CE only applies to the entire machine when P/N 40831 is included

BW1000

WELDING MACHINE

OPERATING MANUAL

ORIGINAL INSTRUCTIONS

CLIMAX
Portable Machining & Welding Systems

P/N 40831
October 2022
Revision 5

CLIMAX | BORTECH CALDER H&S TOOL

Table of Contents

Labeling Guidelines

The purpose of product safety signs and labels is to increase the level of awareness to possible dangers.

Safety Alert Symbols indicate DANGER, WARNING or CAUTION. These symbols may be used in conjunction with other symbols or pictographs. Failure to obey safety warnings can result in serious injury. Always follow safety precautions to reduce the risk of hazards and serious injury.

	**DANGER** **Indicates a hazardous situation that could be fatal or cause serious injury.**
	**WARNING** **Indicates a potentially hazardous situation that could be fatal or cause serious injury.**
	**CAUTION** **Indicates a potentially hazardous situation that could result in minor to moderate injury, damage to the machine or interruption of an important process.**
	**IMPORTANT** **Provides critical information for the completion of a task. There is no associated hazard to people or the machine.**
	**TIP** **Provides important information regarding the machine.**

Safety

Precautions and Rules for Safe Operation

- The BW1000 is designed for safety and ease of use. As with the operation of any machinery, safety depends on the operator.
- It is most important that the operators read and understand the specific instructions for set-up and operation of the BW1000 found in the operator's guide as well as the following safety information.
- Only qualified individuals should attempt set-up, maintenance, and operation of the BW1000.
- To assure that nothing gets caught in rotating BW1000 members, avoid wearing loose fitting clothing and keep hair back or in a cap when operating the machine.
- Turn off the input power before changing torches or working on the machine.
- Read and follow all instructions for the power supply unit that you have chosen to use with the BW1000.

Additional Welding Safety Precautions

- The operator and any personnel observing the machine when in use must use a protective shield with a filter and cover plates which conform to ANSI Z87.1 standards.
- The operator needs protective clothing such as heavy shirts and cuffless pants of a durable flame resistant material for protection from sparks and flame. Other personnel in the area need to be protected from the arc rays by a screen and/or a warning not to watch or otherwise expose themselves to the rays or to any hot spatter.
- Practice "good housekeeping" in the area around the Borewelder. Keep combustibles or any other fire hazards well away from the work area. For in-shop use have a fire extinguisher readily available.
- Welding may produce gases and fumes that are dangerous to breathe. Sufficient ventilation is needed to remove smoke while the machine is in use. The operator should keep his head out of the fumes.
- Make the electrical installation in accordance with the National Electrical Code and all local codes where applicable.
- Caution must be taken with regard to potentially dangerous electric shock. Do not ever contact electrically live parts. Your hands can be insulated with dry, hole-free leather gloves. When working in any damp areas or on metal floors, you must insulate yourself from the ground and the work, making sure you have complete protection if you are sitting or lying on the ground to operate the machine.
- If welding and boring are conducted at the same time, take care with the location and quality of the weld ground conductor. Poor grounding may result in irreparable damage to the equipment.

  To obtain additional details on safety precautions, CLIMAX highly recommends "Safety in Welding and Cutting", American National Standard ANSI Z49.1, which can be purchased from the American Welding Society, Inc., 550 N.W. Lejeune Rd., Miami, Florida 33126. Their ordering number is 1-800-443-9353.

Safety Precautions: General Hazards

The primary challenge for most on-site maintenance is that repairs are often done under difficult conditions. Climax Portable Machining & Welding Systems leads the way in promoting the safe use of portable machine tools. Safety is a joint effort. As the operator of this machine, you are expected to do your part by scrutinizing the job site and closely following the operating procedures outlined in this manual, your own company rules, and local regulations. Save all warnings and instructions for future reference.

WARNING

Read all safety warnings and all instructions !

For maximum safety and performance, read and understand this entire manual and all other related safety instructions before using this equipment. Failure to follow the warnings, instructions and guidelines in this manual could cause personal injury, fatalities, electric shock, fire and/or property damage.

QUALIFIED PERSONNEL

Before operating this machine, you must receive training specific to this machine from a qualified trainer. If you are not familiar with the proper and safe operation, do not use the machine.

OBEY WARNING LABELS

Obey all warnings and warning labels. Failure to follow instructions or heed warnings could result in injury, or even be fatal. Proper care is your responsibility. Contact Climax immediately for replacement of damaged or lost manuals or safety decals. 1-800-333-8311

INTENDED USE

Only use the machine according to the instructions in this operating manual. Do not use this machine for any purpose other than the intended use as described in this manual. When using tools, machine, accessories and/or tool bits, you must determine the proper working conditions and the work to be performed.

STAY CLEAR OF MOVING PARTS

Keep clear of the machine during operation. Never lean toward or reach into the machine to remove chips or to adjust the machine while it is running. Keep bystanders away while operating this machinery.

ROTATING MACHINERY

Rotating machinery can seriously injure an operator. Lock out all power sources before you interact with the machine.

KEEP YOUR WORK AREA CLEAN AND TIDY

Keep all cords and hoses away from moving parts during operation. Do not clutter the area around the machine. Keep the work area clean and well lit.

AMBIENT LIGHTING

Do not operate this machine in ambient lighting that is less than normal intensity.

SECURE LOOSE CLOTHING AND LONG HAIR

Rotating machinery can seriously injure an operator as well as others close by. Don’t wear loose fitting clothing or jewelry. Tie back long hair or wear a hat.

HAZARDOUS ENVIRONMENTS

Do not use the machine in a hazardous environment, such as near explosive chemicals, flammable liquids, gasses, toxic fumes, or inappropriate radiation hazards.

HOSES, PENDANT AND ELECTRICAL CABLES

Do not abuse cables. 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 or moving parts. Plugs must match the outlet. Never modify the plugs in any way. Do not use an adapter plug with grounded power tools. Do not expose the machine to rain or wet conditions. Always examine hoses and cables for damage before use. Be cautious and never drop electrical equipment, this will damage the components.

REPETITIVE MOTION

Individuals can be susceptible to disorders of the hands and arms when exposed to tasks that involve highly repetitive motions and/or vibration.

STAY ALERT

Stay alert, watch what you are doing and use common sense when operating machinery. Do not operate machinery while you are tired or under the influence of drugs, alcohol or medication.

Risk assessment and hazard mitigation

Machine Tools are specifically designed to perform precise material-removal operations.

Stationary Machine Tools include lathes and milling machines and are typically found in a machine shop. They are mounted in a fixed location during operation and are considered to be a complete, self-contained machine. Stationary Machine Tools achieve the rigidity needed to accomplish material-removal operations from the structure that is an integral part of the machine tool.

In contrast, Portable Machine Tools are designed for on-site machining applications. They typically attach directly to the workpiece itself, or to an adjacent structure, and achieve their rigidity from the structure to which it is attached. The design intent is that the Portable Machine Tool and the structure attached to it become one complete machine during the material-removal process.

To achieve the intended results and to promote safety, the operator must understand and follow the design intent, set-up, and operation practices that are unique to Portable Machine Tools.

The operator must perform an overall review and on-site risk assessment of the intended application. Due to the unique nature of portable machining 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 Machine Tool and the workpiece as a whole.

Risk assessment checklist

Use these checklists as part of your on-site risk assessment and include any additional considerations that may pertain to your specific application.

TABLE 1. 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, cutting, crushing, entanglement, shearing, or falling objects).
☐	I considered the need for personnel safety guarding and installed any necessary guards.
☐	I read the Machine Assembly instructions and took inventory of all the items required but not supplied.
☐	I created a lift plan, including identifying the proper rigging, for each of the setup lifts required during the setup of the support structure and machine.
☐	I located the fall paths involved in lifting and rigging operations. I have taken precautions to keep workers away from the identified fall path.
☐	I considered how this machine operates and the best placement for the controls, cabling, and the operator.
☐	I evaluated and mitigated any other potential risks specific to my work area.

