 mm)	
#2 Torch	29032	4.5–7.5" (114.3–190.5 mm)	
#3 Torch	29033	6–9" (152–228 mm)	
#4 Torch	29034	8–11" (203.2–279.4 mm)	
#5 Torch	29035	10–13" (254–330 mm)	BW2600 is only rated to 12" max diameter bore

## 2.4 ITEMS REQUIRED BUT NOT SUPPLIED

The following items are required but not supplied in your CLIMAX product kit:

- Wire feeder with burnback control
- Welding power supply with 200-ampere minimum and 100% duty cycle
- Welding wire
- Standard hand tools
- Watch or clock with seconds display
- Shielding gas
- Regulator
- Negative welding lead
- Personal protective equipment
- Diagonal cutters

CLIMAX offers a wire feeder for purchase. Contact CLIMAX for more information.

# 3 SETUP

IN THIS CHAPTER:

This chapter explains how to set up the machine for operation.

#### 3.1 Preparing the machine for use

#### 3.1.1 Inspecting the machine

Your CLIMAX product was inspected and tested prior to shipment, and packaged for normal shipment conditions. CLIMAX does not guarantee the condition of your machine upon delivery.

When you receive your CLIMAX product, perform the following receipt checks:

- 1. Inspect the shipping containers for damage.
- 2. Check the contents of the shipping containers against the included invoice to make sure that all components have been shipped.
- 3. Inspect all components for damage.

Contact CLIMAX immediately to report damaged or missing components.

# NOTICE

Keep the shipping container and all packing materials for future storage and shipping of the machine.

The machine ships from CLIMAX with heavy coating of LPS 3. The recommended cleaner is LPS PreSolve Orange Degreaser. All parts must be cleaned before use.

### 3.1.2 Assessing the work area

The BW2600 often is used in dangerous locations (in elevated positions, near other operating equipment, overhead, etc.). CLIMAX cannot foresee where this machine will be used; therefore, you must perform a site-specific risk assessment (Section 1.5 on page 4 and Section 1.6 on page 6) for each job before starting work.

The BW2600 machine has an optional remote operator pendant that enables you to choose the optimum location to work from (Section 1.6 on page 6).



Always follow safe work practices, including site-specific safety requirements. It is your responsibility to perform a risk assessment before you set up the machine and each time before you operate the machine.

### 3.2 LIFTING AND RIGGING

There are no special rigging and lifting instructions for the BW2600.



Use caution and follow all site procedures such as a lift plan, never allowing anyone under the load, etc. Falling or uncontrolled swinging of machinery can cause serious injury or death to the operator and bystanders.

#### 3.3 Installing the Bore Welder

This section outlines the steps needed to get the BW2600 set up and ready to weld.

The bore welder may be used in any position with the boring bar interface or the adjustable base.

If using a boring bar interface, start with the installation procedure in Section 3.3.1.

If using an adjustable base, start with the installation procedure in Section 3.3.2 on page 38.

Whether using a boring bar interface or the adjustable base, both installation procedures conclude with Section 3.3.3 on page 43.



The procedure for vertical bore welding is similar to the horizontal bore welding installation, with the addition of a locking collar to prevent the bore welder from slipping on the mounting rod.

## 3.3.1 Mounting to a boring bar

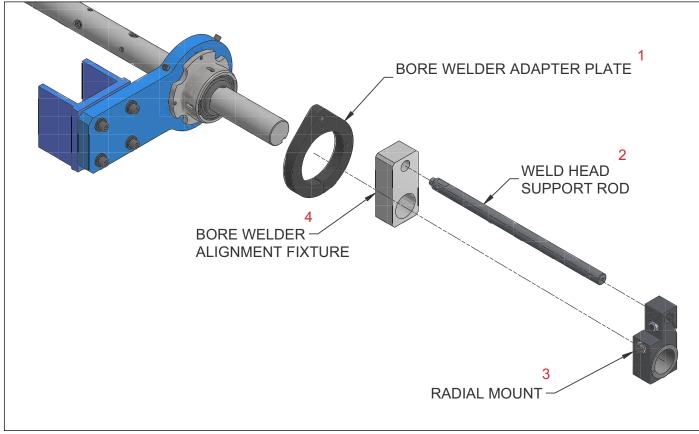


FIGURE 3-1. DETAIL OF INSTALLING THE BORING BAR ADAPTER KIT

**TABLEAU 3-1. ADAPTER KIT IDENTIFICATION** 

Number	Component	
1	Borewelder adapter plate	
2	Weld head support rod	
3	Radial mount	
4	Borewelder alignment fixture	

Do the following to install the boring bar adapter kit:

1. Screw the mounting rod into the bore welder adapter plate and torque to a minimum of 10 ft-lbs (13 Nm).

- 2. Turn the two set screws at 3 o'clock and 9 o'clock until they protrude by 0.25" (6.4 mm) from the bearing side of the adapter plate (see Figure 3-2).
- 3. Slide the bore welder adapter plate over the external spherical mount on the bar with the mounting rod at 12 o'clock.



FIGURE 3-2. SET SCREWS IN ADAPTER PLATE

- 4. Slide the alignment tool over the mounting rod and the boring bar (see Figure 3-3).
- 5. Align the mounting rod to the boring bar by sliding the alignment tool back and forth, then tighten the interface plate clamp screw enough to prevent movement.



FIGURE 3-3. ALIGNMENT TOOL OVER THE MOUNTING ROD

## **NOTICE**

Completing the tightening of the bore welder adapter plate before the bearing is removed will bind the bearing in the housing, preventing removal.

- 6. Remove the alignment tool.
- 7. Remove the boring bar.
- 8. Remove the cartridge bearing with the bearing removal tool.
- 9. Complete the final tightening on the bore welder adapter plate clamp.



10. Extend the two set screws (used in step 2) until they touch the bearing mount.



FIGURE 3-4. TIGHTENING THE SET SCREWS

## 3.3.1.1 Installing the bore welder onto the mounting rod

Do the following to install the bore welder onto the mounting rod:

1. Slide the BW2600 radial mount over the nose collar of the weld head assembly and hand-tighten the clamp bolt (see Figure 3-5).

TABLE 3-2. ASSEMBLY COMPONENT IDENTIFICATION

Number	Component
1	BW2600 radial mount
2	Mounting rod
3	Bore welder adapter plate
4	Weld head assembly

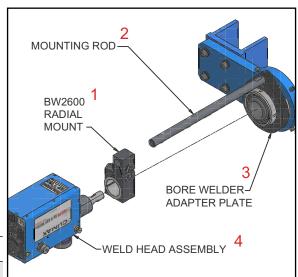


FIGURE 3-5. BW2600 ASSEMBLY COMPONENTS

- 2. Slide the BW2600 and radial mount halfway down the mounting rod (see Figure 3-6).
- 3. Hand-tighten the clamp to the mounting rod.



FIGURE 3-6. BW2600 AND RADIAL MOUNT ON MOUNTING ROD

#### 3.3.1.2 Installing the torch and torch extensions

Do the following to install the torch and torch extensions:

1. Select the appropriate torch and (if necessary) extensions for the bore size, using Table 2-8 and Table 2-9.

## **NOTICE**

All the torches in Table 2-9 require a standard torch adapter to use with the swivel head.

- 2. Assemble the torch and swivel assembly by doing the following:
  - a) If the liner is in the torch, insert the liner extending from the torch into the swivel assembly.
  - b) Screw on the torch approximately half-way, or until the liner is flush with the back of the swivel assembly.

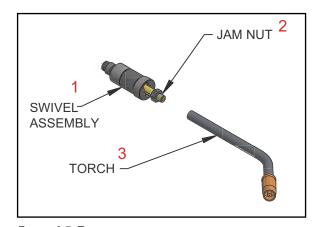


FIGURE 3-7. TORCH AND SWIVEL ASSEMBLY

TABLE 3-3. TORCH AND SWIVEL IDENTIFICATION

Number	Component
1	Swivel assembly



TABLE 3-3. TORCH AND SWIVEL IDENTIFICATION

Number	Component
2	Jam nut
3	Torch

c) Align the torch with the travel direction of the swivel assembly (see Figure 3-8).



FIGURE 3-8. TORCH ALIGNED WITH THE TRAVEL SLOT

- d) Tighten the jam nut (see Figure 3-9).
- e) If liner was not in the torch, do the following:
  - Install the liner into the torch and swivel assembly.
  - ii. Cut the liner flush at the male 3/4-10 fitting.
  - iii. Secure the liner with the set screw.

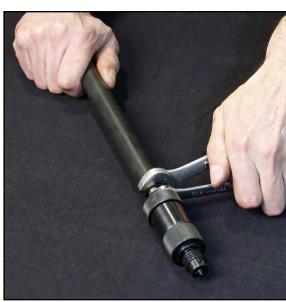


FIGURE 3-9. JAM NUT TIGHTENED

f) Check that the liner is visible through the diffuser gas holes (see Figure 3-10).



FIGURE 3-10. LINER THROUGH DIFFUSER GAS HOLES

- 3. Install the extensions, torch, and swivel assembly onto the BW2600.
- 4. Check that all the connections are tight in order to obtain good electrical contact and gas seal.

TABLE 3-4. TORCH EXTENSION IDENTIFICA-TION

Number	Component
1	6" and 12" torch extensions
2	Swivel assembly
3	Torch adapter
4	Torch

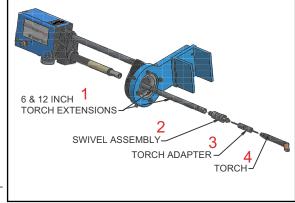


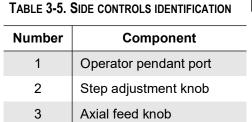
FIGURE 3-11. TORCH EXTENSION ASSEMBLY

## 3.3.1.3 Setting the bore welder stroke

Do the following to set the bore welder stroke, referring to Figure 3-12:



- 1. Rotate the feed engagement lever <u>clockwise</u> and then rotate the axial feed knob to move the spindle to the far end of the bore.
- 2. Check that the axial stroke of the machine is set to provide full coverage (maximum of 9" [229 mm]) of the bore. At full spindle extension, the torch should start at the end of the bore farthest away from the machine.



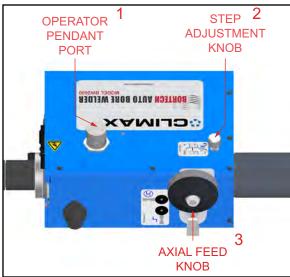


FIGURE 3-12. BW2600 CONTROLS SIDE VIEW

# NOTICE

If the stroke is less than the bore length, then the extensions may be used to extend the reach. After reaching the end of the stroke, extensions may be removed and the process restarted.

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#### TIP:

The automated feed of the bore welder pulls the torch towards the machine incrementally while welding. Achieve correct stroke/torch placement by moving the machine axially on the mounting rod, or by adding extensions (sized 3", 6", 12", or 18" [76, 152, 305, 457 mm]).

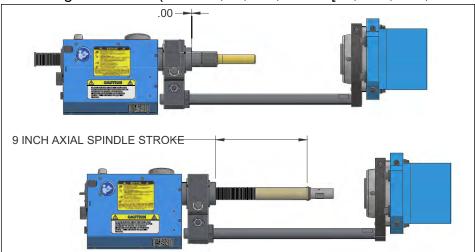


FIGURE 3-13. BW2600 AXIAL STROKE DISTANCE SHOWING 9" AXIAL SPINDLE STROKE (LOWER)

#### 3.3.1.4 Centering the bore welder

Do the following to center the bore welder:

- 1. Connect the BW2600 to AC mains power with the provided power cord.
- 2. Rotate the bore welder spindle by connecting the AC mains cable (but not the wire feeder cable) and using the WELD switch, or by hand-turning it (see Figure 3-14). If the pendant is in use, push ROT/JOG (rotate/jog) on the remote control pendant.



3. Check the 3 o'clock and 9 o'clock positions (see Figure 3-14) using the torch as a guide, and "swing" the bore welder on the mounting rod to attain center (see Figure 3-15).

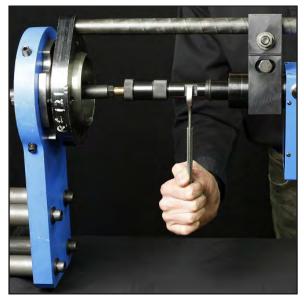
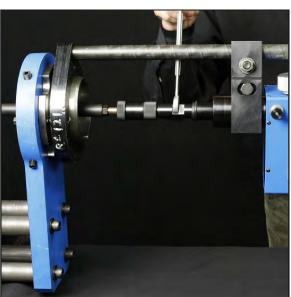


FIGURE 3-14. 3 O'CLOCK AND 9 O'CLOCK POSITIONS





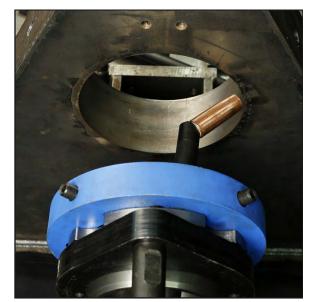


FIGURE 3-15. SWINGING THE BORE WELDER TO ATTAIN CENTER

## **NOTICE**

The use of extensions installed as a "mandrel" reaching through the bore can facilitate quick centering of the machine. Use a scale or divider to find the center.

#### 3.3.1.5 Adjusting the bore welder extension "sag"

In cases where sag may be an issue due to extended reach, the set screws (mentioned in step 10 of Section 3.3.1 on page 31) allow pivoting of the bore welder without losing left/right alignment.

While supporting the bore welder, the operator loosens the bore welder adapter plate slightly.



Failure to support the bore welder while loosening the bore welder adapter plate may result in machine damage or personnel injury.

The operator then pivots the bore welder adapter plate and BW2600 around the contact point of those two setscrews (see Figure 3-16).



FIGURE 3-16. SUPPORTING THE BORE WELDER FOR SAG ADJUSTMENT (EXTENSIONS NOT SHOWN)

This allows for adjustment of the vertical height of the torch.

#### 3.3.1.6 Setting the torch offset

Do the following to set the torch offset:

- 1. Set the torch nozzle approximately 1/8" (3.2 mm) away from the surface to be welded.
- 2. Check that the swivel nut in the swivel assembly is as tight as possible by hand (to make it secure enough to prevent the torch from inadvertently moving radially during welding).

Complete the bore welder setup by turning to Section 3.3.3 on page 43.

## 3.3.2 Installing the bore welder with an adjustable base

Do the following to install the BW2600 on the workpiece with an adjustable base:

- 1. Weld the mounting bolt of suitable length to a position approximately 11" (279 mm) from the center of the bore to be welded.
- 2. Place the adjustable base on the adjustment surface with the bolt protruding through the hole in the center of the base.
- 3. Orient the base to align the mounting rod with the mounting bolt and the center of the bore to be welded.



### TIP:

The four spring washers and nut included with the adjustable base should be placed over the 0.5" (12 mm) bolt and finger tightened, plus a half turn with a wrench. See Figure 3-17.

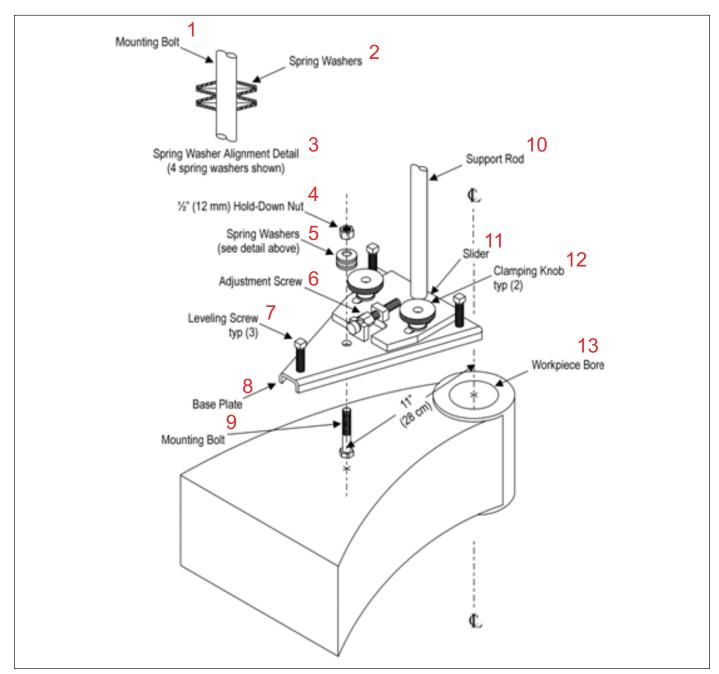


FIGURE 3-17. ASSEMBLY ON THE ADJUSTABLE BASE

TABLEAU 3-6. ASSEMBLY ON ADJUSTABLE BASE IDENTIFICATION

Number	Component
1	Mounting bolt
2	Spring washers
3	Spring washer alignment detail (4 spring washers shown)
4	1/2" (12 mm) hold-down nut
5	Spring washers (see detail above)
6	Adjustment screw
7	Leveling screw (quantity 3)
8	Base plate
9	Mounting bolt
10	Support rod
11	Slider
12	Clamping knob (quantity 2)
13	Workpiece bore

- 4. Screw the mounting rod into the slider hole on the adjustable base and tighten.
- 5. Slide the locking collar onto the mounting rod and install the radial mount onto the mounting rod (see Figure 3-18).