TABLE 2. RISK ASSESSMENT CHECKLIST AFTER SET-UP

After Set-up	
☐	I checked that the machine is safely installed and the potential fall path is clear. If the machine is elevated, I checked that the machine is safeguarded against falling.
☐	I identified all possible pinch points, such as those caused by rotating parts, and informed the affected personnel.
☐	I planned for containment of any chips or swarf produced by the machine.
	I followed the Maintenance Intervals with the recommended lubricants.
☐	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.
☐	I evaluated and mitigated any other potential risks specific to my work area.

Limited Warranty

CLIMAX Portable Machine Tools, Inc. (hereafter referred to as “CLIMAX”) warrants that all new machines are free from defects in materials and workmanship. This warranty is available to the original purchaser for a period of one year after delivery. If the original purchaser finds any defect in materials or workmanship within the warranty period, the original purchaser should contact its factory representative and return the entire machine, shipping prepaid, to the factory. CLIMAX will, at its option, either repair or replace the defective machine at no charge and will return the machine with shipping prepaid.

CLIMAX warrants that all parts are free from defects in materials and workmanship, and that all labor has been performed properly. This warranty is available to the customer purchasing parts or labor for a period of 90 days after delivery of the part or repaired machine or 180 days on used machines and components. If the customer purchasing parts or labor finds any defect in materials or workmanship within the warranty period, the purchaser should contact its factory representative and return the part or repaired machine, shipping pre- paid, to the factory. CLIMAX will, at its option, either repair or replace the defective part and/ or correct any defect in the labor performed, both at no charge, and return the part or repaired machine shipping prepaid.

These warranties do not apply to the following:

- Damage after the date of shipment not caused by defects in materials or workmanship
- Damage caused by improper or inadequate machine maintenance
- Damage caused by unauthorized machine modification or repair
- Damage caused by machine abuse
- Damage caused by using the machine beyond its rated capacity

All other warranties, express or implied, including without limitation the warranties of merchantability and fitness for a particular purpose are disclaimed and excluded.

Terms of sale

Be sure to review the terms of sale which appear on the reverse side of your invoice. These terms control and limit your rights with respect to the goods purchased from CLIMAX.

About this manual

CLIMAX provides the contents of this manual in good faith as a guideline to the operator. CLIMAX cannot guarantee that the information contained in this manual is correct for applications other than the application described in this manual. Product specifications are subject to change without notice.

Bortech Limited Warranty

Bortech warrants new equipment, not classified as expendable, against defects in workmanship and material for one year of normal use from the date of receipt by the end user. The following conditions shall be met in order for this warranty to be enforced:

- Equipment has been stored in accordance with Bortech's instructions.
- Equipment has been operated in accordance with Bortech's instructions.
- Equipment has been maintained in accordance with Bortech's instructions.
- Equipment has not been partially or completely disassembled, or otherwise tampered with - without proper written authorization.
- Equipment is owned by the original purchaser

It shall be the warrantee's responsibility to prove compliance with the above conditions of warranty enforcement. Bortech has the option to repair or replace any components or parts of the BW1000 that are determined by Bortech to be defective.

Goods returned are done so at the customers risk and expense, including all transportation and packaging costs. The liability of Bortech Corporation with respect to supplying said equipment or its use by the Buyer, shall not exceed the cost of correcting defects in the equipment or replacing defective parts. When the period of warranty expires, all such liability shall terminate.

Expendable items referred to above, include, but are not limited to torches number 00 and 0, and all tips, nozzles, diffusers, and liners.

CE Data

DECLARATION OF CONFORMITY

Issued by: Climax Portable Machining and Welding Systems

Date of Issue: (Original Dated)

Type of Equipment: Automated Bore Welding Equipment

Brand Name: Climax Portable Machining and Welding Systems BoreWelder

Model Number: BW1000

Serial Numbers: (See Machine)

Audible Noise Levels:

- Surface sound pressure level (in dBA) 70 dBA
- Sound power level (in dBA) 84 dBA
- Sound pressure level for operator (80 dBA) and bystander (75 dBA)

Please note that this information is provided as a guide and you, or your manufacturer, are cautioned that specific requirements are contained within each directive.

Declaration of Conformity

2006/42/EC Machinery Directive

2014/35/EU Low Voltage Directive

2014/30/EU EMC Directive

Name of Manufacturer:
Climax Portable Machining and Welding Systems

Full postal address including country of origin:
2712 E. Second St., Newberg, OR 97132, USA
This declaration of conformity is issued under the sole responsibility of the manufactured (stated above).

Object(s) of the Declaration:
Portable Bore Welder(s)

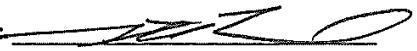
Name, type or model, batch or serial number:
BW1000, BW2600, BW3000, BW5000:
Electrically Powered

S/N Range: 11016661 - 25000000

Harmonised Standards used, including number:
EN 1032:2003+A1:2008 - Mechanical Vibration Testing
EN ISO 12100:2010 - Safety for Machinery; Principles
EN ISO 13849-1:2015 - Safety of Machinery; Controls
EN 61000 series - EMC Emissions and Immunity
EN ISO 3744:2010 - Acoustic Power
EN ISO 13732-1:2008 - Temperature of Touchable Surfaces
EN 60204-1:2018 - Safety of Machinery; Electrical Equipment

Full postal address of the authorized person in the Community:
Guido Ewers zum Rode
Climax GmbH
Am Langen Graben 8
52353 Duren, Germany

Declaration
I declare that the above information in relation to the supply / manufacture of this product is in conformity with the relevant provisions of the Directives and Harmonised Standards listed above in this document along with their respective amendments and other related documents.

Signature of Manufacturer: 

Position Held: VP of Engineering

Date and Place: 9/29/2021 USA

CE

Safety

In accordance with CE standards

- Crushing risk exists if clamps are not tightened.
- Modification of safety features may result in operator or bystander harm.
- Do not integrate with faulty or poorly maintained equipment.
- Modification of thermal safety features may result in operator or bystander harm.
- Modification of noise safety features may result in operator or bystander harm.
- Modification of vibration safety features may result in operator or bystander harm.
- Grease and/or oil native to machinery may result in allergic reaction to operator.
- Smoke from welding metals may be harmful if inhaled.
- Gas bottle needs to be closed when not in use and ventilation always adequate.
- Modification of ergonomic safety features may result in operator or bystander harm.
- Dust from grinding wheel may be inhaled or get into eyes.
- Dust, dirt, and/or sand may cause machine to cease, posing risk to operator.
- Grease and/or oil may cease in cold weather, posing risk to operator.
- Do not operate with substance outside of specifications.
- Do not operate without proper ear protection.

Operation

The BW1000 is an automated welding device that uses a rotating and helically retracting spindle/torch, which must be coupled with a MIG Wire-feeder to deposit Weld on the surface of a bore or pin. The rate of axial feed per revolution is fixed. Torch selection, and/or adjustments to the swivel head accommodate differences in bore diameter.

During set-up, the operator is required to:

- Align the Borewelder to the bore, (using either the appropriate interface tooling for Boring bar to be used, or the Bortech Adjustable base).
- Determine the proper torch/bore clearance, and to set the initial Rotation speed and Wire speed and Voltage settings.
- Start the BW1000 spindle rotation, and the Wirefeeder / Power supply in use.
- Remain in visual contact with the welding process, and make adjustments necessary to wire speed, voltage and rotation speed to maintain good weld quality.
- Stop the BW1000 spindle rotation, and Wirefeeder / Power supply in use.

Specifications

Welding Process: Metal-Inert-gas (MIG).
Wire Diameter Range: 0.030–0.045" (0.8–1.2 mm)
Unsupported Torch Reach: 39" (990.6 mm)
Stroke Length: 9" (229 mm)
Feed thread: 8 TPI or 0.125” (3.12 mm) per revolution
Maximum Continuous Welding Current: 140 amps
Welding Power Required: Constant Voltage (CV)
BW1000 Power: 220v 50/60Hz VAC (120v model also available)
Contactor Control: provided via remote switch
Typical Voltage Operating Range: (short arc/0.035" wire) 16–17.5 volts
Component Weight: 17 lbs.