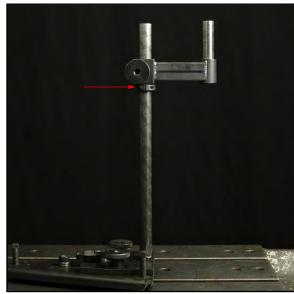


FIGURE 3-18. RADIAL MOUNT ON THE MOUNTING ROD



#### TIP:

If a greater distance from the BW2600 mounting rod is required, use the radial mount (P/N 28208). This will change the bolt setting to between 11–14" (279–356 mm).

Use the BW3000 radial mounts (P/N 28208) for a maximum of 5" (127 mm). If more radial torch clearance is required, use a 10" (254 mm) radial mount (P/N 35006). BW3000 radial mounts can be joined together if required.

If a longer mounting rod is required, use the mounting rod extender to increase the length of the mounting rod without affecting stiffness.

- 6. Install the BW2600 onto the radial mount.
- 7. Attach the extensions to the BW2600 and reach through the hole to be welded for quick adjustment of the base (see Figure 3-19).

## **NOTICE**

Use of a scale or dividers immediately clarify movements required to swing the bore welder spindle axis into the bore center.



FIGURE 3-19. BW2600 ON THE MOUNTING ROD

#### 3.3.2.1 Adjusting for parallelism

Do the following to adjust for parallelism:

1. For axis-to-bore alignment, swing the BW2600 over until the extension is close to the 3 o'clock or 9 o'clock position.

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2. Adjust the two forward leveling jacks as a pair, while noting the distance from the extension to the bore surface at the top and bottom of the bore. (In the example in Figure 3-20, the adjustable base sits at 6 o'clock.)

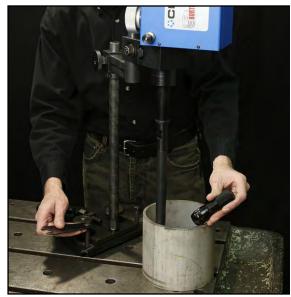


FIGURE 3-20. PARALLELISM CHECK AT 3 O'CLOCK

3. Position the extension at the 6 o'clock position and adjust the rear-leveling jack until the extension appears parallel to the bore surface. In this way, the rear jack makes the base pivot on the forward jacks, not affecting the other axis as already set (see Figure 3-21).

### TIP:

If clockwise adjustment of the rear jack causes the mounting rod to move toward the adjustable base, that indicates that the spring washers are at maximum capacity, thereby bowing the adjustable base. Loosen the



FIGURE 3-21. PARALLELISM CHECK AT 6 O'CLOCK

mounting bolt until the spring washers are no longer collapsed to allow further adjustment.

4. Tighten the 0.5" (12.7 mm) hold-down nut to a torque of 15 ft-lb (20 Nm).



#### 3.3.2.2 Achieving concentricity

Do the following to achieve concentricity:

- 1. Articulate the BW2600 and extension to the approximate bore center and lock the articulation joint (see Figure 3-22).
- 2. Attach the correct torch for the bore see (Table 3-3).
- 3. Retract the BW2600 to bring the torch nozzle to the end of the bore.
- 4. Check the X axis by rotating the torch between the 12 o'clock and 6 o'clock positions, and adjust the slider on the base to center the torch in the X axis.



FIGURE 3-22. BW2600 ARTICULATED AT THE BORE CENTER (ARTICULATION JOINT SHOWN)

## **NOTICE**

The torch and spindle may be rotated manually or by using the controls.



When using the panel controls, unplug the wire feeder cable, or the wire feed circuit will be active. When using the remote control, Rot/Jog (rotate/jog) will not activate the wire feed circuit.

5. Check the Y axis by rotating the torch between the 3 o'clock and 9 o'clock positions, and swing the bore welder radial mount assembly from the mounting rod to center the torch in the Y axis.

### 3.3.3 Finishing the installation

Whether installing with a boring bar interface or an adjustable base, do the following to complete the installation:

1. Rotate the feed knob to move the spindle to the extended position.

2. Connect the power cord to the BW2600 (see Figure 3-23).



FIGURE 3-23. POWER CORD CONNECTION

3. Connect the wire feed conduit to the BW2600 (see Figure 3-24) and tighten the set screw.



FIGURE 3-24. WIRE FEED CONDUIT CONNECTED

4. Connect the wire feed control cable to the BW2600 (Figure 3-25).



FIGURE 3-25. WIRE FEED CONTROL CABLE CONNECTED

5. Connect the wire feed conduit to the wire feeder (see Figure 3-26).

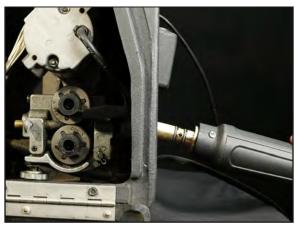


FIGURE 3-26. WIRE FEED CONDUIT CONNECTION

- 6. Connect the wire feed control cable to the wire feeder (see Figure 3-27).
- 7. Stage the wire into the feed rollers and clamp the feed rolls.



FIGURE 3-27. WIRE FEED CONTROL CABLE CONNECTED TO THE WIRE FEEDER

## **NOTICE**

If there are issues feeding wire through the torches, straighten an 8" (203 mm) section of wire before loading the wire feeder (see Figure 3-28).



FIGURE 3-28. WIRE STRAIGHTENED BEFORE FEEDING

8. Without weld power hooked to the wire feeder, push the weld start switch to feed wire into the system (see Figure 3-29).



If your wire feeder does not have a Wire Jog function and does not easily disconnect the weld power, remove the weld ground connection before placing the BW2600 in weld mode.

9. Once wire has exited the torch, clip the excess wire.



FIGURE 3-29. WELD START SWITCH

## **NOTICE**

If there are issues feeding wire through the torch system, remove the torch system from the BW2600 and manually feed wire through the torch system. Then reinstall the torch onto the machine.



- 10. Extend the spindle through the bore again by rotating the feed knob, and place the machine so that the wire will contact approximately 1/16–1/8" (1.6–3.2 mm) from the edge of the bore.
- 11. Connect the weld cable from the wire feed to the power supply.
- 12. Check that the shielding gas, power supply, and welding leads are properly connected and ready for welding.
- 13. Check that the approximate voltage and wire speed are appropriate for your application.



With MIG welding, the wire speed bears a direct relationship to the weld current.

## 3.4 Installing accessories

Setup of optional accessories are described in the following sections.

## 3.4.1 Standard torch adapter

The standard torch adapter is designed to utilize standard CLIMAX BW3000 torches.

Do the following to use the standard torch adapter:

- 1. Install the standard torch adapter onto the swivel.
- 2. Install the liner into the assembly (see Figure 3-30).

## **NOTICE**

The liner length should be flush with the inner bore base of the female fitting and the top of the male fitting.



FIGURE 3-30. LINER AND STANDARD TORCH ADAPTER

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3. Tighten the liner in the male fitting of the swivel (see Figure 3-31).

## **NOTICE**

The liner is secured in the male fitting on the swivel coupling and not in the adapter.

- 4. Screw the standard torch (#0 or #00) into the standard torch adapter.
- 5. Orient the torch nozzle so it is parallel with the swivel travel (see Figure 3-32).
- 6. Secure the locknut.



FIGURE 3-31. LINER TIGHTENED IN THE SWIVEL



FIGURE 3-32. TORCH NOZZLE ORIENTATION

#### 3.4.2 Torch #00 and #0

These torches are used to build up bores ranging in diameter from 0.88–1.7" (22–44 mm) and 1.7–3" (44–76 mm) respectively. They are used with the standard torch adapter described in Section 3.4.1.



Because these torches have non-insulated nozzles, clearance between the nozzle and the workpiece is crucial.

If it is necessary to feed the wire through the BW2600 and swivel assembly with the torch detached, push the wire through the torch with pliers, and then re-attach the torch to the swivel head.



#### TIP:

Filing the wire to a point, straightening a short section at the end, or rotating the bore welder spindle may help automatic feeding of the wire.

Do the following to change torch tips:

- 1. Loosen the setscrew holding the tip.
- 2. Remove the tip from the torch body.
- 3. Insert the new tip into the body and the liner.
- 4. Hold the torch horizontally so that the tip falls into its seat.
- 5. Tighten the set screw to prevent movement.
- 6. Position the tip axially to a point slightly below center to the nozzle opening, using the hex wrench as a gauge, as shown in (Figure 3-33).

#### TIP:

Because the wire is curved when exiting the tip, the point of contact with the work is higher than might otherwise be expected. Therefore, position the tip slightly toward the end of the nozzle.



FIGURE 3-33. TIP POSITION WITH HEX WRENCHES

After rotating torches for setup, centering, or screwing into an

extension, jog the wire through the torch until it exits the tip in a stable condition, producing a clean spiral of wire. This relieves the torsional stresses built up in the wire (because wire was not fed while rotating), so that the weld process will not be affected by wire wandering at startup.

### 3.4.3 Torch extension support kit

The torch extension support kit is ideal when the distance from the bore welder to the torch is great enough to make torch stability uncertain and alignment difficult.

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Do the following to set up the torch extension support kit.

- 1. Slip the support body over an extension near the bore to be welded, at a position where the extension support rod may be clamped or tack welded to provide support.
- 2. Orient the support block so that both shoulder screws are at right angles to the extension string.
- 3. Obtain concentricity of the support body with the bore.
- 4. Attach the extension support rod to the foundation determined in step 1.

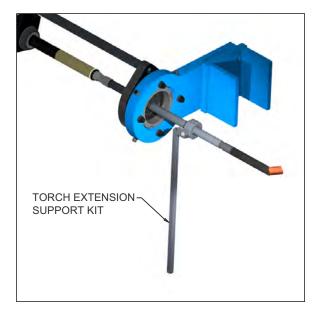


FIGURE 3-34. TORCH EXTENSION SUPPORT KIT

5. Continue with the set up as described in Section 3.3 on page 28.

#### TIP:

With MIG welding, the wire speed bears a direct relationship to the weld current. With variable step, it is possible to lay down a small bead and small step, or to lay down huge beads with a large step.



# **4 OPERATION**

# IN THIS CHAPTER:

4.1 OPERATION MODES	
4.2 PRINCIPLES OF OPERATION	
4.3 PRE-OPERATION CHECKS	
4.4 Preparing the Bore Welder for Welding	
4.4.1 SETTING THE ROTATION SPEED	
4.4.2 SETTING THE GAS FLOW	
4.4.3 SETTING THE WIRE SPEED	
4.4.4 CHECKING THE STEP SETTING	4
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4.5 WELDING	
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## 4.1 **OPERATION MODES**

The BW2600 is capable of welding any cylindrical workpiece, including bores, faces, and outsider diameters.

Operation modes include:

- Standard bore welding
- Skip bore welding
- Fill bore welding

# **CAUTION**

Weld spatter and other debris can damage the machine and degrade its performance. Remove all weld spatter and other debris from the machine before and after each use.

#### 4.2 PRINCIPLES OF OPERATION

# **WARNING**

Always follow safe work practices, including site-specific safety requirements. It is your responsibility to perform a risk assessment before you set up the machine and each time before you operate the machine.

Do not operate this machine without adequate training to fully understand safe setup, operation, and maintenance.



To avoid serious personal injury, keep clear of moving machinery during operation.

The BW2600 often is used in dangerous locations (such as in elevated positions or near other operating equipment). The operator must perform a site-specific risk assessment (Section 4.3 and Section 1.6 on page 6) for each job before starting work.

The BW2600 has an optional remote operation pendant that allows the operator to choose the best location to operate the machine.

### 4.3 PRE-OPERATION CHECKS



Rotating machinery can cause serious injuries. Turn off and lock out the machine before performing the pre-operation checks. When operating the machine, always be aware of the location of all people in the vicinity of the machine.

Each time before starting the machine, check the following:

- 1. The machine is securely mounted to the workpiece.
- 2. All lines, cables, and hoses are properly connected and secured away from moving parts.
- 3. All machine parts are secure.
- 4. The welding parameters are set correctly (Section 3.4 on page 47).
- 5. All handles and tools are removed from the machine.
- 6. All preventative maintenance is up to date (Section 5).

## 4.4 Preparing the Bore welder for welding

## 4.4.1 Setting the rotation speed

Do the following to set the rotation speed:

- 1. Set the rotation speed of the torch to the desired linear travel speed along the bore surface.
- 2. Use Table 4-1 for approximate adjustments.
- 3. Time the spindle for fine adjustments according to the following guidelines:
  - a) For horizontal axis welding, multiply the bore diameter in inches by 8.4 to get the total seconds per rotation of the spindle at 22 in/min (559 mm/min) of linear travel speed.
  - b) For vertical axis welding, multiply the bore diameter in inches by 10.4 to get the total seconds per rotation of the spindle at 18 in/min (457 mm/min) linear travel speed.

TABLE 4-1. ROTATIONAL SPEED IN INCHES AT 20 IN/MIN (508 MM/MIN)

Dial settings	Bore size	Seconds per rotation
1	25" (635 mm)	240
2	4.3" (109 mm)	40
3	2.8" (71 mm)	26
4	2.1" (53 mm)	20
5	1.7" (43 mm)	16
6	1.4" (36 mm)	13
7	1.2" (30 mm)	11
8	1.1" (28 mm)	10
9	1.0" (25 mm)	9
10	0.9" (23 mm)	8

<sup>\*.</sup> Table 4-1 is for reference only.

Optimum travel speed for MIG welding is 20 in/min (508 mm/min). With vertical bore welder axis welding, travel speed may be decreased. With horizontal bore welder axis welding, travel speed should be increased to prevent lack of fusion on the downhill section. For accurate results, use a stopwatch to time the spindle rotation.

#### 4.4.2 Setting the gas flow

Check that the shielding gas is connected to the feeder mechanism and that the flow is adequate for MIG welding (25–35 cfh).

The following gas compositions are recommended:

- 75% argon + 25% CO<sub>2</sub> for horizontal bore welder axis welding
- 92% argon + 8% CO<sub>2</sub> for vertical bore welder axis welding

## 4.4.3 Setting the wire speed

Follow the manufacturer's instructions for the customer-supplied wire feeder to set the wire speed.

# NOTICE

With 0.035" (0.889 mm) wire, a wire speed of 250"/min equals approximately 125 amps. This setting is recommended as a baseline when starting welding. At a travel speed of 22"/min, the bead size is approximately 0.115" in depth.

### 4.4.4 Checking the step setting

Do the following to check the step setting:

- 1. Check that the bore welder is clear of rotational obstructions.
- 2. Disconnect the wire feed control cable.

TABLE 4-2. CONTROLS IDENTIFICATION

Number	Component
1	Remote operator pendant port
2	Arc interrupt
3	Rotation speed knob
4	Wirefeed contactor control port

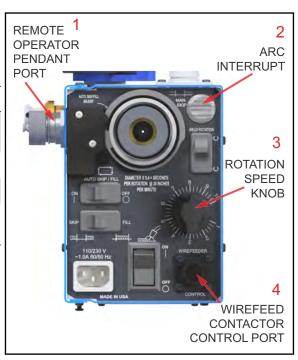


FIGURE 4-1. CONTROLS FOR CHECKING THE STEP SETTING



3. Rotate the bore welder spindle by connecting the AC mains cable (but not the wire feeder cable) and using the WELD switch to turn the spindle. If the pendant is in use, push ROT/JOG on the remote control pendant.