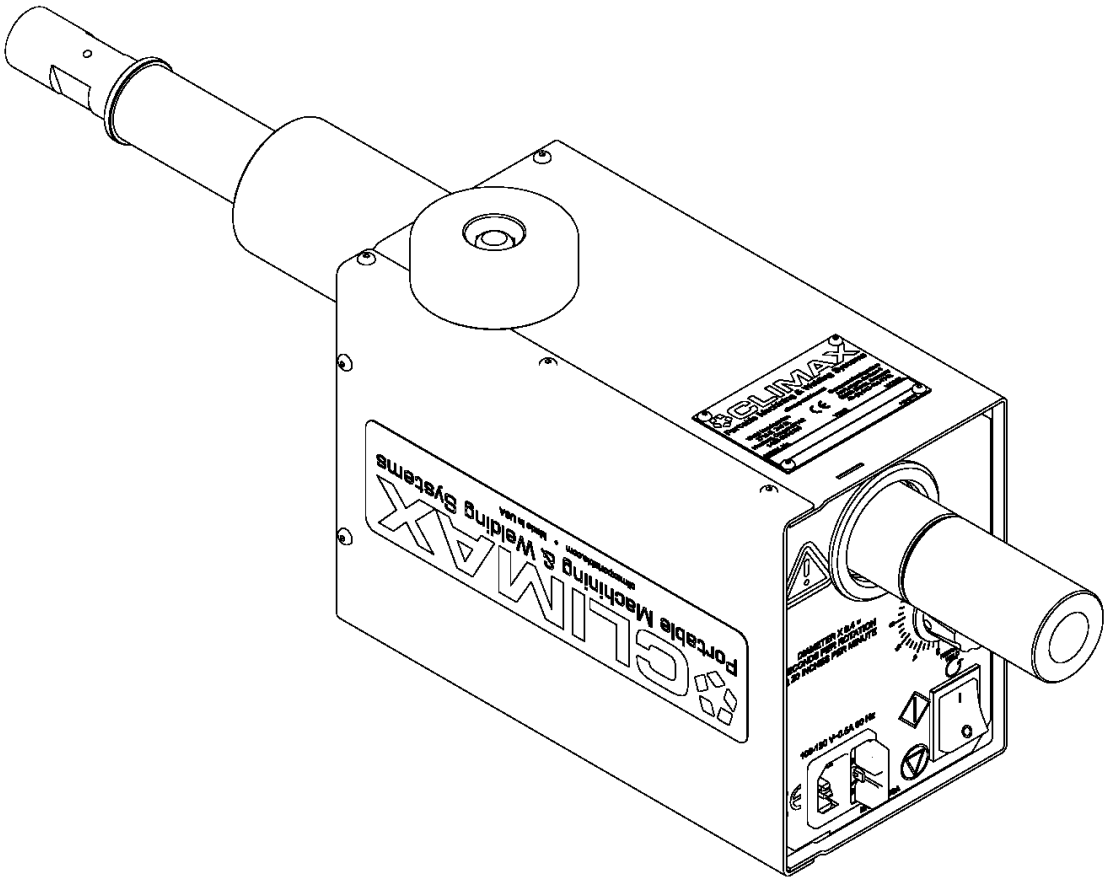
Buildup Diameter Ranges

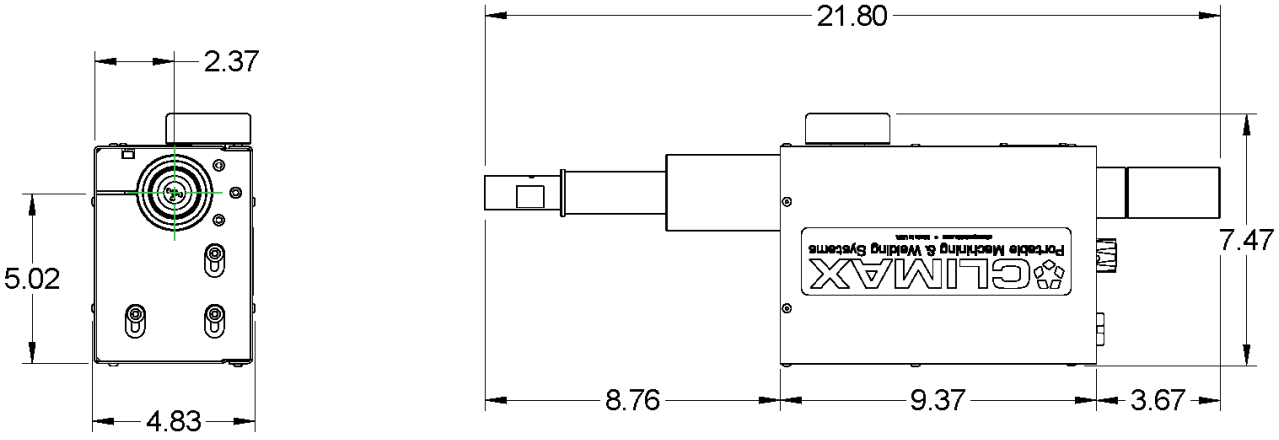
BW1000 buildup diameter ranges at 20 IPM 0.88–24" (22.34–610 mm):

- #00 Torch 0.88–1.8" (P/N 29063)
- #0 Torch 1.80–3.0" (P/N 28448)
- Head # 1 Swivel 2.7–8.2" (P/N 39725)
- Head # 2 Swivel 8.0–12.0" (P/N 39726)

Contact CLIMAX for the necessary components when welding bores 12–24" (305–610 mm)

Borewelder dimensions are shown on the next page.





103269 - BW1000 ASSY CE W/G 120/230V 50-60HZ - REV B

FOR REFERENCE ONLY

Power Supply Compatibility

The BW1000 works well with numerous wire-feeders. It is imperative however that a Constant Voltage MIG Process is utilized.

Power supplies with a rating of 175 amps are sufficient for the BW1000. The power supply must be of the constant voltage (CV) type (suitable for MIG welding).

Only licensed electricians should perform attachment of the power supply control cable (trigger or contactor control) to the wire-feeder. This should be done only after a thorough appreciation of the theory of operation of the wire-feeder/power supply has been gained by studying this manual and appropriate power supply information.

WARNING

Improper connections may result in dangerous electrical shock.

Damage to the power supply or wire-feeder is possible.

Major Assemblies

Borewelders are highly configurable with many options and accessories. This manual covers the use and operation of all of those possible options. The machine configuration purchased by a customer 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 in obtaining the needed components.

The BW1000 provides the circular and axial motion required to accomplish bore build up. It also provides for the passage of weld current, welding wire, and shielding gas to the welding torch. BW1000 rotational speed and direction is controlled at the rear face of the machine.

BW1000

Provides the circular and axial motion required to accomplish bore build up. It also provides for the passage of weld current, welding wire, and shielding gas to the welding torch. BW1000 rotation speed is controlled at the rear face of the machine.

Conduit Assembly

Provides passage of welding current, welding wire, and shielding gas to the BW1000. Includes Wire feed Control Cable for actuation of trigger circuit contactor.

Swivel Head Assembly (P/N 35603)

Designed for use with multiple torch heads, this ball-and-seat device incorporates a conductive path and gas seal for weld current while providing a fine diameter adjustment for torches (P/N 39725) and (P/N 39726). Angle changes of the 7/16–20 stem of up to 10 degrees off-center can be accommodated.

Torch Assemblies (P/N 39725 and 39726)

Sized for welding holes from 2.7–12" in diameter when used in conjunction with the swivel head. In addition, the Standard Torch Adapter (P/N 36170) is for use of #00 torch (29063) and #0 torch (28448) enabling bore-welding range capability down to 0.875” diameter.

Extension Assemblies

Facilitate remote placement of Swivel head and torches for extended reach.

- 3" (76.2 mm) for P/N 29038
- 6" (152 mm) for P/N 29039
- 12" (305 mm) for P/N 29040

Headless Support Kit Assembly (P/N 40877)

Supports extensions when rigidity in setup is needed (greater than 40" [1,016 mm] reach).

Mounting rod (P/N 30773)

Mounts the BW1000 to adjustable base or Boring Bar interface.

Carrying Case (P/N 54282)

Protects your Borewelder between use and for storage.

Optional Equipment

Adjustable Base (P/N 29037)

Provides support for the *BW1000* while allowing leveling and centering adjustment. This is generally required when a boring bar interface is not available. This is a nonmagnetic base for safe attachment and can be leveled on a variety of uneven surfaces.

Radial Mount (P/N 40958)

This part was designed for use between the mounting rod and the Borewelder, extending the distance between them to 3.98" (101 mm). This mount is the correct distance for most Boring bar interfaces that designed for the CLIMAX BW3000. The BW1000 is a center mount system enabling Climax Boring Bars to interface kits more effectively than previous designs. The radial mount resolves the issue of a newly design machine interfacing with an old environment, while making possible the use of the Auto-Borewelder with adjustable base.

Extension (P/N 29065)

18” (457 mm) extension

Trammel Torch (P/N 27013)

For buildup of outside diameters up to 14" (356 mm) diameter at 10" (254 mm) long.

Headless Support Kit (P/N 40877)

Provides support of extensions when more rigidity in setup is desirable and when extension reach is greater than 40” reach.

Bearing Clearance Torch (P/N 63916)

Capable of welding 12–27" (305–686 mm) diameter bores.

Quick Set-Up Procedure

1. Connect remote trigger switch and Wire feed conduit to wirefeeder.
2. Attach Mounting rod to Boring Bar interface if applicable. (Or Adjustable Base)
3. Install BW1000 in appropriate position onto Mounting Rod for coarse alignment of spindle to bore axis. (If utilizing Adjustable base, See “Detailed use of Adjustable base”.)
4. Connect Swivel Head and proper torch for the size bore to be welded. (See Use of Swivel Head for details on this part.)
5. Rotate Feed Knob to move spindle to the extended position
6. Slide the BW1000 along the Mounting Rod to bring the torch end to the bore end.
7. Lock the Radial Mount to the Mounting Rod
8. Retract the machine to the top of the Bore
9. Connect the power cord to the end of the BW1000.
10. To center the machine, check the adjustable axes by using the Torch nozzle as an indicator, and rotating the torch, referencing the bore surface. Only one axis is adjustable with the Boring Bar interface; i.e. the “swing” axis from mounting rod.
11. Set the torch nozzle to bore clearance from 1/8 to 1/4 inch.
12. Connect BW1000 end of Wirefeeder Conduit to the Brass Power Coupling and secure setscrew.
13. Without weld power hooked to wirefeeder, push the Trigger switch and feed wire through the conduit of the BW1000. If there are issues feeding wire through the torches, try straightening an 8 inch section of wire before loading the wirefeeder to help the wire to pass through the system.
14. Set Rotation Speed to dial setting by use of the chart at the end of this manual. Timing the spindle rotation for accuracy is good practice.
15. Extend spindle through bore again, by rotating the feed knob, and place machine so that the wire will contact approximately 1/16 to 1/8 inches from the edge of the bore.
16. Ensure that shielding gas, power supply and welding leads are properly connected and ready for welding.
17. Ensure that the approximate voltage of your Power supply is not above 18 volts and set wirespeed to 250 IPM. (This is approximately 130 amperes for .035 wire, or 4.2 lbs per hour.) In MIG welding, the wire speed bears a direct relationship to the weld current.

Using .035" wire

100amps @ 16v = 170ipm (inches per minute)
125amps @ 16½v = 240ipm
150amps @ 17v = 280ipm

1. To begin welding, flip Rotation switch to Retract/Weld and then depress the Weld Trigger switch into the ON position. Small changes to Voltage on power supply may be required to stabilize the weld process. 16 to 18 volts is typical borewelding voltage range.
2. Visual confirmation that the Spindle axial feed rate matches weld deposition is very important. Adjust wirespeed to place bead at intersection of previous bead and base metal or slightly above.
3. When process is complete, depress Weld Trigger Switch to disengage wirefeeder/power supply and then halt rotation.

Table 1 - Rotational Speed Chart		
Inches at 20 IPM		
Dial Setting	**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

Setting the rotation speed

See the chart on the machine to find the coarse setting for the rotation speed. Optimum travel speed for MIG welding is 20 inches per minute (IPM) or 508 mm per minute. In vertical Borewelder axis welding, travel speed can be decreased. In the horizontal Borewelder axis welding, travel speed should be increased to prevent lack of fusion on the downhill section. For accurate results, ***time*** the spindle rotation.

To calculate the time per revolution, multiply the diameter of the bore by one of the three IPM constants below to get Seconds per Rotation.

Seconds Per Rotation @ 18 IPM = Bore Dia. x 10.4 VERT. BORE AXIS

Seconds Per Rotation @ 20 IPM = Bore Dia. x 9.4

Seconds Per Rotation @ 22 IPM = Bore Dia. x 8.5 HORZ BORE AXIS

1. Extend the spindle through the bore by rotating the feed knob. Position the torch so the wire contacts approximately 1/8 to 1/16 of an inch inside of the end of the bore.
2. Ensure that shielding gas, power supply, and welding leads are properly connected and ready for welding.
3. Ensure that the voltage of your power supply is not greater than 18-volts and set wire speed to 250 inches/minute (with .035 wire this is approximately 130 amps, or 4.2 lb per hour. In MIG welding, the wire speed bears a direct relationship to the weld current.

Operation

1. Weld a ½”-13 mounting bolt of suitable length to a position approximately 11 inches from the center of the bore to be welded. (If a greater distance from the BW1000 mounting rod is required, use radial mount (28208). This will change the bolt setting to between 11 and 14 inches).
2. Place the Adjustable Base on the adjustment surface with the ½-13 inch bolt provided protruding through the hole in the center of the base. **Orient the base to align the mounting rod with the mounting bolt just installed and the center of the bore to be welded.** The four spring washers and nut included with the adjustable base should be placed over the 1/2-inch (12mm) bolt and finger tightened, plus a 1/2 turn with a wrench.
3. Screw the Mounting Rod (30773) into the slider hole on the adjustable base and tighten.

	CAUTION
	**As with all close-fitting parts, it is imperative that they be free of weld spatter, dirt, grit, and such before screwing together.**

4. Slide the locking collar (40320) onto the mounting rod if in the vertical axis. (This prevents the BW1000 from sliding down the mounting rod when adjustments are being made). Install the radial mount onto the mounting rod, and then the BW1000 into the Radial Mount.
5. Attaching extensions to the *BW1000* and reaching through the hole to be welded facilitates quick adjustment of the adjustable base.

   Adjustment for parallelism is made as follows

   - The *BW1000 axis*-to-bore alignment is made by swinging the *BW1000* over until the extension is close to the 3 o’clock or 9 o’clock position.
   - Next, adjust the two forward leveling jacks as a pair, while noting the distance from the extension to the bore surface at the top and at the bottom of the bore. (Adjustable Base sits at 6 o’clock for purposes of this discussion).
   - Next, after swinging the *BW1000* back to the center of the hole, adjust of the rear-leveling jack while viewing the proximity of the extension to the bore surface directly away from the extension (In relation to the Adjustable Base). In this way, the rear jack makes the base pivot on the forward jacks, not affecting the other axis as already set.

	CAUTION
	**If clockwise adjustment of your rear jack causes the mounting rod to move toward the adjustable base, you have used up the entire cushion in the spring washers, thereby bowing the adjustable base. Loosen the mounting bolt until the spring washers are no longer collapsed to allow further adjustment.**

6. Tighten the 1/2-inch hold-down nut after finishing the parallelism adjustment. A torque of 15 ft-lb (2 kg-m) is sufficient.