# **CAUTION**

Failure to disconnect the control cable in step 2 could result in unwanted weld activity.

4. Measure the length of feed in one rotation and set the step knob to provide an axial movement of 1/8" (3.2 mm).

TABLE 4-3. PORT AND KNOB IDENTIFICATION

Number	Component
1	Operator pendant port
2	Step adjustment knob

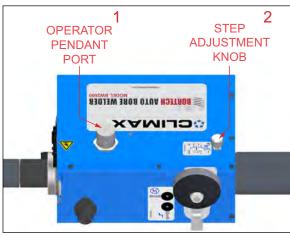


FIGURE 4-2. LOCATION OF THE STEP ADJUSTMENT KNOB

# NOTICE

Adjustments to step size and wire speed are

necessary to attain the desired buildup. Smaller bead size require a smaller step (with lower amperage and wire speed), and a larger bead size require a larger step (with higher amperage and wire speed).

## 4.4.5 Attaching the weld ground clamp

Attach the power supply ground clamp to the part to be welded. The surface to which the clamp is attached should be clean bare metal and located with a good conductive path to the workpiece. The C-clamp type is recommended (shown in Figure 4-3).



As with any electric welding process, a poor ground can be detrimental to weld quality and increase the risk of electrical shock



FIGURE 4-3. C-CLAMP EXAMPLE

### 4.5 WELDING

# **WARNING**

Welding must only be done by qualified persons. Welding requires a high degree of training, and qualified welders are aware of the possibility of an arc flash occurrence, hot surfaces, and burn hazard at the welding nozzle and workpiece. Wear appropriate PPE at all times during welding.

# **WARNING**

The workpiece can become extremely hot during welding. Contact with a hot workpiece could cause severe burns to bare skin. Wear welding gloves when you touch or work around a workpiece that is being welded.

To begin welding, press the WELD switch.

Visual confirmation that the spindle axial feed rate matches weld deposition is crucial. Adjust the wire speed to place the bead at intersection of previous bead and the base metal or slightly above.

If the step is too small, increase the step by unscrewing the step adjustment knob; if the step is too large, decrease the step by screwing in the step adjustment knob (see Figure 4-2 on page 55).

When process is complete, turn off the WELD switch.

### 4.5.1 Welding safety during adjustments

As with any arc welding process, visual observation should only be made with an appropriate light shield. Many welders employ a combination of a #9 hand-held shield and #3 safety eyeglasses. This combination allows the operator to adjust the control while being protected from flash burn by the glasses.

View the arc through the combination of the hand-held shield and the glasses, to observe accurate definition of wire location.



## 4.5.2 Weld interrupt options

Figure 4-4 shows the difference in skip/fill capabilities.

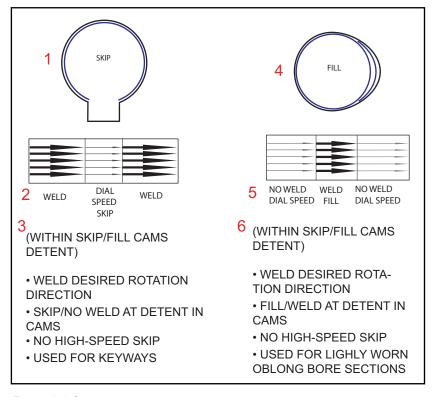


FIGURE 4-4. SKIP AND FILL COMPARISON

TABLEAU 4-4. SKIP AND FILL COMPARISON IDENTIFICATION

Number	Component
1	Skip
2	Weld – Dial speed skip – Weld
	(Within skip/fill cams detent)
	Weld in the desired rotation direction
3	Skip/no weld at the detent in cams
	No high-speed skip
	Used for keyways
4	Fill
5	No weld dial speed – Weld fill – No weld dial speed
	(Within skip/fill cams detent)
	Weld in the desired rotation direction
6	Fill/weld at the detent in cams
	No high-speed skip
	Used for lightly worn oblong bore sections

#### Avoiding key ways

If skipping a key way is required, do the following when preparing for welding:

- 1. Set the SKIP/FILL switch to SKIP.
- 2. Turn the SKIP switch on.
- 3. Rotate the torch in the weld direction until the torch tip reaches the stop point or a point ahead of the key way.
- 4. Squeeze the outside diameter of the cam discs with the thumb and forefinger to open a low spot in the cam discs.
- 5. Rotate the discs until the SKIP switch falls into the low area.
- 6. Rotate the torch as in step 3 to the end of the interrupt area.
- 7. Hold the first disc where it was set in step 5. Then move the other disc until the SKIP switch actuates.
- 8. Re-check the disc settings by rotating the spindle through the "interrupt" zone in the welding rotation direction.

#### Filling oblong sections of the bore

The BW2600 is capable of correcting moderately oblong bores.

When filling oblong sections, do the following when preparing for welding:

- 1. Set the SKIP/FILL switch to FILL.
- 2. Turn the SKIP switch on.
- 3. Rotate the torch in the weld direction until the torch tip reaches where welding should begin.
- 4. Squeeze the outside diameter of the cam discs with the thumb and forefinger to open a low spot in the cam discs.
- 5. Rotate the discs until the cam microswitch (shown under the 6 in Figure 2-23 on page 21) falls into the low area.
- 6. Rotate the torch as in step 3 to the end of the interrupt area.
- 7. Hold the first disc where it was set in step 5. Then move the other disc until the SKIP switch actuates.
- 8. Re-check the disc settings by rotating the spindle through the "interrupt" zone in the welding rotation direction.

## NOTICE

The BW2600 is limited in its capability of fixing oblong bores, as it must rotate 360°.

#### Manual interrupt over grease holes

For panel operation of manual skip, push the MANUAL SKIP button to halt welding while continuing rotation. To resume welding, release the button.

For remote pendant operation, push the rotation JOG / MANUAL SKIP button.



## NOTICE

Repeat this procedure for each revolution until the non-weld area is passed.

## 4.6 WELDING POINTERS

#### 4.6.1 Arc voltage

A voltage setting of 17–19 volts is a recommended initial range. Small changes to voltage on the power supply will be required to stabilize the weld process.

A lower voltage delivers a steady, less violent arc. This produces less spatter and smaller diameter spatter beads, allowing longer periods of continuous welding between nozzle cleanings and extends tip life.

## NOTICE

The arc voltage should be adjusted during welding to maintain the best bead profile and shorting performance. Due to variations in the environment and welding systems, this manual cannot provide exact specifications. Contact CLIMAX for technical support related to welding parameters.

#### 4.6.2 Using 0.035" wire

Follow these guidelines when using 0.035" wire:

- 100 amps = 200 in/min at 16-17 volts
- 125 amps = 240 in/min at 17-18 volts
- 150 amps = 300 in/min at 18-19 volts

## NOTICE

These numbers are only guidelines and do not take into account the variations of equipment and consumables.

## 4.6.3 Shielding gas

A flow range of 25–35 cfh (1 m<sup>3</sup>/hour) is recommended. Avoid excessive flow, as this creates turbulence and could cause poor shielding.

If poor shielding is suspected, check for dirty nozzle or an obstructed gas flow from the diffuser. If wind is a problem, make a shield from leather or other available non-conductive materials.

#### 4.6.4 Wire and gas

The BW2600 is designed for solid steel wire using the MIG welding process.

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The length of time that the bore welder may be used continuously depends on spatter build-up in the welding nozzle. When deciding the type of wire, gas, and power supply to use, select a combination that produces the smoothest arc action. That will produce less spatter buildup.

Wires with higher de-oxidizer content usually work best. Wires E-70S-2 and E-70S-6 are recommended; E-70S-2 produces finer spatter and less glass buildup in multilayer buildups.

Any commonly used inert gas may be used, but those with high argon content are preferred, such as the following combinations:

- 75% argon + 25% CO<sub>2</sub> for horizontal bore welder axis welding
- 92% argon + 8% CO<sub>2</sub> for vertical bore welder axis welding

Straight argon or helium should not be used for steel. Straight CO<sub>2</sub> produces a significant amount of spatter.

Welding wire usually contains silicon as a de-oxidizer. During the welding process, this transforms to silicon dioxide (glass) and solidifies in clumps on the surface of the weld. If the wire speed is too high and rotational speed too low, these glass clumps might become large enough to interfere with the welding arc, producing small glass inclusions (this does not normally occur). Likewise, when many layers of buildup are stacked, the glass from the lower level re-melts and is added to the new glass, forming larger clumps. Therefore, it is good practice to clean the glass from the bore after each successive pass before applying more.

#### 4.6.5 Spindle feed and wire location

During welding, check that the mechanical step feed is providing appropriate axial movement on each revolution, with the following guidelines:

- If the feed is too much for the parameters in use, the bead will appear ropey and might have spaces between the beads.
- If the step is feeding too little, the surface of the weld may appear smooth and flaw free, but it may be poorly fused to the base metal.

Check that the arc is directed slightly above the intersection point between the base metal and the previous bead.

The first step (ending the first revolution) should be made slightly smaller than those that follow. An alternative is to use a slightly lower wire speed during the first revolution.

## 4.6.6 Welding in the horizontal axis

Welding in the horizontal axis requires special attention to the machine settings. The weld bead must travel through the lower, vertical-up, overhead, and vertical-down positions. These correspond to the 6 o'clock, 9 o'clock, 12 o'clock, and 3 o'clock positions of the bore, in that order.



The following sections offer some practical suggestions for developing skills for work in the horizontal.

#### 4.6.6.1 Welding on the vertical upside

The BW2600 has no difficulty with lower and overhead (that is, 6 and 12 o'clock) positions of the bore.

When the torch is welding in the vertical upside (the 9 o'clock position of the bore), the weld tends to run downward. With controls set correctly, the solidifying weld-metal forms a shelf that supports the molten metal, so vertical-up is nearly as easy as flat.

The first rotation may be more difficult to obtain a well-formed bead than the subsequent ones. The V produced by the previously laid bead and the base metal provide optimal conditions for successful out-of-position bore welding.

#### 4.6.6.2 If welding current is too high

If the welding current (controlled by the wire speed) is too high, the arc may be too forceful and gouge the base metal. Gouged out metal will flow and form globules, or it may form a humped bead in less severe cases. This also produces undercutting at the edge of the weld bead.

Increasing the rotational speed of the bore welder helps cool the weld, but only to a point. Decreasing the weld current (by slowing the wire speed) should keep the weld metal in place. Using a smaller wire and proportionately lower current will produce a more manageable bead. A wire size of 0.030" (0.762 mm) should be easy to manage, and after some use, the operator should be able to master 0.035" (0.889 mm) wire horizontally. The preferred wire size is 0.035" in most instances.

#### 4.6.6.3 Welding on the vertical downside

When welding on the vertical downside (the 3 o'clock position of the bore), different issues may arise, but the solution is the same as described in Section 4.6.6.2.

Deposited metal has a tendency to flow downhill with the welding arc. If the deposited metal does not solidify quickly enough, it will follow or even run ahead of the arc, and in the process use up all its de-oxidizers (the welding wire contains elements to cleanse the weld). This can produce porosity and contribute to lack of fusion on the down hand.

Do not increase gas flow. Instead, quickly solidify the weld metal in place with the following options (combine if necessary):

- Speeding up the BW2600's rotational speed
- Decreasing the welding current
- Using a smaller wire size

Another related problem is the arc playing on the molten metal rather than on the base metal, resulting in a lack of fusion to the base metal. This problem can go undetected until machining the bore to size, at which time large sections of the weld may separate from the base metal.

The solution for most problems in horizontal bore buildup is to run slightly faster travel speeds (at 22 in/min) and not to use excessive current. If the rotational speed becomes too great, the weld may also not flow in well and tend to undercut or hump into a stringy bead.

Starting with a wire size of 0.035" (0.889 mm) is recommended. A wire size of 0.030" (0.762 mm) with less current and a smaller step is also manageable - although if "wire flip" is present, "tie-in" is more difficult with 0.030" (0.762 mm) wire.

## 4.7 DISASSEMBLY

To disassemble the BW2600 bore welding machine, follow the setup instructions (Section 3.3 on page 28) in reverse.



# **5 MAINTENANCE AND TROUBLESHOOTING**

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### 5.1 OVERVIEW

This chapter explains periodic maintenance intervals and tasks and provides troubleshooting guidance.



Failure to properly clean and maintain the machine can result in machine damage and void the warranty.

Following the required maintenance schedule is critical to obtaining normal machine life.

Keep all machine components in clean, working condition.

To prevent corrosion, thoroughly rinse with fresh, clear water any machine parts that are exposed to salt water.

### 5.2 MAINTENANCE INTERVALS

Table 5-1 lists maintenance intervals and tasks.

TABLE 5-1. MAINTENANCE INTERVALS AND TASKS

Interval	Task	See section
	Inspect O-rings and sealing surfaces.	
Before each use	Inspect all components for damage in conducting areas.	
	Check hoses and cables for damage or kinks.	
Before and after each use	Remove debris, oil, and moisture from machine surfaces.	
Periodically	Clean the liners, replacing as needed.	Section 5.3.
·	Inspect the torch and extension ends for dings or burrs.	Section 5.3

### 5.3 MAINTENANCE TASKS

Daily maintenance consists primarily of keeping the BW2600 clean and protected. The BW2600 is designed to tolerate industrial environments that are dusty and gritty. However, the BW2600 is a machine tool with close-fitting parts that will last longer if cared for.

Long-term maintenance includes cleaning or replacing the liners. Occasionally inspect the torch and extension ends where they mate for dings and burrs. These parts require smooth surfaces for a gas seal.

If it becomes difficult to insert the conduit into the BW2600, the O-ring may be dry or badly worn. If worn, replace with CLIMAX P/N 36379. It may be helpful to apply a small amount of O-ring grease to the ring, though the unit is shipped with a lubricated O-ring.

The needle bearings that support the spindle are greased for the life of the machine.

#### 5.3.1 Replacing liners

When a liner needs replacement, follow these guidelines:

- If the liner is installed in any curved BW2600 accessory, pre-load the liner.
- If replacing the liner in a wire feeder conduit, do the following:
  - a) Coil the conduit into a 24" (60 mm) circle.
  - b) Push the liner into so that it contacts the outer wall of the conduit.
  - c) Secure it in place with the setscrews while in the coiled position.



This procedure is helpful in assuring consistent wire feeding. Be careful not to over-tighten the setscrews that secure the liner.

#### 5.3.2 Motor maintenance

If the operator needs to replace the gear motor (P/N 61210), use kit P/N 103306 as shown in Table 5-2 on page 65.

TABLE 5-2. MOTOR DRIVE REPLACEMENT KIT (P/N 103306)

Part number	Description	Quantity
103142	GEARMOTOR 90 VDC 6.6 RPM 189 IN-LBS TORQUE 776.76:1	1
103280	BRACKET MOTOR DRIVE (MMP)	1
103281	PULLEY ROTATION MOTOR STD (MMP)	1
103282	PLATE BASE MOTOR MOUNT (MMP)	1
103284	CLAMP LOOP VIBRATION DAMPENING 1-1/2 ID	1
103285	NUT CLIP ON 8-32 0.04IN MAX THICKNESS	1
103632	SCREW 8-32 X 1 BHSCS	1
103633	STUD PARTIALLY THREADED M4 X 0.70 X 12MM LG STEEL	1
10877	SCREW 10-32 X 1/2 SHCS	1
11256	SCREW 10-24 X 1/4 SSSCP	1
11315	WASHER #10 FLTW BLACK OXIDE	6
11676	SCREW 10-32 X 3/4 SHCS	3
11852	SCREW 8-32 X 1/2 BHSCS	3
17986	SCREW 10-32 X 1-1/4 SHCS	2
20758	WASHER #6 ITSTRW	1
26468	SCREW 6-32 X 3/16 BHSCS	1
32575	BELT SLOW ROTATION	1
67403	TERMINAL SNAP-PLUG MALE 22-18AWG HEAT-SHRINK	1
67404	TERMINAL SNAP-PLUG FEMALE 22-18AWG HEAT-SHRINK	1

## 5.3.3 Step positioner assembly replacement

Generation 2 BW2600 step positioners (P/N 90590) may be replaced using kit P/N 106412.

#### 5.4 TROUBLESHOOTING

This section is intended to help solve basic machine performance problems. Contact CLIMAX for serious maintenance or for questions on the following procedures.