7. The *BW1000* should be positioned along the mounting rod so that the axial torch travel will reach both extremes of the welding that is to be done in the bore. Slide the *BW1000* along the mounting rod as necessary to position the stroke.
8. Concentricity to the bore is obtained by working in the two axes. The X-axis adjusted by slightly loosening the two Clamping Knobs on the adjustable base and moving the Slider by turning the Adjustment Screw. This moves the Mounting Rod to and from the work hole. The Y-axis is adjusted by loosening the Radial Mount nut and swinging the *BW1000* on the Mounting Rod. The resulting arc is largely in the Y-axis. Utilizing the Extensions already reaching through the hole, roughly center the *BW1000 in* the X-axis first (using the adjustment screw) and then center the Y-axis by swinging the *BW1000 from* the mounting rod. This procedure will approximately center the machine to the bore.
9. After the correct torch (and extensions if necessary) is installed, successful centering of the Borewelder to the bore requires rotation of the Torch/Spindle, (by hand or by switching on Rotation). While noting the proximity of the torch to the bore surface through four quadrants, check 12 o'clock and 6 o'clock as a pair, then 3 o'clock and 9 o'clock as a pair as described above.
10. Rotational Speed Setting: See chart on machine to determine the coarse setting for the rotational speed. Optimum travel speed for MIG welding is 20-inches/minute. In vertical borewelder axis welding, travel speed can be reduced. Horizontal borewelder axis, travel speed should be increased to minimize any lack of fusion in the downhill section. For accurate results, *time* the spindle rotation. Multiply the diameter of the bore by one of the three inches/minute constants to obtain the seconds/revolution:

    Seconds/Rev. @ 18 inches/minute = Bore Dia. x 10.4 VERT. BORE AXIS

    Seconds/Rev. @ 20 inches/minute = Bore Dia. x 9.4

    Seconds/Rev. @ 22 inches/minute = Bore Dia. x 8.5 HORZ. BORE AXIS
11. Ground Cable: 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 be located such that there is a good conductive path to the workpiece. As with any electric welding process, a poor ground can be detrimental to weld quality and increase the risk of electrical shock.
12. Shielding Gas: A flow of 35 CFH (1 m^3/hour) is good. (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, dams can be made from leather, or other available non-conductive materials.
13. Adjustment Modifications: As with any arc welding process, visual observation should only be made when using an appropriate light shield. Many users employ a combination of a #9 handheld shield and #3 safety eyeglasses. This combination allows the operator to adjust the control while being protected from flash burn by the glasses. Also, view the arc through the combination of the handheld shield and the glasses, to observe accurate definition of wire location. (See "Welding Pointers" and "Welding in the Horizontal Axis").
14. Keyways and Grease holes: Depress the wire-feed Trigger Switch **OFF** as the torch approaches such an area and welding will stop while the torch continues rotating. Welding will resume when the wire-feed Trigger Switch is pressed **ON**. Note that this procedure must be repeated for each revolution until the area where weld is not to be deposited is passed, and should be observed while using an appropriate light shield.

Use of Accessories

The Swivel Assembly: A spherical mild steel seat and brass ball arrangement which can swivel 10° off center while conducting weld current and providing a passageway for shielding gas and welding wire. The Swivel head is equipped with a locking nut on the brass stem that can be loosened to remove the torch. Upon reinstallation, torch nozzle should aim in the direction of the arc that the brass stem prescribes. The liner (40424) should be inserted far enough to be visible in the gas holes of the diffuser. Also, when head #1 or #2 are installed, cut liner slightly long and lightly push into the male fitting on top of swivel coupling while securing lightly with the setscrew.

Standard Torch adapter: Designed to utilize Standard Climax torches. As always, the orientation of the torch nozzle shall parallel Swivel travel. Screw Climax Standard torch (#0 or #00) firmly into the Standard torch adapter then install onto the brass swivel stem approximately 10 turns. Secure Locknut after proper orientation (as described above) is reached. Remove Standard Climax torch after this is accomplished and install liner in the Swivel/Adapter combination. Liner is secured in the male fitting on the swivel coupling and as well in the Adapter.

Torch #00 and #0: These torches are used to build up bores ranging in diameter from .88 to 1.75 inches (2.2 to 4.4 cm), and 1.75 to 3 inches (4.4 to 7.6 cm) respectively. Works in conjunction with the Standard Torch Adapter described above.

These Torches have "live" copper nozzles, making clearance between the nozzle and the bore particularly important.

Though not usually required, it may be necessary to feed the wire through the *BW1000* 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. Filing the wire to a point, straightening a short section at the end, or rotating the BoreWelder spindle may help automatic feeding of the wire.

Change Tips by loosening the setscrews holding the Tip and the liner and removing both tip and liner from the Torch Body. Insert the liner into the new curved Torch Tip and the combination into the Torch Body through the Nozzle. Once properly located, tighten the setscrews to prevent movement. (If the torch is held horizontally the tip tends to fall correctly into its seat). Position the tip axially to a point slightly below center to the nozzle opening. Keep in mind that the wire is curved on exiting the tip and therefore the point of contact with the work is higher than might otherwise be expected. Therefore, the tip should be positioned slightly toward the end of the nozzle.

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 is to relieve the torsional stresses built up in the wire (because wire was not being fed while rotating) so that the weld process will not be affected by wire wandering upon startup.

Torch Extension Support Kit: This is used to provide Extension/Torch support when the distance from the Borewelder to the torch is far enough to make torch stability uncertain and alignment difficult.

Procedures for set up

1. Slip the Support Body over an extension located close to the bore to be welded, and at a position where the Extension Support Rod can be clamped or tack welded to provide necessary support.
2. Orient the Support Block such that both Shoulder Screws are at right angles to the Torch Extension.
3. Once concentricity of the Support Body with the bore is obtained, attach the Extension Support Rod to an appropriate foundation as described above.

Radial Mount: This accessory is used to extend the reach of the *BW1000* when doing buildup on large diameter holes, or when attachment near the bore is impractical. The Radial Mount used extends the reach by 3.98 inches.

Use as follows:

Attach the Radial Mount to the Mounting Rod (vertical axis also use 40320 locking collar) by slipping the open end over the rod, and tightening the nut. The BW1000 can then be installed into Radial Mount.

Maintenance

Daily maintenance consists primarily of keeping the *BW1000* clean and protected. The *BW1000* is designed to tolerate industrial environments that are usually dusty and gritty. However, the *BW1000* is a machine tool with close fitting parts that will last longer if cared for.

Long-term maintenance should include 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 at some point it becomes difficult to insert the conduit into the *BW1000,* the O-ring may have become dry or badly worn. If worn, replace with Climax part 36379. It may be helpful to apply a small amount of O-ring grease to the ring. The unit is shipped with a lubricated O-ring.

It is not necessary to oil the needle bearings that support the spindle. Factory lubrication is low viscosity oil in sparing quantities.

Replacing Liners

NOTE

Liners and related parts in the BW1000 seldom require replacement. However, there are occasions when liner replacement is called for. In these situations, it is important to observe a simple though not obvious, procedure.

If the liner is being installed in a portion of the *BW1000* accessories where it forms a curve, it is important to preload the liner. That is, press the liner into the torch or conduit until the liner is felt to be contacting the outer wall of the bend in the torch or conduit. When replacing the liner in a wire feeder conduit, coil the conduit into a 24" [60mm] circle and push the liner in so that it contacts the outer wall of the conduit. Then secure in place with the setscrews while in this coiled position. This procedure is helpful in assuring consistent wire feeding. Be careful not to over tighten the setscrews that secure the liner.

Operator Training

Initiation procedure: When first using the *BW1000,* begin by working with mild steel prior to attempting work with any other alloys.

ER70S-6 or ER70S-2 wires are recommended.

1. Use a wire with a large arc or “cast.” Cut about 6 feet from the roll of wire and toss it on the floor. It will form a cast that is the diameter of the circle the wire makes on the floor when it settles. The cast diameter should be as large as possible and at least 40”. Casts below 30” are likely to cause difficulties. A cast of 40" (1,016 mm) or more is desirable because it 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.
2. Practice on a vertical axis bore first. This position should be mastered before any other is attempted. Short sections of heavy wall pipe make good coupons. It is a good idea to bore the coupons to be sure they are round and clean. This enables the trainee to focus on learning operation of the machine without complicating the experience with a contaminated base metal. Experiment with dirty material later if desired - after some experience has been gained.
3. The operator should re-find the center each time a coupon is welded rather than just place the coupon in a fixture to hold the piece in a centered position. This way, the operator gets needed practice at this task. If this is done, it won't be long before the operator is able to center the machine in less than 1 or 2 minutes, particularly if the suggestions in the manual on centering are observed.
4. Bore some or all of the coupons to be sure of proper fusion etc.
5. Perform multi-layered build-ups.
6. When learning, it is probably best if the operator measures the step and times both rotation and wire speed and writes them down. In this way, an operator can compare the measurements with what the manual suggests to determine how to repeat successful buildups.
7. Measure the wire speed in inches/minute by jogging the wire for 10 seconds, measuring the amount fed out and multiplying that number by six.
8. Spindle Rotation Time/Travel Speed calculated by multiplying Diameter times PI (3.14) times 60, and dividing that answer by Desired Travel Speed (in inches per minute) Example for 3” bore is (3 * 3.14 * 60) / 20 inches/minute = 28.26 Seconds per Revolution

While performing the buildups, the operator could vary each of the parameters to see how it effects the buildup operation. Experimentation is a key element to becoming proficient. In addition, use the manufacturer’s suggested parameters and learn to recognize the buildup they produce. This is a benchmark to ease startup woes.