#### 5.4.1 If the feed will not work

The feed will not work under the following conditions:

- The feed engagement lever is not fully rotated <u>counter-clockwise</u> to engage the feed.
- The drag brake is set too tight. A maximum of 15 in-lbs (1.67 Nm) is required to allow manual axial spindle movement, yet also allow retraction of the spindle and torch components when the spindle feed is engaged.
- The cam follower arm is not resetting. For example, the indicator on top of the machine is not returning to the "maximum feed amount" indication after each step. This could be due to the loosening of the spring that keeps the cam follower up against the cam, or if something is jamming the cam follower arm.
- The feed engagement lever cannot create enough pressure on the internal clutch face. See instructions below.

To address the lack of pressure on the internal clutch face, do the following:

- 1. Remove the axial feed knob (P/N 105772).
- 2. Loosen the set screw (P/N 12897) and clutch tension jam nut (P/N 105781) as shown in Figure 5-1.
- 3. While the step engagement lever is fully seated in the counter-clockwise position, tighten the clutch tension jam nut to 50 in-lbs (5.65 Nm).
- 4. Tighten the set screw to 3 in-lbs (0.4 Nm), reinstall the axial feed knob, and set the drop back tension nut to 11 in-lbs (1.24 Nm).



FIGURE 5-1. CLUTCH TENSION JAM NUT



#### 5.4.2 If there is a lack of fusion to the bore surface

Lack of fusion in MIG welding occurs when the weld metal lacks a metallurgical bond to the base metal.

Reasons for lack of fusion include the following:

- The rotational travel speed is too slow. Proper travel speed allows the arc to play on the puddle and the base metal simultaneously, providing complete fusion. Slowing rotation speed prevents the arc from playing on the base metal, limiting fusion.
- The step size is too short, causing the weld to play on the previous bead and not the base metal, causing a lack of fusion.

#### 5.4.3 If the wire feeding stops and wire burns back to tip

A mechanical blockage of the welding wire causes wire feeding to stop and wire burn back.

This may be caused by a pile-up of debris at the "cone" entrance to the contact tip. This debris jams between the wire and contact tip bore. When the wire stops and the welding power supply remains on, the wire burns back to the contact tip and the contact tip melts as it becomes the new electrode.

In addition, as the contact tip becomes too hot, the wire may seize to it. If this happens, it probably means the arc voltage is too high and lowering it should prevent the seizing and may improve the welding.

Changing the liners is usually not necessary in cases of wire stoppage. Occasionally the liner at the torch nozzle overheats and should be replaced. Generally, liners last a long time.

## 5.4.4 If weld beads are "ropey"

"Ropey" is defined as the undesirable excessive "crown" of the weld metal, such as narrow tall beads that deviate from the preferred convex shape of the bead profile. Causes include mill scale, rust, contamination of wire or base metal, improper shielding gas, high-resistance weld ground/positive connection, or welding parameters.

To make the beads wet-out more and become less ropey, an increase in the arc voltage up to about 18 volts may help. However, most wetting will be obtained with increased inductance of the system. Most welding power supplies have an inductance control. Observe what happens as you rotate the inductance knob. Higher inductance tends to spread out the weld puddle.

# NOTICE

As the inductance is changed, the arc voltage will need to be adjusted to compensate for the variation in inductance.

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If the power supply does not have an inductance control, you can create inductance by wrapping either welding cable around a steel core. A piece of heavy wall 4" (102 mm) pipe or a 4" solid bar works well. Try one wrap at a time while welding. Typically, 2–20 wraps should be sufficient.

A sign of too much inductance is difficulty in starting the arc. The wire tends to "stub" and has trouble recovering. In addition, if the electrode tends to stub excessively while welding and arc voltage is not too low, high inductance is likely.

### 5.4.5 If there is too much spatter

Spatter is the formation and ejection of molten droplets of welding consumable due to repetitive arc extinguishments (short circuiting) and arc reestablishments. Factors that reduce spatter include changes in voltage, inductance, welding consumables, and travel speed.

Within the bore welding scope, spatter is usually a problem due to its buildup on the nozzle and its undesirable effect on gas flow and / or interruption of continuous welding.

The usual cause for too much spatter is that the arc voltage is too high. The arc should have an even sound that is not violent. A setting of 15.5–18 volts is normal. If higher than 18 volts, the arc will become much more uneven and labored and the metal transfer will become globular. Avoid this range.

The shielding gas also has a marked effect on weld spatter. For spatter control, a shielding of argon with less than 15% CO<sub>2</sub> is recommended. (CLIMAX often uses 92% argon, 8% CO<sub>2</sub>.) More CO<sub>2</sub> than this tends to cause excessive spatter.

#### 5.4.6 If the weld is porous

Porosity is an undesirable sponge-like matrix of small voids in the weld metal, caused by reactive gases and impurities in or around the molten weld puddle. Although the welding wires used contain substantial amounts of de-oxidizer and cleansers, there is a point at which these additives cannot keep up with the impurities.

Some other reasons for porosity are listed in the following sections.

#### 5.4.6.1 Problem with shielding gas

This might include a restriction in flow due to spatter buildup, etc. Alternatively, the gas flow rate may be too high causing turbulence. A flow rate of 20 to 40 CFH is recommended. If the weld is not shielded from the atmosphere, the oxygen and nitrogen will react with the weld metal, causing porosity.

#### 5.4.6.2 Dirty bore surface

Although the BW2600 usually handles these problems well, excessive oil or other organic compounds could cause porosity. These may be on the surface or embedded in crevices or grease holes. A thorough cleaning should be done prior to



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welding; sandblasting or even pre-machining may be in order. In certain cases preheating before buildup may drive out the grease.

If the porosity affects the entire weld bead, it can be related to shielding gas not properly shielding the process from drafts or flow restrictions. If drafts are an issue, creating screens out of leather or aluminum foil can help.

# NOTICE

Aluminum foil is a good conductor of electricity, so be careful not to short bore welder components to the piece being welded.

#### 5.4.7 If experiencing wire flip

Wire flip is a weld defect caused when the weld wire is twisted due to torch rotation, to the point that it can overcome the forces twisting it. When this occurs, the wire untwists violently and cause the weld puddle to disperse.

If experiencing "wire flip," try the following to eliminate it:

- 1. Avoid an S shape in the conduit. A circular shape is preferred.
- 2. Position the wire conduit in such a way that the conduit makes only one continuous curve. The conduit should begin curving at its attachment point on top of the BW2600 and continue this curve for about 270°, then straighten out as it heads toward the wire feeder. This method works particularly well with long conduits.

#### TIP:

If the wire has a tight cast and it still flips in this configuration, try "tightening up" the curve. However, long torch extensions tend to negate any benefit that this conduit shape may have.

### 5.4.8 If steel weld deposits are too hard to machine

Assuming the wire is a mild steel wire (such as 70s-series), the ability to harden must be coming from the base material. Ordinarily, mild steel with its lack of carbon will not harden. If the deposit is hard, it must have obtained carbon and possibly other elements from the base material, which make it susceptible to hardening. When welding wire is deposited on this base metal, some elements of the base metal melt and flow with the welding wire. Thus, if enough carbon is added, the weld wire becomes susceptible to hardening.

Generally, to prevent hardening, slow down the cooling rate. To do so, increase the pre-heat temperature of the part and/or decrease the rotational travel speed of the torch. Fast travel speeds produce a rapid quench of the weld beads.

Keep in mind that once the weld bead is hardened, it can be annealed to soften it. For this to happen, the weld must be allowed to cool below about 400°F and then reheated to about 950–1,250°F (510–676°C). The welding arc often can be used to

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accomplish this). Slow travel speeds allow the welding arc to reheat the previous beads, thus having an annealing effect. In addition, sometimes it is advantageous to deposit another layer of weld on top of the hard layer solely to temper it.

If the buildup is still too hard, re-heat it after welding. If the buildup is brought to a temperature of about 1,100°F (593°C) and allowed to cool slowly, it will then be machinable. It is important that the part is allowed to cool to below 400°F (204°C) before the reheating is done. It is also important not to allow any part of the weld to rise above the critical temperature (about 1,300°F [704°C]) even for a short time, as undesired changes to the weld metal atomic structure may occur.

### 5.4.9 If the weld is "graping" in the horizontal axis

Graping is the undesirable breach of surface tension of the molten puddle (i.e. "dripping" of the molten weld metal). This typically occurs on the overhead section of a bore welded in the horizontal axis. It can also occur when the bore is in the vertical axis. Causes include excessive voltage, amperage, interpass temperature, too slow a travel speed, too small or too large a step, and contamination.

During the first revolution, the weld bead must be applied to the vertical cylinder bore. During this first time around, there is not yet a previous weld bead to act as a shelf to help support the bead. For most normal work, this is not a problem. If it becomes a problem, use lower current and voltage for the first revolution.

Often it may be advantageous to increase the travel speed slightly. Maintain 22 in/min travel speed.

During the remainder of the buildup operation, graping should not be experienced within the current limits of the BW2600. If graping is experienced during the remainder of the buildup operation, the weld current probably is too high or the travel speed is too slow. The bead becomes so large that its weight overcomes the surface tension that otherwise would hold it in place and the bead spills.

It also is possible for graping to occur if the step is too great or too little. In these cases, the bead will be unsupported and its surface tension will no longer hold it in place.

## 5.4.10 If the weld voltage is hard to control

Sometimes the weld voltage is hard to control resulting in a ropey bead or an inability to clear stubbing in the bead. In some cases, during welding, the weld bead will not wash out properly, the voltage is difficult to stabilize, (i.e. the process is stubbing or spray, never settling into a stable short arc mode, no matter what adjustments are made to voltage and wire speed.)

In this case, look for issues in the positive and negative weld current path. High resistance connections in cable junctions can cause intermittent issues that are frustrating and time consuming to track down. A thorough inspection of all connections, in weld cables and all connections to power supply and work piece should be double checked for signs of corrosion, overheating, or being loose.

#### 5.5 TRAINING

The following are suggested training practices:

- Work with mild steel before attempting work with any other alloys.
- Use a wire with a large arc or "cast" (that is, the diameter of the circle that the welding wire makes as it leaves the wire reel). To determine the cast: cut about 72" (1,828 mm) from the roll of wire and toss it on the floor. It will form a circle on the floor, which is the "cast" of the wire.

#### TIP:

The cast diameter should be as large as possible and at least 40" (1,016 mm), as casts below 30" (762 mm) likely cause difficulties; a cast of 40" or more will reduce or eliminate the effect of the "Wire Flip" that can occur at each rotation). Consult with your sales representative if you are unable to find large cast wires.

Practice welding on a vertical axis bore. This position should be mastered before any other is attempted. Short sections of heavy wall pipe make good coupons.

#### TIP:

It is recommended to bore the coupons to be sure they are round and clean. This enables the trainee to focus on learning without complicating the experience with a contaminated base metal.

- Re-find the center each time a coupon is welded, rather than placing the coupon in a fixture to hold the piece in a centered position. Repeating this technique will allow the operator to center the machine in under a couple of minutes, particularly if also following the suggestions in Section 3.3.1.4 on page 36 on centering.
- Bore coupons to check for proper fusion.
- Perform multi-layered build-ups.
- Measure and record the step size, rotation time, and wire speed. Then the operator may compare the data with Section 4.4.1 on page 53 to determine how to repeat successful buildups.
- Measure the wire speed in inches/minute by jogging the wire for six seconds, measuring the amount fed, and multiplying that number by 10.
- Calculate the spindle rotation time/travel speed with the following formula: (diameter x 3.14 x 60) / desired travel speed in/min.

#### TIP:

Example for 3" (76 mm) bore: (3 \* 3.14 \* 60) / 20 inches/minute = 28.26 seconds per revolution

While performing the buildups, the operator may vary each of the parameters to measure the effect on the buildup operation. Experimentation is a key element to building proficiency.

## 5.6 TOOL KIT

TABLE 5-3. P/N 86863 TOOL KIT

Part number	Name	Quantity
10600	WRENCH HEX 5/32 SHORT ARM	1
11082	WRENCH HEX 3/16 SHORT ARM	1
11094	WRENCH HEX 5/64 SHORT ARM	1
40424	SP LINER STAINLESS STEEL .065 ID X .144 OD X 16 FT FOR .023/.045 WIRE (KB)	1
66860	WRENCH OPEN END 3/4 X 6.0 LONG	1
66861	WRENCH OPEN END 11/16 X 6-3/8 LONG	1
66862	WRENCH HEX L-KEY 1/8 X 2-5/16 LONG	1
67082	GLOVES WELDING CLIMAX BRANDED SIZE LARGE	1
67337	LUBRICANT 3 OZ WD-40	1
70176	CONSUMABLE PACKAGE BW1000 .035/.9MM TIPS (KB)	1



# **6 STORAGE AND SHIPPING**

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6.1.1 SHORT-TERM STORAGE	
6.1.2 Long-term storage	
2 SHIPPING	73
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## 6.1 STORAGE

Proper storage of the BW2600 will extend its usefulness and prevent undue damage.

Store the BW2600 in its original shipping container. Keep all packing materials for repackaging the machine.

## 6.1.1 Short-term storage

Short term storage is defined as less than or equal to three months. For short-term storage:

- 1. Clean and dry the machine to remove grease, metal chips, and moisture.
- 2. Package the machine in its shipping container as shown in Figure 6-1.

## 6.1.2 Long-term storage

Long term storage is defined as longer than three months. For long-term storage:

- 1. Clean and dry the machine to remove grease, metal chips, and moisture.
- 2. Package the machine in its shipping container as shown in Figure 6-1.
- 3. Add a desiccant pouch to the shipping container. Replace the pouch according to the manufacturer's instructions.
- 4. Store the shipping container out of direct sunlight in an environment where the temperature is between -4–160 °F (-40–70 °C).

## 6.2 SHIPPING

The BW2600 should be shipped in its original shipping container.

Package the machine as shown in Figure 6-1.

CONDUIT ASSY 1 16 TORCH #2 — REMOTE OPERATOR PENDANT TORCH #0 -TORCH #00 <sup>4</sup> TORCH #1 TORCH EXTENSION 3" <sup>5</sup> SWIVEL ASSEMBLY TORCH ADAPTER 6 COLLAR CLAMP -WELD HEAD ASSEMBLY **TORCH EXTENSION 6"** WELD HEAD 10 SUPPORT ROD-TORCH EXTENSION 12" -ADJUSTABLE BASE ASSEMBLY PELICAN CASE

FIGURE 6-1. BW2600 SHIPPING CONTAINER WITH COMPONENTS PACKED

TABLEAU 6-1. SHIPPING CONTAINER AND COMPONENTS IDENTIFICATION

Number	Component
1	Conduit assembly
2	Remote operator pendant
3	Torch #0
4	Torch #00

TABLEAU 6-1. SHIPPING CONTAINER AND COMPONENTS IDENTIFICATION

Number	Component
5	Torch extension 3"
6	Torch adapter
7	Pelican case
8	Adjustable base assembly
9	Torch extension 12"
10	Weld head support rod
11	Torch extension 6"
12	Weld head assembly
13	Collar clamp
14	Swivel assembly
15	Torch #1
16	Torch #2

## 6.3 DECOMMISSIONING

To decommission the BW2600 before disposal, dispose or recycle machine parts according to local regulations.



## APPENDIX A EXPLODED VIEWS AND PARTS LISTS

#### IN THIS CHAPTER:

Figure A-1. Weld head assembly (P/N 106402)
Figure A-2. Weld head assembly parts list 1 (P/N 106402)
Figure A-3. Weld head assembly parts list 2 (P/N 106402)
Figure A-4. Step positioner assembly (P/N 105778)
Figure A-5. Step positioner assembly parts list (P/N 105778)
Figure A-6. Radial isolation mount assembly (P/N 85771)
Figure A-7. Base unit and pelican case assembly (P/N 106404)
Figure A-8. Blank end contractor with four pin assembly (P/N 85396) $$
Figure A-9. Conduit assembly with euro connector (P/N 85435)
FIGURE A-10. POWER SUPPLY FOR SWITCH MILLER ASSEMBLY (P/N 85475)
Figure A-11. Conduit assembly for miller (P/N 85476)
Figure A-12. Conduit power assembly for MIG 225 Lincoln (P/N 85527)
Figure A-13. Contactor assembly for Hobart and Thermal arc (P/N 85530) 90
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Figure A-15. Conduit assembly for TWECO (P/N 85534)
Figure A-16. Conduit assembly for Lincoln (P/N 855360)
FIGURE A-17. CONTACTOR ASSEMBLY FOR LINCOLN 5 PIN (P/N 85540) 94

# NOTICE

The following diagrams and parts lists are for your reference purposes only. The machine Limited Warranty is void if the machine has been tampered with by anyone who has not been authorized in writing by CLIMAX to perform service on the machine.