Typical parameters for .035 ER70S-6 wire with 92%Ar/8%CO2 shield gas are:

- 250 inches/minute wire speed (130 amps) .035 diameter wire
- 17 Arc Volts
- 20 inches/minute Travel speed

Welding Pointers

Wire and Gas

The BW1000 is designed for solid steel wire using the MIG welding process. The length of time that the Borewelder can be used continuously is dependent mostly on spatter build up in the welding nozzle. Therefore, a main objective when deciding what kind of wire, gas and power supply to use is usually to select a combination that produces the smoothest and least violent arc action. Such a combination will produce less spatter buildup and extended welding times.

Wires with higher de-oxidizer content usually work best. Wires E-70S-2 and E-70S-6 work well, with E-70S-2 probably being the better choice due to finer spatter and less glass buildup in multilayer buildups. Any commonly used inert gas can be used, but those with high argon content are preferred. A mixture of 92% argon 8% CO2 works well as does 75% argon 25% CO2. The former is generally preferred though many operators prefer the latter for out-of-position welding. Straight argon or helium should not be used for steel. Straight CO2 produces a lot of spatter.

Welding wire usually contains some silicon as a de-oxidizer. During the welding process, this changes to silicon dioxide (glass) and solidifies in clumps on the surface of the weld. These normally do not cause a problem, but if the wire speed is too high and rotational speed too low, 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 applied one on top of another, 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.

Wire Flip

If “Wire Flip” is a problem, try the following to eliminate it.

1. Avoid an “S” shape in the conduit. A “C” shape is preferred.
2. Position the Wire Conduit in such a way that the conduit makes only one continuous curve. That is, the conduit should begin curving at its attachment point on the top of the BW1000 and continue this curve for about 270° (¾ of a turn) and then straighten out as it heads toward the wire feeder. This method works particularly well with long conduits.
3. If the wire has a tight cast and it still flips in this configuration, try “tightening up” the curve (even though this probably is contrary to what you might think). However, long torch extensions tend to negate any benefit that this conduit shape may have. For more information, please refer to the CLIMAX paper entitled "Borewelding and Wire Flip".

Voltage

Resist the temptation to use high welding voltages. The globular transfer that this produces is generally undesirable. A lower voltage usually delivers a steady, quiet, less violent arc. This produces less spatter and smaller diameter spatter beads allowing longer periods of continuous welding between nozzle cleanings. Also, if your welding power source has several ranges, choose a range toward the lower end of the scale. This is likely to provide a more stable welding arc.

Spindle Feed and Wire Location

During welding, make sure the helix feed is providing appropriate axial movement on each revolution. If the feed is too much for the parameters in use, the bead will appear ropy and

possibly have spaces between the beads. If the helix is feeding too little, the surface of the weld may appear smooth and flaw free, but can be poorly fused to the base metal.

Make sure the arc is directed slightly above the intersection point between the base metal and the previous bead. Since the Helix feed is non-adjustable, the operator will have to change the wire feed rate to properly “tie in“ the weld beads. At the beginning of the welding process, the first circular bead has no previously laid bead to provide support and is therefore a different shape than those that will follow.

It is best if the first step (ending of the first revolution) were made slightly smaller than those that follow. An alternative might be to use a slightly lower wire speed during the first revolution.

Welding in the Horizontal Axis

Welding in the horizontal axis requires special attention to the machine settings than welding in the vertical axis. In the horizontal axis, the weld bead must travel through the lower, vertical-up, overhead, and vertical-down positions.

The following discussion provides insight for developing skills for work in the horizontal. Some practical suggestions are listed below.

Lower and overhead positions of the bore present no problem for the BW1000. When the torch is welding vertical-up, the weld of course has a tendency to run downward. With controls set correctly, the solidifying weld-metal forms a shelf that supports the molten metal so vertical-up is done almost as easily as flat. The fact that welding is done against, not only the bore surface, but the previously laid weld bead, also greatly helps due to the small “V” created. Therefore, it may be more difficult to obtain a well-formed initial bead than the ones that follow. If welding current (current is 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 "grapes", or in less severe cases, it may form a humped bead. This also produces undercutting at the edge of the weld bead. Increasing the Rotational speed of the Borewelder 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 .030" should be easy to manage and after some use one should be able to master .035" wire horizontally. .035 wire is the preferred wire size in most instances.

On the vertical downside, problems are different, but the cure is the same. 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 produces porosity. A normal reaction at such point is to increase gas flow, but it is unlikely this will help. The remedy is to make the weld metal solidify in place quickly by speeding up the BW1000 's rotational speed, decreasing the welding current, using a smaller wire size, or a combination of the three.

A second problem, related to the molten metal running ahead of the arc is, the arc playing on the molten metal rather than on the base metal. This results in a lack of fusion to the base metal. This problem is one that can easily go undetected until machining the bore to size, at which time large sections of the weld may separate from the base metal.

Therefore, the remedy for most problems in horizontal bore build up is to run slightly faster travel speeds (22 IPM) and not 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. Using a wire size of .035" (0.89 mm) is good unless problems are encountered. A wire size of .030" (0.76 mm) with less current and a smaller step is very manageable - although if "Wire Flip" is present, "tie-in" is more difficult with .030” (0.76 mm).

CHART FOR DETERMINING SECONDS PER ROTATION

"ROT DIAL" For customer entry of actual dial setting at desired travel speeds and bore sizes

Shaded columns indicate Seconds Per Rotation		TRAVEL SPEED (INCHES PER MINUTE) (IPM)								
		16	ROT DIAL	18	ROT DIAL	20	ROT DIAL	22	ROT DIAL	24
DIAMETER IN INCHES	1	11. 78		10. 47		9. 42		8. 56		7. 85
	1. 5	17. 66		15. 70		14. 13		12. 85		11. 78
	2	23. 55		20. 93		18. 84		17. 13		15. 70
	2. 5	29. 44		26. 17		23. 55		21. 41		19. 63
	3	35. 33		31. 40		28. 26		25. 69		23. 55
	3. 5	41. 21		36. 63		32. 97		29. 97		27. 48
	4	47. 10		41. 87		37. 68		34. 25		31. 40
	4. 5	52. 99		47. 10		42. 39		38. 54		35. 33
	5	58. 88		52. 33		47. 10		42. 82		39. 25
	5. 5	64. 76		57. 57		51. 81		47. 10		43. 18
	6	70. 65		62. 80		56. 52		51. 38		47. 10
	6. 5	76. 54		68. 03		61. 23		55. 66		51. 03
	7	82. 43		73. 27		65. 94		59. 95		54. 95
	7. 5	88. 31		78. 50		70. 65		64. 23		58. 88
	8	94. 20		83. 73		75. 36		68. 51		62. 80
	8. 5	100. 09		88. 97		80. 07		72. 79		66. 73
	9	105. 98		94. 20		84. 78		77. 07		70. 65
	9. 5	111. 86		99. 43		89. 49		81. 35		74. 58
	10	117. 75		104. 67		94. 20		85. 64		78. 50
	10. 5	123. 64		109. 90		98. 91		89. 92		82. 43
	11	129. 53		115. 13		103. 62		94. 20		86. 35
	11. 5	135. 41		120. 37		108. 33		98. 48		90. 28
	12	141. 30		125. 60		113. 04		102. 76		94. 20
	12. 5	147. 19		130. 83		117. 75		107. 05		98. 13
	13	153. 08		136. 07		122. 46		111. 33		102. 05
	13. 5	158. 96		141. 30		127. 17		115. 61		105. 98
	14	164. 85		146. 53		131. 88		119. 89		109. 90
	14. 5	170. 74		151. 77		136. 59		124. 17		113. 83
	15	176. 63		157. 00		141. 30		128. 45		117. 75
	15. 5	182. 51		162. 23		146. 01		132. 74		121. 68
	16	188. 40		167. 47		150. 72		137. 02		125. 60
	16. 5	194. 29		172. 70		155. 43		141. 30		129. 53
	17	200. 18		177. 93		160. 14		145. 58		133. 45
	17. 5	206. 06		183. 17		164. 85		149. 86		137. 38
	18	211. 95		188. 40		169. 56		154. 15		141. 30
	18. 5	217. 84		193. 63		174. 27		158. 43		145. 23
	19	223. 73		198. 87		178. 98		162. 71		149. 15
	19. 5	229. 61		204. 10		183. 69		166. 99		153. 08
	20	235. 50		209. 33		188. 40		171. 27		157. 00
	20. 5	241. 39		214. 57		193. 11		175. 55		160. 93
	21	247. 28		219. 80		197. 82		179. 84		164. 85
	21. 5	253. 16		225. 03		202. 53		184. 12		168. 78
	22	259. 05		230. 27		207. 24		188. 40		172. 70
	22. 5	264. 94		235. 50		211. 95		192. 68		176. 63
	23	270. 83		240. 73		216. 66		196. 96		180. 55
	23. 5	276. 71		245. 97		221. 37		201. 25		184. 48
	24	282. 60		251. 20		226. 08		205. 53		188. 40
	24. 5	288. 49		256. 43		230. 79		209. 81		192. 33
	25	294. 38		261. 67		235. 50		214. 09		196. 25
	25. 5	300. 26		266. 90		240. 21		218. 37		200. 18
	26	306. 15		272. 13		244. 92		222. 65		204. 10
	26. 5	312. 04		277. 37		249. 63		226. 94		208. 03
	27	317. 93		282. 60		254. 34		231. 22		211. 95
	27. 5	323. 81		287. 83		259. 05		235. 50		215. 88
	28	329. 70		293. 07		263. 76		239. 78		219. 80