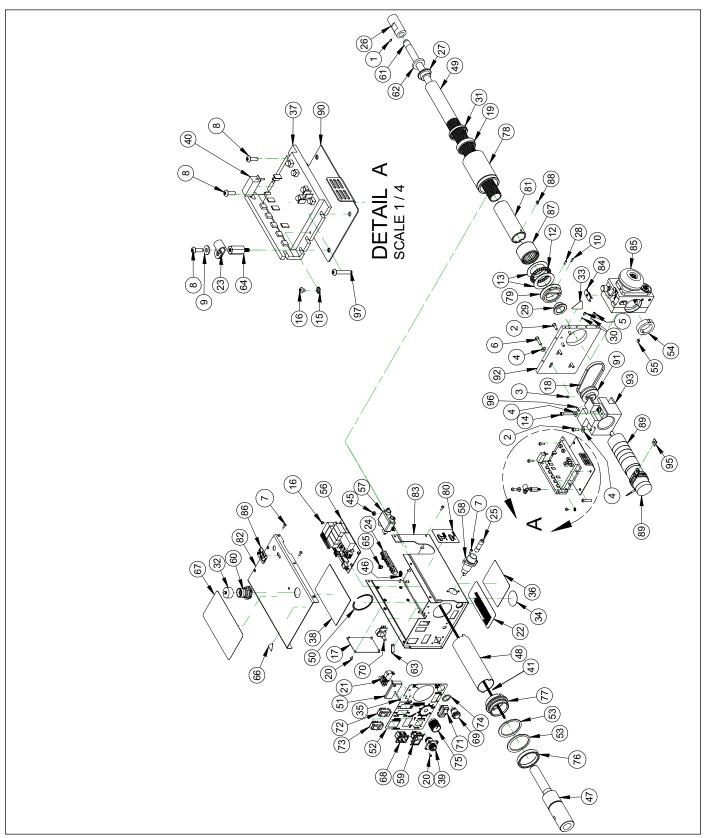


FIGURE A-1. WELD HEAD ASSEMBLY (P/N 106402)



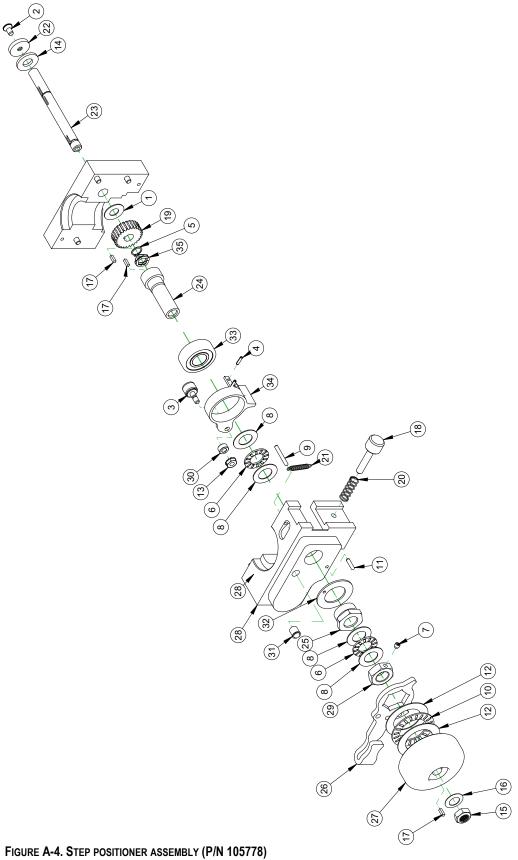
			PARTS LIST
ITEM	QTY	P/N:	DESCRIPTION
1	1	10841	SCREW 8-32 X 3/16 SSSCP
2	4	10877	SCREW 10-32 X 1/2 SHCS
3	1	11256	SCREW 10-24-UNC-2B X 1/4 SSSCP
4	6	11315	WASHER #10 FLTW BLACK OXIDE
5	2	11672	SCREW 10-32 X 1/4 SSSCP
6	3	11676	SCREW 10-32 X 3/4 SHCS
7	14	11677	SCREW 6-32 X 3/8 BHSCS
8	3	11852	SCREW 8-32 X 1/2 BHSCS
9	1	11872	WASHER #8 FLTW SAE ZINC PLATED
10	1	13111	PIN ROLL 1/8 DIA x 3/8
11	10	13243	(NOT SHOWN) WIRE TIE MEDIUM .14 X 8
12	1	16113	BEARING THRUST 1.500 DI X 2.187 OD X .0781
13	2	16568	WASHER THRUST 1.500 ID X 2.187 OD X .030
14	2	17986	SCREW 10-32 X 1.25 SHCS
15	1	20758	WASHER #6 ITSTRW
16	5	26468	SCREW 6-32 X 3/16 BHSCS
17	1	29154	PLATE SERIAL YEAR MODEL CE 2.0 X 3.0
18	1	32575	BELT SLOW ROTATION
19	1	34740	BRG NEEDLE 1-1/2 ID X 1-7/8 X 1/2 OPEN
20	8	37397	SCREW 4-40 X 1/4 BHSCS
21	1	37407	SWITCH STEP LIMIT
22	1	37576	LABEL ELECTRICAL WARNING
23	1	37941	CABLE MOUNT CLIP .50 OD MAX #10 SCREW
24	1	38444	GROUND BUSS 7 POLE COPPER CE CERTIFIED
25	1	38575	FUSE LP-CC-5 13/32X1 1/2 600VAC 5AMP REJ
26	1	40966	TORCH ADAPTER SPINDLE
27	1	40968	ISOLATOR TORCH END SPINDLE TUBE
28	1	40980	SCREW 6-32 X 3/8 SSSDPPL
29	1	40980	BUSHING ISOLATOR SWIVEL
30	2	43489	
			BALL NYLON 1/8 DIA
31	1	44724	SEAL 1.500 X 1.874 X .250 MODIFIED
32 33	1	46446 46902	CONNECTOR CLOSURE CAP FOR MALE M23
33	1		LABEL WARNING HOT SURFACE GRAPHIC 1.13" TALL
	1	59044	LABEL WARNING - CONSULT OPERATOR'S MANUAL 1.5 DIA
35	2	62487	SCREW 4-40 X 3/4 BHSCS
36	1	63504	LABEL WARNING
37	1	63525	DRIVE MOTOR CONTROL 115/230VAC
38	1	66867	INSULATION SHEET HIGH TEMPERATURE BW1000 220V CE
39	1	67063	CONNECTOR PLUG 11-4 PLASTIC
40	1	67143	RESISTOR HORSEPOWER PLC CONTROL DRIVES CE BW3000
41	19	67162	LINER BOREWELDER SPINDLE .065 ID X .188 OD
42	1	67313	(NOT SHOWN) WELD SAMPLE 2.750 ID X 3.500 OD X 2.000
43	1	67403	(NOT SHOWN) TERMINAL SNAP-PLUG MALE 22-18AWG HEAT-SHRINK
44	1	67404	(NOT SHOWN) TERMINAL SNAP-PLUG FEMALE 22-18AWG HEAT-SHRINK
45	2	73763	NUT 8-32 NYLON INSERT LOCKNUT HEX ZINC PLATED
46	1	77568	LABEL PROTECTIVE EARTH 1/2" DIA
47	1	80019	BW1 POWER SWIVEL COUPLING
48	1	84399	TUBE CAM DRIVE WIRE GUARD
49	1	84411	SPINDLE TUBE 9 IN STROKE
50	1	84431	RING SPIRAL EXTERNAL RETAINING 1.922 ID  FIGURE A.2 WELD HEAD ASSEMBLY DADTS LIST 1 (D/N 106402)

FIGURE A-2. WELD HEAD ASSEMBLY PARTS LIST 1 (P/N 106402)

			PARTS LIST
ITEM	QTY	P/N:	DESCRIPTION
51	1	84510	COVER SWITCH AUTO SKIP
52	1	84511	PANEL OVERLAY BW2600 CLIMAX CE
53	2	84519	SKIP FILL CAM
54	1	84530	COLLAR CAM DRIVE
55	1	84594	KEY 1/8 X 1/4 X 5/16 LONG RADIUS BOTH ENDS
56	1	84636	CIRCUIT BOARD, COMPONENT LAYOUT, POPULATED
57	1	84752	LINE FILTER 3 AMP 250 VAC 50/60 HZ QUICK CONNECTION
58	1	84757	FUSE HOLDER
59	1	84898	CABLE ASSY ROCKER SWITCH BW2600
60	1	85037	REMOTE PENDANT CONNECTOR ASSY
61	1	85449	DRAWBAR 5/8 DIA X 13.31
62	1	85520	WASHER 17mm ID X 32mm OD X 3.9mm BLACK OXIDE
63	1	85869	PLATE AUTO SKIP BACK
64	1	85880	STANDOFF 8-32 MALE X 8-32 FEMALE X 3/4" LONG
65	2	85976	NUT SOCKET CAP 8-32 X .31 OD X .27 LG
66	1	86036	LABEL WARNING - HAND PINCH / MOVING PARTS - GRAPHIC .69 TALL
67	1	86158	LABEL BORTECH BW2600 LOGO 6.3 X 3.5
68	1	86514	ASSY POWER ENTRY MODULE BW2600
69	1	86516	ASSY HARNESS POWER AND CONTROL BW2600
70	1	86517	ASSY POTENTIOMETER AND HARNESS BW2600
71	1	86518	ASSY SWITCH ROTATION AND HARNESS BW2600
72	1	86520	ASSY SWITCH SKIP FILL ON/OFF HARNESS BW2600
73	1	86521	ASSY SWITCH SKIP/FILL AND HARNESS BW2600
74	2	87039	WASHER 5/8 ID X 7/8 OD X .015 THK HARD FIBER
75	1	89797	KNOB POTENTIOMETER 1/4 SHAFT X 1.01 TALL X .92 DIA BLACK PLASTIC
76	1	89798	RING LOCKING AUTO SKIP CAM
77	1	89799	COLLAR CAM HOLDER
78	1	90481	BARREL SHEATH TUBE
79	1	90483	SHEAVE DRIVE AND CAM
80	1	90488	SHEATH TUBE
81	1	90489	COVER SHROUD
82	1	90490	ENCLOSURE SHROUD
83	1	90539	INDICATOR FEED
84	1	90627	LABEL - RUN POSITION BW2600
85	1	90843	BRG NEEDLE 1-1/2 ID X 1-7/8 X 1.312 OPEN 1 SEAL
86	1	90865	KEY 1/8 X 3/16 X 5/16 LONG RADIUS BOTH ENDS
87	1	103142	GEARMOTOR 90 VDC 6.6 RPM 189 IN-LBS TORQUE 776.76:1
88	1	103280	BRACKET MOTOR DRIVE (MMP)
89	1	103281	PULLEY ROTATION MOTOR STD (MMP)
90	1	103282	PLATE BASE MOTOR MOUNT (MMP)
91	1	103283	BLOCK MOTOR MOUNT BW2600 / BW1000 (MMP)
92	1	103284	CLAMP LOOP VIBRATION DAMPENING 1-1/2 ID
93	1	103285	NUT CLIP ON 8-32 0.04IN MAX THICKNESS
94	1	103632	SCREW 8-32 X 1 BHSCS
95	1	103633	STUD PARTIALLY THREADED M4 X 0.70 X 12MM LG STEEL
96	1	105778	POSITIONER BW2600 SPRAG CLUTCH
97	1	106481	LABEL STEP ENGAGED POSITION BW2600 GEN III

FIGURE A-3. WELD HEAD ASSEMBLY PARTS LIST 2 (P/N 106402)



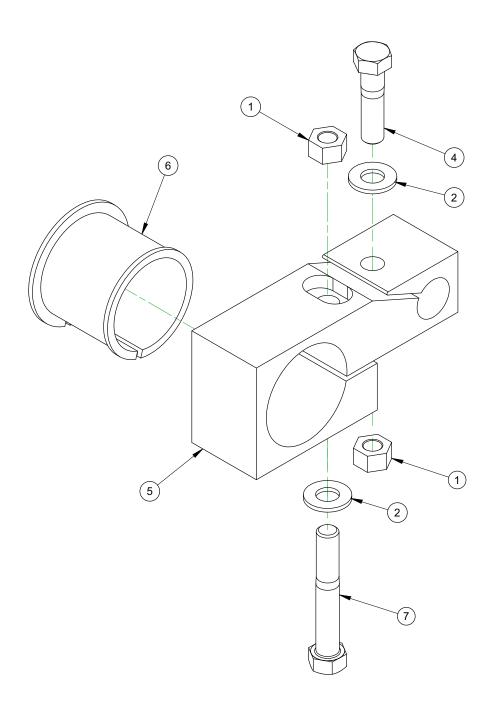


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			PARTS LIST
ITEM	QTY	P/N:	DESCRIPTION
1	1	10058	WASHER THRUST .375 ID X .812 OD X .032
2	1	10560	SCREW 10-32 X 3/8 FHSCS
3	1	10836	BRG CAM FOLLOW .500 X .344
4	2	10846	PIN ROLL 3/32 DIA X 3/8
5	1	11808	RING EXTERNAL SNAP 3/8 ID X .025 THK
6	2	12446	BRG THRUST .562 ID X 1.000 OD X .0781
7	1	12897	SCREW 10-32 X 3/16 SSSNT
8	4	15173	WASHER THRUST .562 ID X 1.000 OD X .030
9	1	17153	PIN DOWEL 1/8 DIA X 1
10	1	17785	BRG THRUST 1.125 ID X 1.750 OD X .078
11	1	22480	PIN DOWEL 1/8 DIA X 1/2
12	2	24331	WASHER THRUST 1.125 X 1.750 X .03
13	1	28060	NUT, 10-32 UNF KEPS
14	1	63514	WASHER FIBER 3/8 ID X 7/8 OD X .11
15	1	84493	NUT 3/8-24 NYLON INSERT LOCKING GRADE 8 LOW PROFILE
16	1	84565	WASHER SPRING BELLEVILLE .438 ID X .75 OD X .02 THICK
17	3	85877	KEY 3/32 SQ X .31 SQ BOTH ENDS
18	1	90844	SCREW 1/4-20 X 1-1/4 THUMB KNURLED
19	1	90849	GEAR SPUR 24 DP 26 TOOTH NO HUB
20	1	91542	SPRING COMP .36 OD X .032 WIRE X 1.00 LONG
21	1	95046	SPRING EXT .180 OD X .029 WIRE X 1.00 LONG SS
22	1	105764	WASHER .203 ID X .812 OD #10 82 COUNTER SUNK
23	1	105766	SHAFT FEED
24	1	105767	SLEEVE STEP DRIVE BW2600
25	1	105768	NUT SPECIAL ENGAGEMENT 7/8-9
26	1	105769	LEVER STEP ACTIVATOR BW2600
27	1	105772	KNOB FEED SELECTOR
28	1	105779	HOUSING FEED ASSY BW2600
29	1	105781	NUT 9/16-18 JAMN MODIFIED
30	1	105832	SPACER .375 OD X .192 ID X .188 LG STEEL
31	1	105833	PLUNGER BALL PUSHFIT 1/8 DIA .252 .75-2.5 LBS
32	1	105834	WASHER THRUST 22MM ID X 38MM OD X 1.5MM PLASTIC
33	1	105836	BRG SPRAG CLUTCH 15MM ID X 35MM OD X 11MMM
34	1	106395	CAM FOLLOWER ARM BW2600 STEP
35	1	106398	WASHER SPRING STACKED WAVE .375 ID X .562 OD X .195 H