Welding Problems and Troubleshooting

Lack of fusion to the bore surface

A possibility when lack of fusion occurs is that the rotational travel speed is too slow for the wire speed being used. If rotation is too slow, the welding arc will be directed on top of the currently melted weld puddle. If this puddle is too large and deep then the melting of the base metal must be done solely from transfer of the heat of the weld puddle. Being only a little over 3,000°F, this seldom is enough. Instead, the arc itself with a temperature of about 10,000°F and very high heat-density will ensure that the base metal is melted before weld metal is deposited on top. In addition, a slow rotational speed can produce a bead thickness that is too great which will contribute to cold lapping.

Wire feeding stops and wire burns back to tip

This is usually caused by a mechanical blockage of the welding wire. It can 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. Sometimes, the liner right at the torch nozzle overheats and should be replaced. Generally, liners will last a long time if blown out occasionally.

Weld Beads are "ropy"

To make the beads wet-out more and become less ropy, 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. Watch what happens as you rotate the inductance knob. Higher inductance tends to spread out the weld puddle.

NOTE

As you rotate the inductance knob, the arc voltage probably requires adjustment somewhat to obtain optimum performance. (Lincoln brand power supplies have what they call “Pinch” control. This is inductance labeled with higher numbers being less inductance).

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” pipe or a 4” solid bar works well. Try one wrap at a time while welding. Typically, 2 to 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.

Too Much Spatter

The usual cause for too much spatter can be that the arc voltage is too high. The arc should have an even sound that is not violent. A setting of 15½ to 18 volts is normal. Above 18 volts, the arc will become much more uneven and labored and the 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_2 is recommended. (Climax often uses 92% argon 8% CO_2.) More CO_2 than this tends to cause excessive spatter.

Porosity in weld:

Porosity is caused by impurities gassing in the weld. 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 reasons for porosity are:

- 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.
- Dirty bore surface. Although the BW1000 usually handles these problems well, excessive oil or other organic compounds could cause porosity. These may be on the surface or imbedded in crevices or grease holes. A thorough cleaning should be done prior to welding. Sometimes 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. DON'T FORGET, Aluminum foil is a good conductor of electricity, so be careful not to short Borewelder components to the piece being welded.

Steel weld deposit 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 receptive 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°-1250°F. (The welding arc often can be used to accomplish this). Slow travel speeds allow the welding arc to reheat the previous beads, thus having an annealing effect. This can work surprisingly well. In addition, sometimes it is advantageous to deposit another layer of weld on top of the hard layer solely to anneal it.

If the buildup is still too hard, re-heat it after welding. If the buildup is brought to a temperature of about 1100°F and allowed to cool slowly, it will then be machinable. It is important that the part is allowed to cool to below 400°F before the reheating is done. It is also important not to allow

any part of the weld to rise above the critical temperature (about 1300°F) even for a short time unless you are prepared to do a full anneal with the associated heat soaking and slow cooling.

Weld "graping" when welding in the horizontal axis:

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 IPM travel speed.

During the remainder of the buildup operation, graping should not be experienced within the current limits of the BW1000. 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.

Bead ropy, voltage hard to control, unable to clear stubbing:

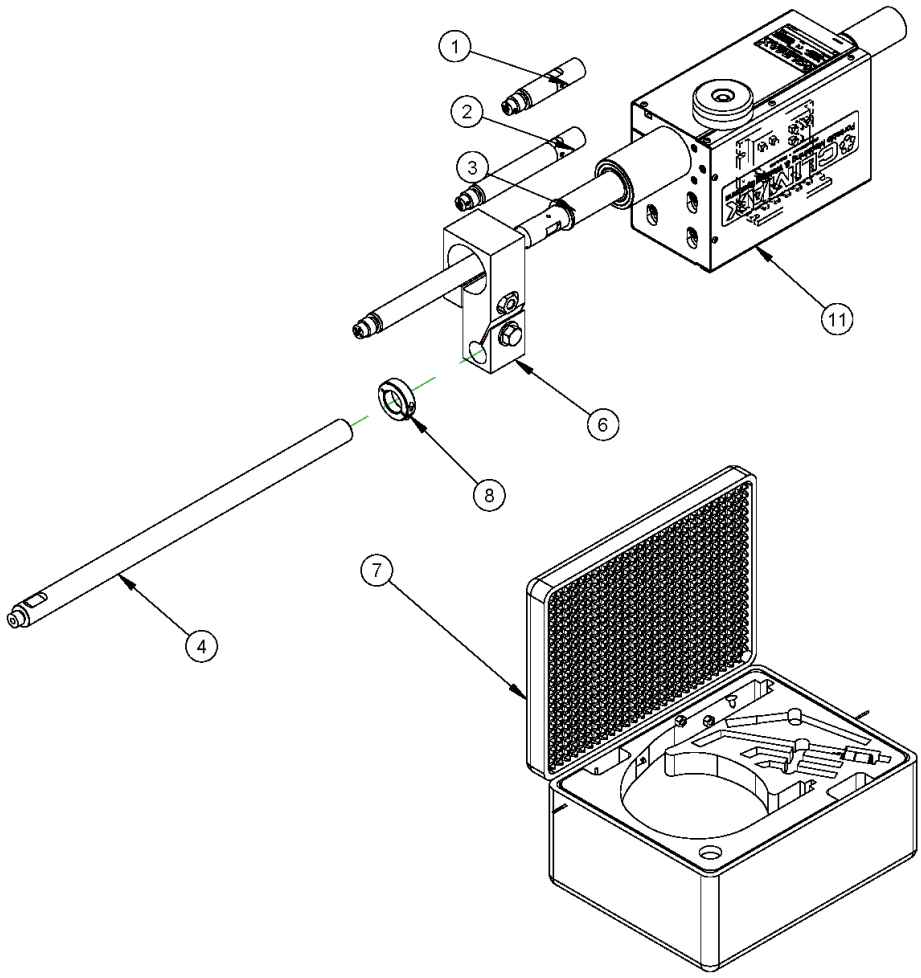
In some cases, during welding, the weld bead will not wash out properly, the voltage is difficult to stabilize, (i.e. the process is stubbing or spray, never settling into a stable short arc mode, no matter what adjustments are made to voltage and wire speed.)

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 loose connections.