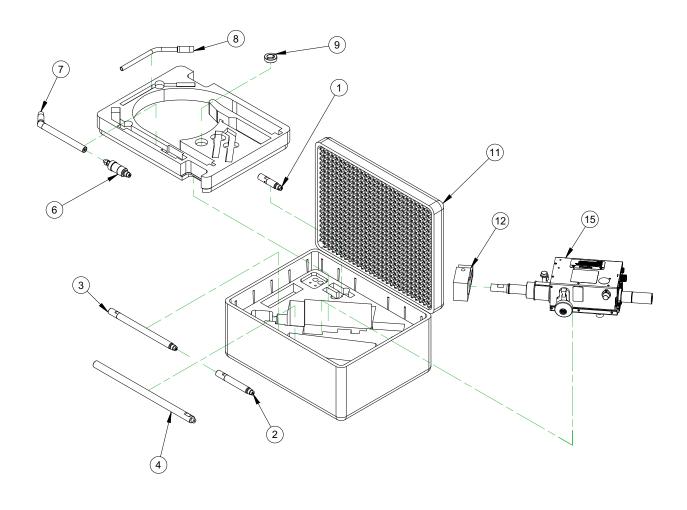
FIGURE A-5. STEP POSITIONER ASSEMBLY PARTS LIST (P/N 105778)





	PARTS LIST				
ITEM	QTY	P/N:	DESCRIPTION		
1	2	10849	NUT 1/2-13 STDN		
2	2	11779	WASHER 1/2 FLTW SAE PLAIN FINISH		
4	1	39179	SCREW 1/2-13 X 2 HHHCS GRADE 8		
5	1	85769	MOUNT RADIAL		
6	1	85770	SLEEVE MOUNT RADIAL ISOLATION		
7	1	85773	SCREW 1/2-13 X 3-1/4 HHCS		

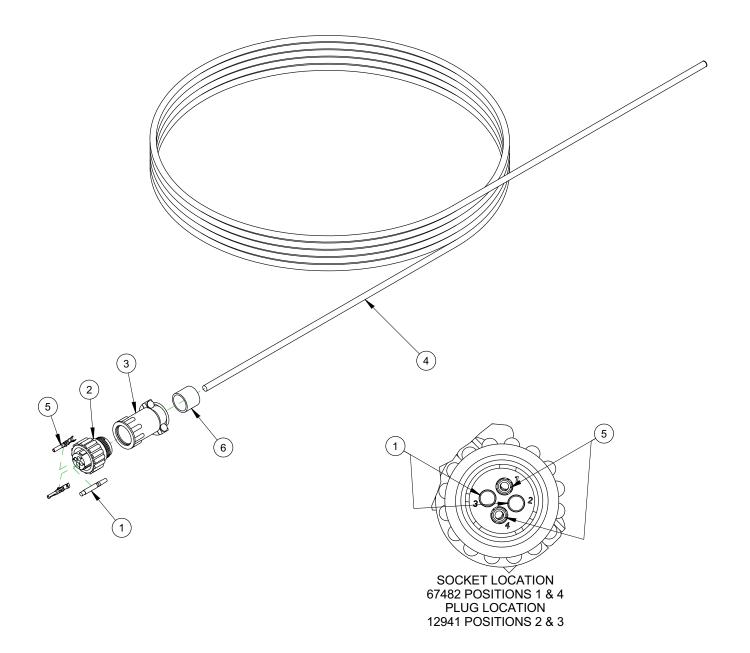
FIGURE A-6. RADIAL ISOLATION MOUNT ASSEMBLY (P/N 85771)



	PARTS LIST				
ITEM	QTY	P/N:	DESCRIPTION		
1	1	29038	TORCH EXTENSION 76MM (3)		
2	1	29039	TORCH EXTENSION 152MM (6)		
3	1	29040	TORCH EXTENSION 305MM (12)		
4	1	30773	SUPPORT ROD WELD HEAD		
5	1	34396	(NOT SHOWN) CORD POWER IEC 320 X NEMA 5-15 7.5 FT		
6	1	35603	ASSY SWIVEL FOR TORCH BW1000		
7	1	39725	TORCH SWIVEL #1 2.75 TO 8.2 INCH DIA (70 TO 208 MM)		
8	1	39726	TORCH SWIVEL #2 8 TO 12 INCH DIA (203 TO 305 MM)		
9	1	63596	CLAMP COLLAR 1 ID X 1-3/4 OD X 1/2 WIDE ONE PIECE		
10	1	73879	(NOT SHOWN) CORD POWER 230V 3 METER 16 AWG IEC320 C13 X CEE7/7 BLACK		
11	1	85731	CASE PELICAN ALL WEATHER B/BW2600 CUSTOM FOAM 1620NL		
12	1	85771	ASSY MOUNT RADIAL ISOLATION		
13	1	86863	(NOT SHOWN) KIT TOOL MODEL BW2600		
14	1_	102344	(NOT SHOWN) DECLARATION OF CONFORMITY CE BW1 BW26 BW3 BW5		
15	1	106402	ASSY WELD HEAD BW2600 120/230VAC CE GEN III		
16	1	106411	(NOT SHOWN) MANUAL INSTRUCTION BW2600 GEN III		

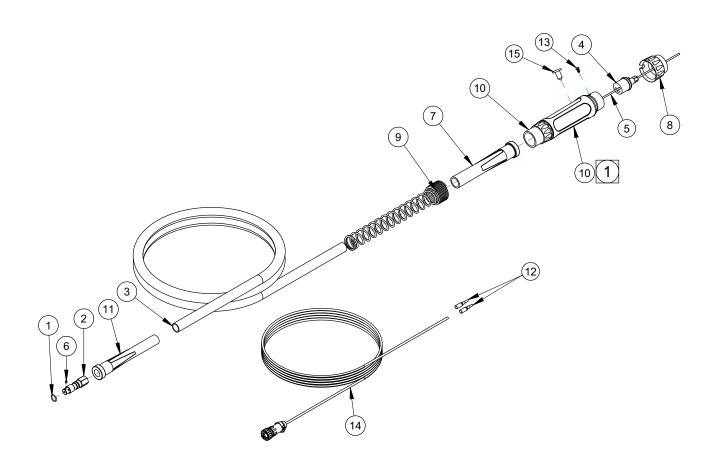
FIGURE A-7. BASE UNIT AND PELICAN CASE ASSEMBLY (P/N 106404)





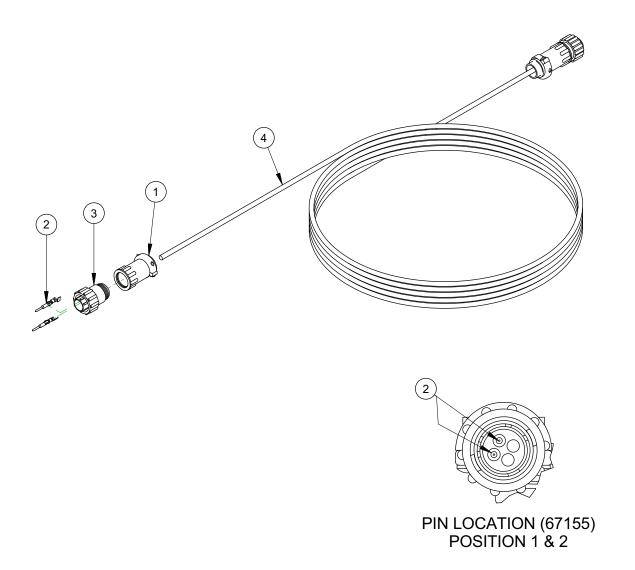
	PARTS LIST					
ITEM	QTY	P/N:	DESCRIPTION			
2	1	67057	CONNECTOR PLUG 11-4 METAL SHELL			
3	1	67060	CABLE CLAMP LARGE SIZE 11			
4	1	67280	CABLE POWER 2 CONDUCTOR 18 AWG 300 VAC RUBBER JACKET BLACK			
5	2	67482	CONTACT SOCKET AWG 18-16 CRIMP			
6	1	67734	HEAT SHRINK TUBE 1/2 DIA BLACK			
1	2	12941	PLUG KEYING CIRCULAR CONNECTOR			

FIGURE A-8. BLANK END CONTRACTOR WITH FOUR PIN ASSEMBLY (P/N 85396)



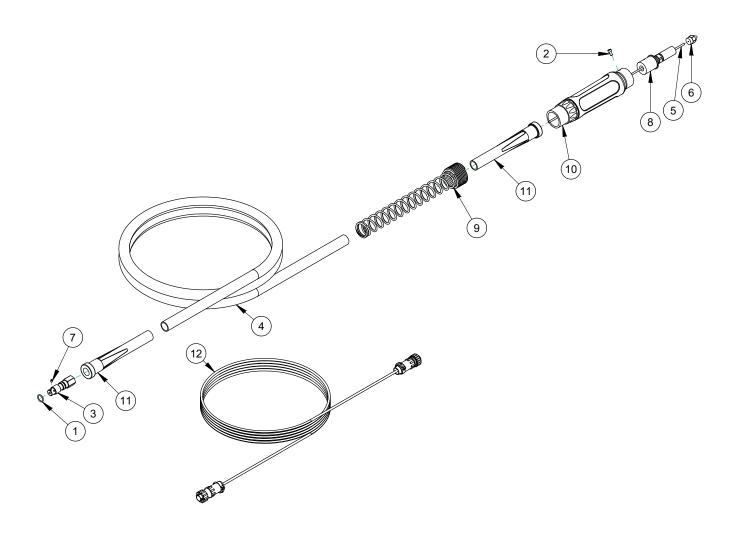
	PARTS LIST				
ITEM	QTY	P/N:	DESCRIPTION		
1	1	10840	RING O 1/16 X 1/2 ID X 5/8 OD (VMI)		
2	1	41003	FTG QUICK COUPLER MALE		
3	1	41006	CABLE ASSY 8FT		
4	1	41010	END CONNECTOR EURO		
5	1	48552	LINER TWECO .023 .045 WIRE X 15 FT LONG		
6	1	66872	SCREW 6-32 X 3/16 SSSCP		
7	1	67307	SUPPORT CABLE LARGE		
8	1	67336	NUT EURO 174X-2		
9	1	67338	SUPPORT CABLE SPRING		
10	1	67341	PLUG HOUSING EURO		
11	1	67342	SUPPORT CABLE EURO BACK END		
12	2	67403	TERMINAL SNAP-PLUG MALE 22-18AWG HEAT-SHRINK		
13	1	79219	SCREW M4 X 0.7 X 8MM BHSCS		
14	1	85396	CONTACTOR BW2600 BLANK END W / 4 PIN ASSY		
15	1	86557	RIVET RIBBED DIA .394 X .06787 THICK NYLON BLK		

FIGURE A-9. CONDUIT ASSEMBLY WITH EURO CONNECTOR (P/N 85435)



	PARTS LIST					
ITEM	QTY	P/N:	DESCRIPTION			
1	1	67060	CABLE CLAMP LARGE SIZE 11			
2	2	67155	TERMINAL PIN 18-16 AWG			
3	1	67160	CONNECTOR PLUG 4 PIN REVERSE MALE/FEMALE SIZE 11			
4	1	85396	CONTACTOR BW2600 BLANK END W / 4 PIN ASSY			

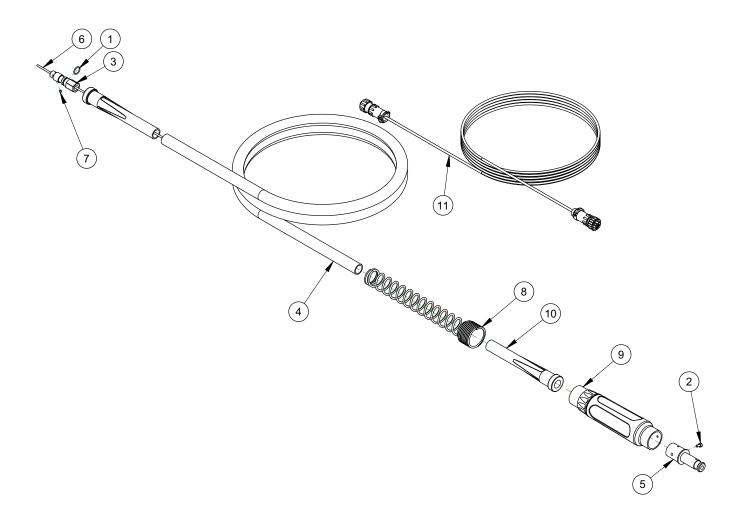
FIGURE A-10. POWER SUPPLY FOR SWITCH MILLER ASSEMBLY (P/N 85475)



			DADTOLICT				
	PARTS LIST						
ITEM	QTY	P/N:	DESCRIPTION				
1	1	10840	RING O 1/16 X 1/2 ID X 5/8 OD (VMI)				
2	1	35910	SCREW M4 X 0.7 X 8MM SHCS				
3	1	41003	FTG QUICK COUPLER MALE				
4	1	41006	CABLE ASSY 8FT				
5	1	48552	LINER TWECO .023 .045 WIRE X 15 FT LONG				
6	1	66853	NUT POWER PIN				
7	1	66872	SCREW 6-32 X 3/16 SSSCP				
8	1	67333	BODY POWER PIN MILLER				
9	1	67338	SUPPORT CABLE SPRING				
10	1	67341	PLUG HOUSING EURO				
11	2	67342	SUPPORT CABLE EURO BACK END				
12	1	85475	SWITCH MILLER PWR SUPPLY BW2600				

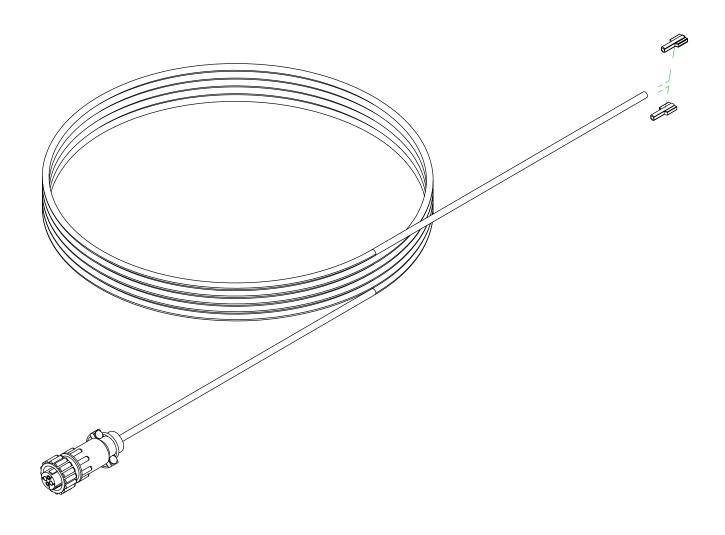
FIGURE A-11. CONDUIT ASSEMBLY FOR MILLER (P/N 85476)





	PARTS LIST				
ITEM	QTY	P/N:	DESCRIPTION		
1	1	10840	RING O 1/16 X 1/2 ID X 5/8 OD (VMI)		
2	1	35910	SCREW M4 X 0.7 X 8MM SHCS		
3	1	41003	FTG QUICK COUPLER MALE		
4	1	41006	CABLE ASSY 8FT		
5	1	41008	SP END TWECO		
6	1	48552	LINER TWECO .023 .045 WIRE X 15 FT LONG		
7	1	66872	SCREW 6-32 X 3/16 SSSCP		
8	1	67338	SUPPORT CABLE SPRING		
9	1	67341	PLUG HOUSING EURO		
10	2	67342	SUPPORT CABLE EURO BACK END		
11	1	85475	SWITCH MILLER PWR SUPPLY BW2600		

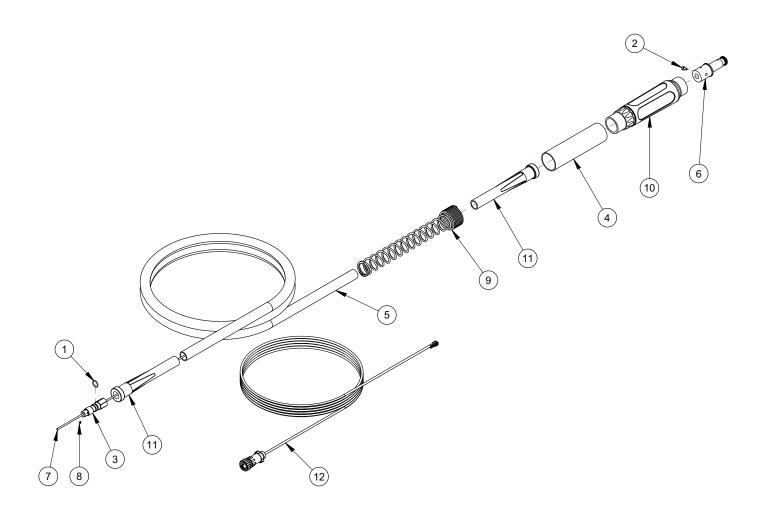
FIGURE A-12. CONDUIT POWER ASSEMBLY FOR MIG 225 LINCOLN (P/N 85527)



	PARTS LIST				
ITEM	QTY	P/N:	DESCRIPTION		
1	2	67050	CONNECTOR SOCKET DBL CRIMP 22-18 AWG .250 X .032 RED		
2	1	85396	CONTACTOR BW2600 BLANK END W / 4 PIN ASSY		

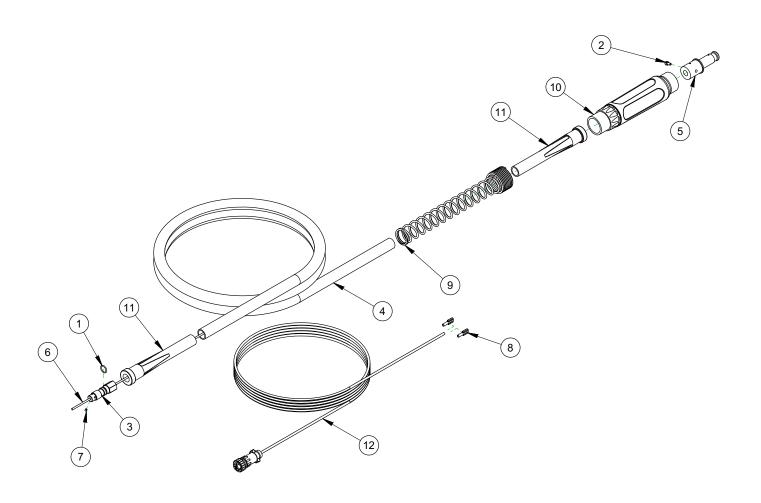
Figure A-13. Contactor assembly for Hobart and Thermal arc (P/N 85530)





	PARTS LIST				
ITEM	QTY	P/N:	DESCRIPTION		
1	1	10840	RING O 1/16 X 1/2 ID X 5/8 OD (VMI)		
2	1	35910	SCREW M4 X 0.7 X 8MM SHCS		
3	1	41003	FTG QUICK COUPLER MALE		
4	1	41005	HEAT SHRINK TUBE 1-1/2 DIA BLACK		
5	1	41006	CABLE ASSY 8FT		
6	1	41008	SP END TWECO		
7	1	48552	LINER TWECO .023 .045 WIRE X 15 FT LONG		
8	1	66872	SCREW 6-32 X 3/16 SSSCP		
9	1	67338	SUPPORT CABLE SPRING		
10	1	67341	PLUG HOUSING EURO		
11	2	67342	SUPPORT CABLE EURO BACK END		
12	1	85530	CONTACTOR ASSY HOBART & THERMAL ARC BW2600		

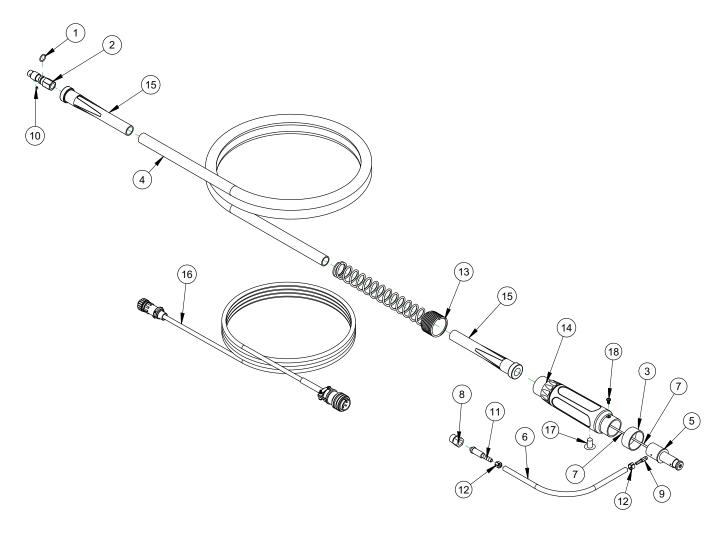
FIGURE A-14. CONDUIT ASSEMBLY FOR HOBART AND THERMAL ARC HEFTY II (P/N 85532)



	PARTS LIST				
ITEM	QTY	P/N:	DESCRIPTION		
1	1	10840	RING O 1/16 X 1/2 ID X 5/8 OD (VMI)		
2	1	35910	SCREW M4 X 0.7 X 8MM SHCS		
3	1	41003	FTG QUICK COUPLER MALE		
4	1	41006	CABLE ASSY 8FT		
5	1	41008	SP END TWECO		
6	1	48552	LINER TWECO .023 .045 WIRE X 15 FT LONG		
7	1	66872	SCREW 6-32 X 3/16 SSSCP		
8	2	67048	TERMINAL QUICK DISCONNECT DBL CRIMP MALE 22-18 AWG .250 X .032 RED		
9	1	67338	SUPPORT CABLE SPRING		
10	1	67341	PLUG HOUSING EURO		
11	2	67342	SUPPORT CABLE EURO BACK END		
12	1	85396	CONTACTOR BW2600 BLANK END W / 4 PIN ASSY		

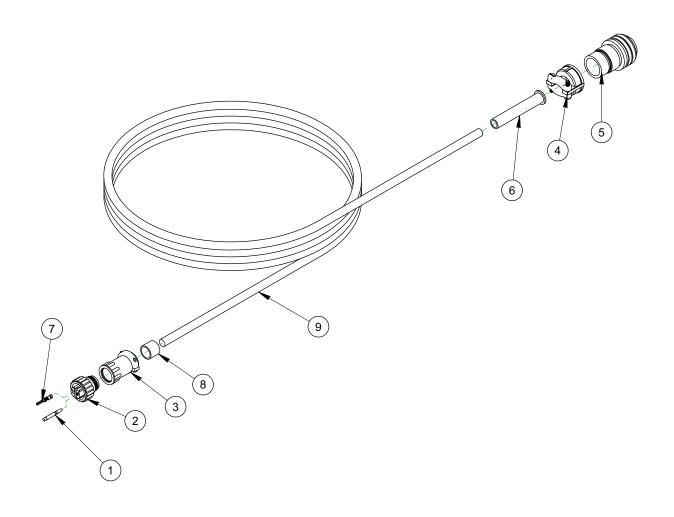
FIGURE A-15. CONDUIT ASSEMBLY FOR TWECO (P/N 85534)





PARTS LIST						
ITEM	QTY	P/N:	DESCRIPTION			
1	1	10840	RING O 1/16 X 1/2 ID X 5/8 OD (VMI)			
2	1	41003	FTG QUICK COUPLER MALE			
3	.75"	41005	HEAT SHRINK TUBE 1-1/2 DIA BLACK			
4	1	41006	CABLE ASSY 8FT			
5	1	41009	SP END LINCOLN			
6	12"	43546	TUBING 3/16 ID 3/8 OD PVC CLEAR			
7	1	48552	LINER TWECO .023 .045 WIRE X 15 FT LONG			
8	1	48939	NUT SIZE B INERT GAS			
9	1	64119	NIPPLE BARBED FOR A 41009			
10	1	66872	SCREW 6-32 X 3/16 SSSCP			
11	1	67033	FTG NIPPLE INERT GAS B SIZE 1/4 HOSE			
12	2	67064	CLAMP HOSE 3/8 DIA DBL PINCH STEEL			
13	1	67338	SUPPORT CABLE SPRING			
14	1	67341	PLUG HOUSING EURO			
15	2	67342	SUPPORT CABLE EURO BACK END			
16	1	85540	CONTACTOR ASSY LINCOLN BW2600			
17	1	86557	RIVET RIBBED DIA .394 X .06787 THICK NYLON BLK			
18	1	86565	5 SCREW M4 X 0.7 X 8MM PPHMS ZINC			

FIGURE A-16. CONDUIT ASSEMBLY FOR LINCOLN (P/N 855360)



PARTS LIST							
ITEM	QTY	P/N:	DESCRIPTION				
1	2	12941	PLUG KEYING CIRCULAR CONNECTOR				
2	1	67057	CONNECTOR PLUG 11-4 METAL SHELL				
3	1	67060	CABLE CLAMP LARGE SIZE 11				
4	1	67138	CONNECTOR CABLE CLAMP MS3057A SIZE 18				
5	1	67147	CONNECTOR STRAIGHT PLUG SIZE 18 5-PIN				
6	1	67214	RUBBER BUSHING FOR MS3057A CABLE CLAMP .312 ID				
9	1	83988	CORD TYPE SOOW 18 AWG 5 COND 600V .325 OD UNSHIELDED				
			GRAY JACKET				
7	2	67482	CONTACT SOCKET AWG 18-16 CRIMP				
8	1	67734	HEAT SHRINK TUBE 1/2 DIA BLACK				

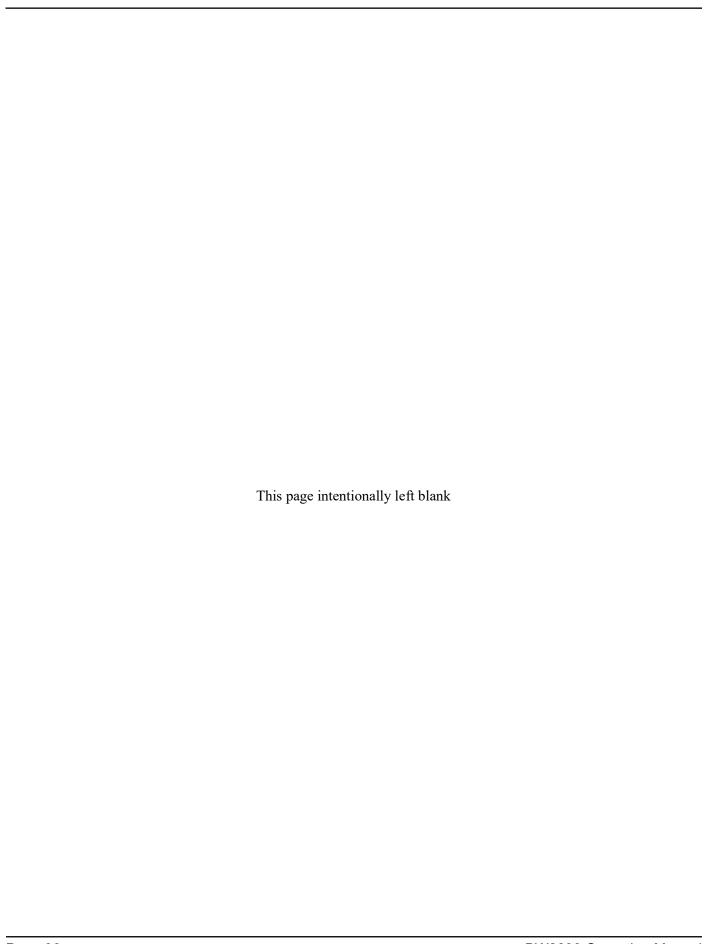
FIGURE A-17. CONTACTOR ASSEMBLY FOR LINCOLN 5 PIN (P/N 85540)



## APPENDIX B SCHEMATICS

## IN THIS CHAPTER:

Figure B-1. Schematic (P/N 84635)	-97
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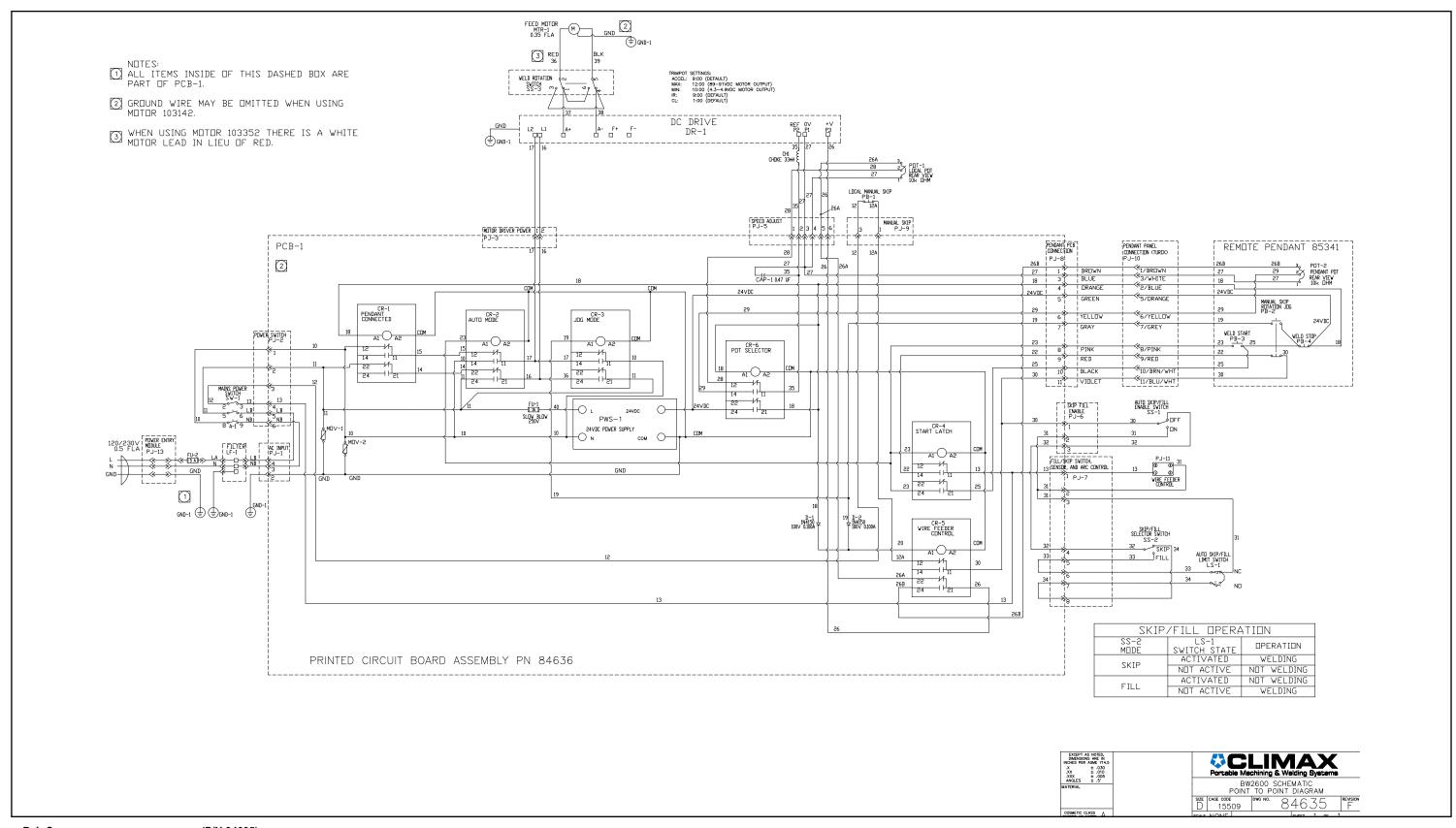


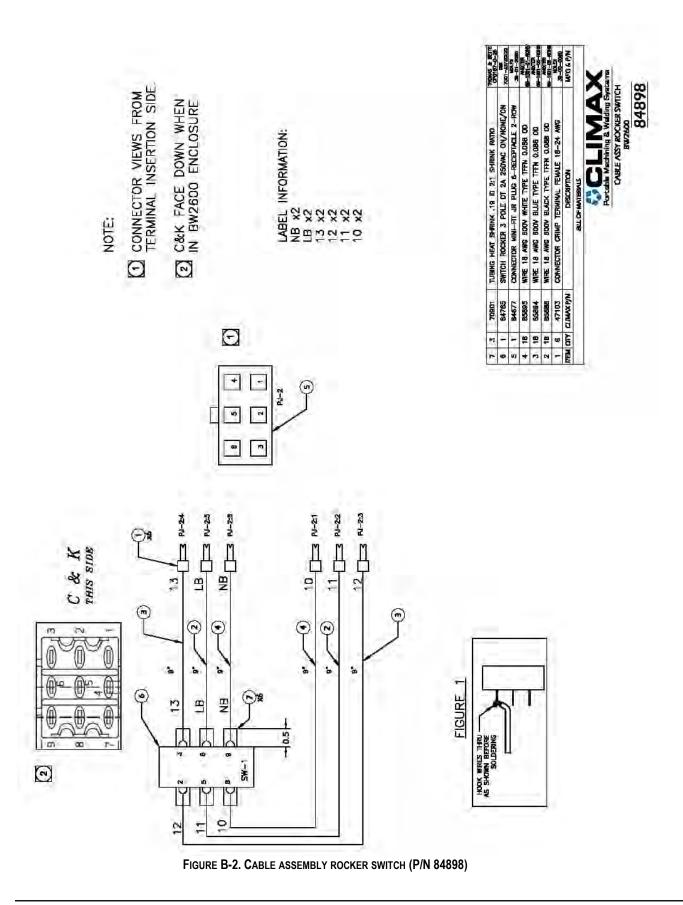
FIGURE B-1. CONTROL ENCLOSURE SCHEMATIC (P/N 84635)

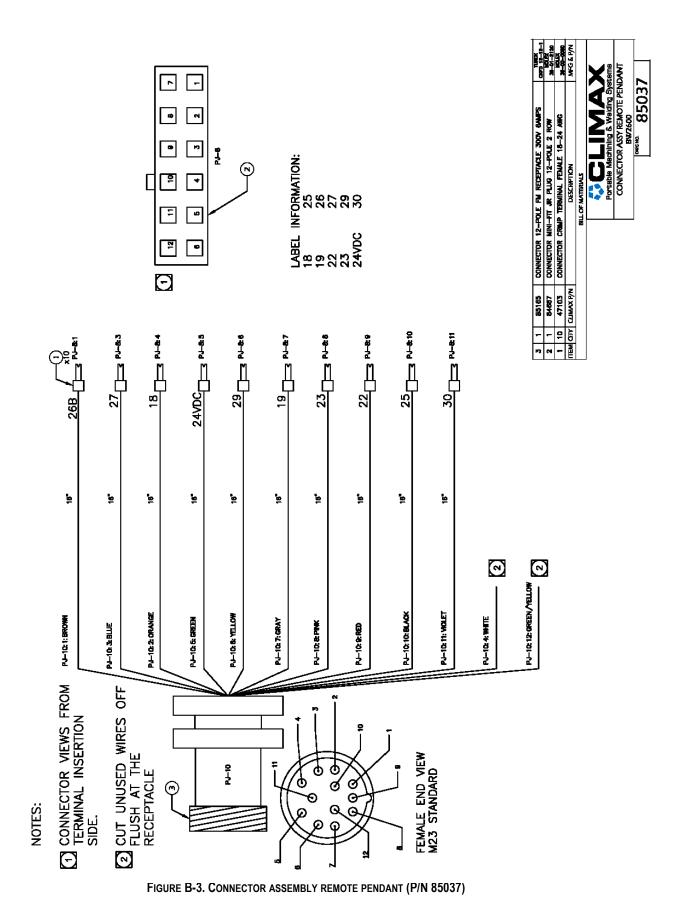
P/N 106411 Rev. 2

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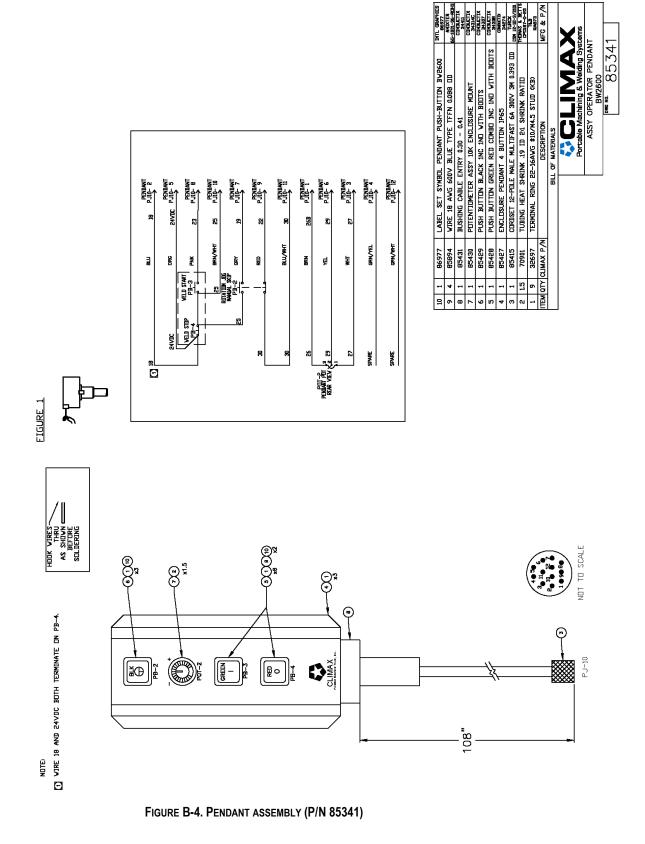
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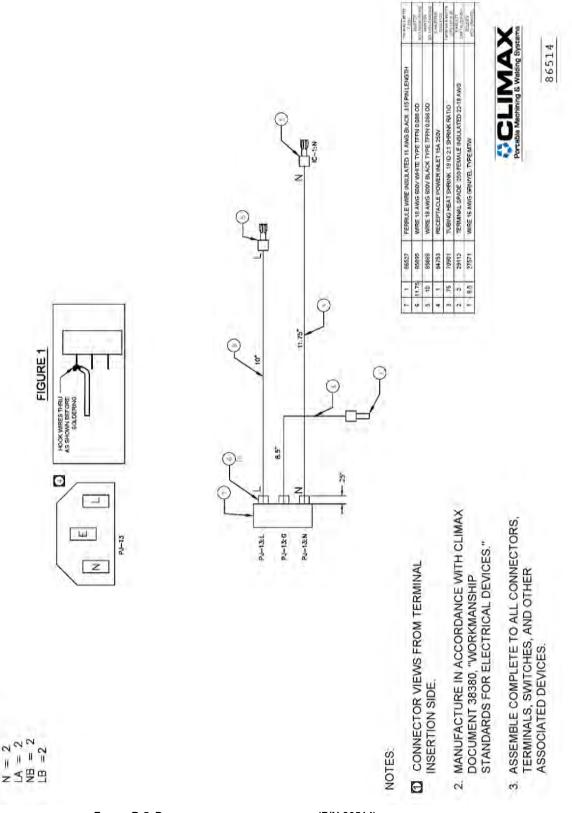


FIGURE B-5. POWER ENTRY MODULE ASSEMBLY (P/N 86514)

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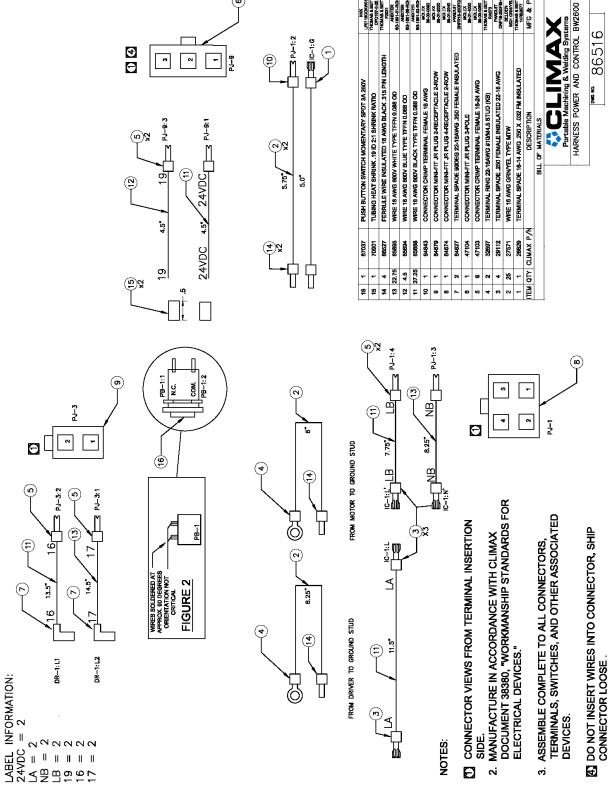
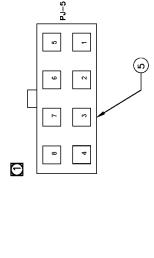


FIGURE B-6. POWER AND CONTROL HARNESS ASSEMBLY (P/N 86516)

P/N 106411 Rev. 2



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- 2X .6" - 2X .5"

> CH1 CHOKE 33mH

> > DR-1: P2

8.5

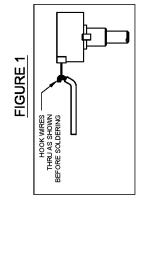
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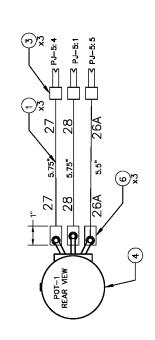
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(80)

DR-1: P3

FIGURE B-7. POTENTIOMETER AND HARNESS ASSEMBLY (P/N 86517)





NOTES:

- CONNECTOR VIEWS FROM TERMINAL INSERTION SIDE.
- MANUFACTURE IN ACCORDANCE WITH CLIMAX DOCUMENT 38380, "WORKMANSHIP STANDARDS FOR ELECTRICAL DEVICES."
- 3. ASSEMBLE COMPLETE TO ALL CONNECTORS, TERMINALS, SWITCHES, AND OTHER ASSOCIATED DEVICES.
- SHRINK .19 ID OVER THE SOLDERED CONNECTION OF THE CHOKE THEN SHRINK .25 ID SHRINK TUBE OVER TOP.

86518

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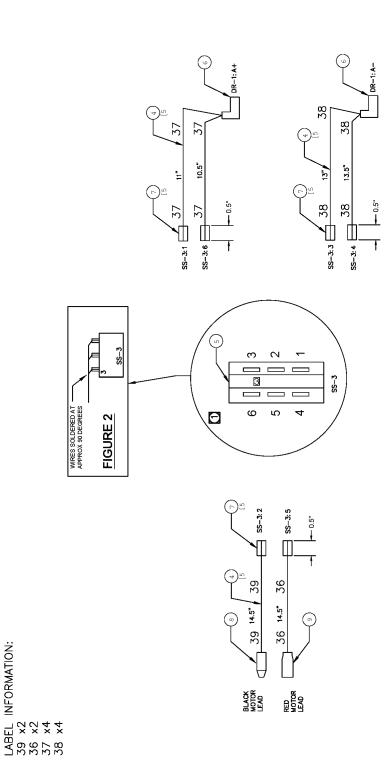


FIGURE B-8. SWITCH ROTATION AND HARNESS ASSEMBLY (P/N 86518)

TERMINAL SPADE 90DEG 16-14AWG .250 FEMALE INSULATED SWITCH SLIDE DPDT 15A@125 VAC 6A@250VAC 1A@125VDC WIRE 18 AWG 600V BLUE TYPE TFFN 0.088 OD TERMINAL SNAP-PLUG FEMALE 22-18AWG HEAT-SHRINK TUBING HEAT SHRINK .19 ID 2:1 SHRINK RATIO 67404 67403 70901



ASSEMBLE COMPLETE TO ALL CONNECTORS, TERMINALS, SWITCHES, AND OTHER ASSOCIATED DEVICES. က်

MANUFACTURE IN ACCORDANCE WITH CLIMAX DOCUMENT 38380, "WORKMANSHIP STANDARDS FOR ELECTRICAL DEVICES." INSERTION SIDE. κi

CONNECTOR VIEWS FROM TERMINAL

NOTES:

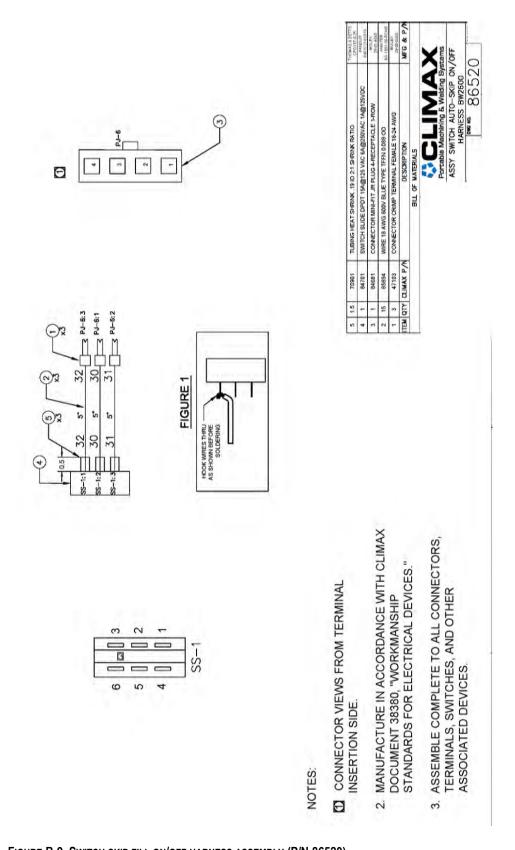
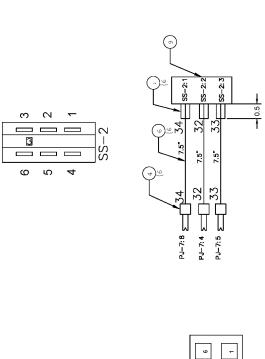


FIGURE B-9. SWITCH SKIP FILL ON/OFF HARNESS ASSEMBLY (P/N 86520)

LABEL INFORMATION: 30 x2 31 x2 32 x2

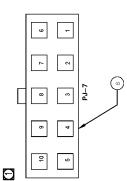


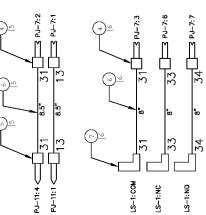
86521

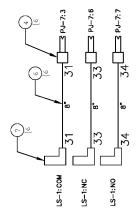










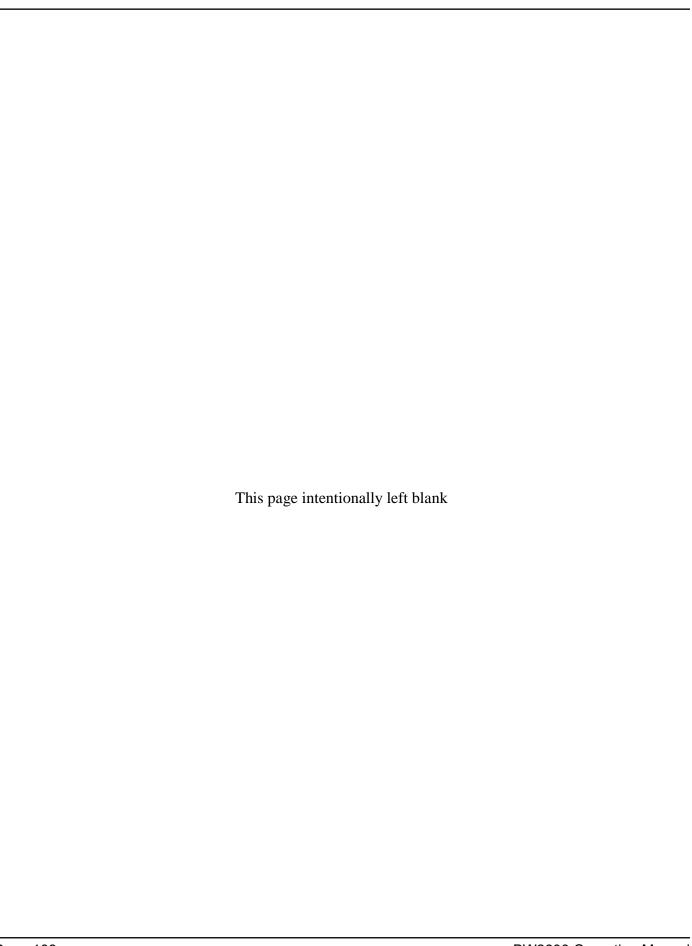


NOTES:

- CONNECTOR VIEWS FROM TERMINAL INSERTION SIDE. oxtless
- MANUFACTURE IN ACCORDANCE WITH CLIMAX DOCUMENT 38380, "WORKMANSHIP STANDARDS FOR ELECTRICAL DEVICES." ςi
- ASSEMBLE COMPLETE TO ALL CONNECTORS, TERMINALS, SWITCHES, AND OTHER ASSOCIATED DEVICES. က

LABEL INFORMATION: 13 x2 31 x4 32 x2 33 x4 34 x4

FIGURE B-10. SWITCH SKIP FILL AND HARNESS ASSEMBLY (P/N 86521)





## APPENDIX C SDS

Contact CLIMAX for the latest Safety Data Sheets.