Exploded View Drawings and Parts Lists

Please contact CLIMAX if you have any questions about parts, service, or operation.

Table 2 – Tool kit		
Part number	**Description**	**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
40831	MANUAL INSTRUCTION BW1000	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

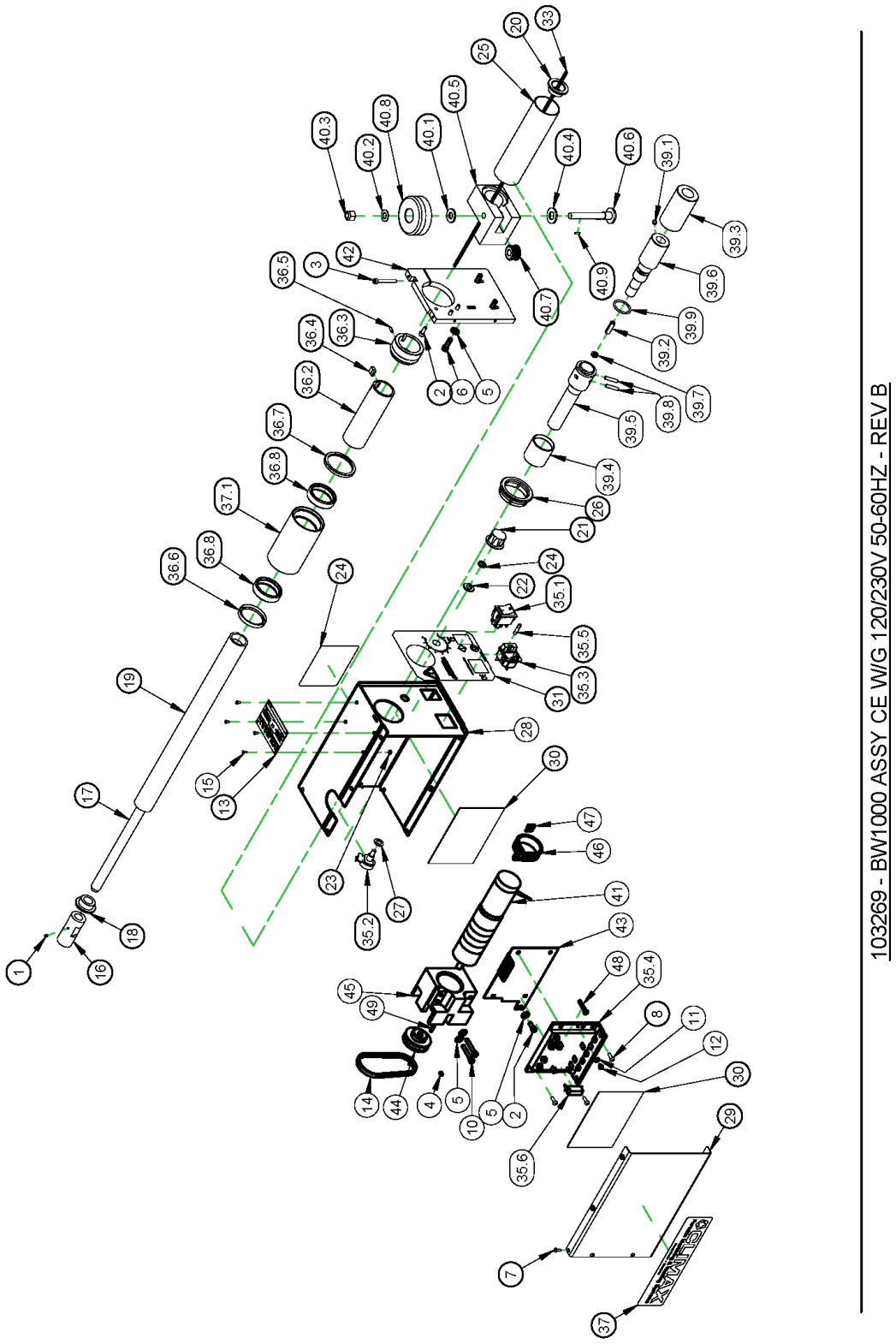


PARTS LIST			
ITEM	QTY	P/N:	DESCRIPTION
1	1	29038	TORCH EXTENSION 76MM (3)
2	1	29039	TORCH EXTENSION 152MM (6)
3	1	29040	TORCH EXTENSION 305MM (12)
4	1	30773	SUPPORT ROD WELD HEAD
5	1	34396	(NOT SHOWN) CORD POWER IEC 320 X NEMA 5-15 7.5 FT
6	1	40958	MOUNT RADIAL BW1000 TO MOUNTING ROD
7	1	54282	CASE PELICAN ALL WEATHER W/ BW1000 CUSTOM FOAM
8	1	63596	CLAMP COLLAR 1 ID X 1-3/4 OD X 1/2 WIDE ONE PIECE
9	1	70199	(NOT SHOWN) KIT TOOL MODEL BW1000
10	1	73879	(NOT SHOWN) CORD POWER 230V 3 METER IEC320 C13 X CEE7/7
11	1	103269	BW1000 ASSY CE W/G 120/230V 50-60HZ

70198 - BASE UNIT MODEL BW1000 - REV C

FOR REFERENCE ONLY

Notice: The P/N 103269 exploded views only apply to Borewelders with serial number 22001030 or later.



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	10936	SCREW 10-32 X 1 1/2 SHCS
4	1	11256	SCREW 10-24-UNC-2B X 1/4 SSSCP
5	6	11315	WASHER #10 FLTW BLACK OXIDE
6	3	11676	SCREW 10-32 X 3/4 SHCS
7	12	11677	SCREW 6-32 X 3/8 BHSCS
8	3	11852	SCREW 8-32 X 1/2 BHSCS
9	4	13243	(NOT SHOWN) WIRE TIE MEDIUM .14 X 8
10	2	17986	SCREW 10-32 X 1.25 SHCS
11	1	20758	WASHER #6 ITSTRW
12	1	26468	SCREW 6-32 X 3/16 BHSCS
13	1	29154	PLATE SERIAL YEAR MODEL CE 2.0 X 3.0
14	1	32575	BELT SLOW ROTATION
15	4	37397	SCREW 4-40 X 1/4 BHSCS
16	1	40966	TORCH ADAPTER SPINDLE
17	1	40967	DRAWBAR 5/8 DIA
18	1	40968	ISOLATOR TORCH END SPINDLE TUBE
19	1	40969	SPINDLE MAIN BW1000
20	1	40991	BUSHING ISOLATOR SWIVEL
21	1	61266	KNOB VOLT SPEED
22	1	61268	WASHER SHLDR SPACER 3/8 BLACK NYLON
23	4	62478	NUT 4-40 NYLON INSERT LOCKNUT
24	1	63504	LABEL WARNING
25	1	64260	TUBE FINGER 1.625 ID X 1.750 OD X .063 WALL WORM GEAR CE
26	1	64262	BUSHING PANEL ISOLATOR TUBE BW1000
27	1	64263	WASHER, 3/8 ID X 5/8 OD X .06 PHENOLIC CE
28	1	65191	SHROUD WORM GEAR BW1000 CE
29	1	65192	COVER SHROUD WORM GEAR BW1000 CE
30	2	66867	INSULATION SHEET HIGH TEMPERATURE BW1000 220V CE
31	1	66870	PANEL OVERLAY BW1000 CLIMAX CE
32	2	66873	(NOT SHOWN) TERMINAL SPADE 90 DEG 22-18 AWG FULL INSULATED RED
33	17.6in	67162	LINER BOREWELDER SPINDLE .065 ID X .188 OD
34	1	67313	WELD SAMPLE 2.750 ID X 3.500 OD X 2.000 (KB) (NOT SHOWN)
35	1	69822	KIT ELECTRICAL PARTS BW1000
35.1	1	42753	SWITCH ROCKER DPST 20A 125V
35.2	1	61265	POTENTIOMETER 5K
35.3	1	63491	RECEPTACLE POWER INLET FUSED 250V CE
35.4	1	63525	DRIVE MOTOR CONTROL 115/230VAC
35.5	2	64264	FUSE 5A 20MM X 5 MM FAST ACTING CE

103269 - BW1000 ASSY CE W/G 120/230V 50-60HZ - REV B

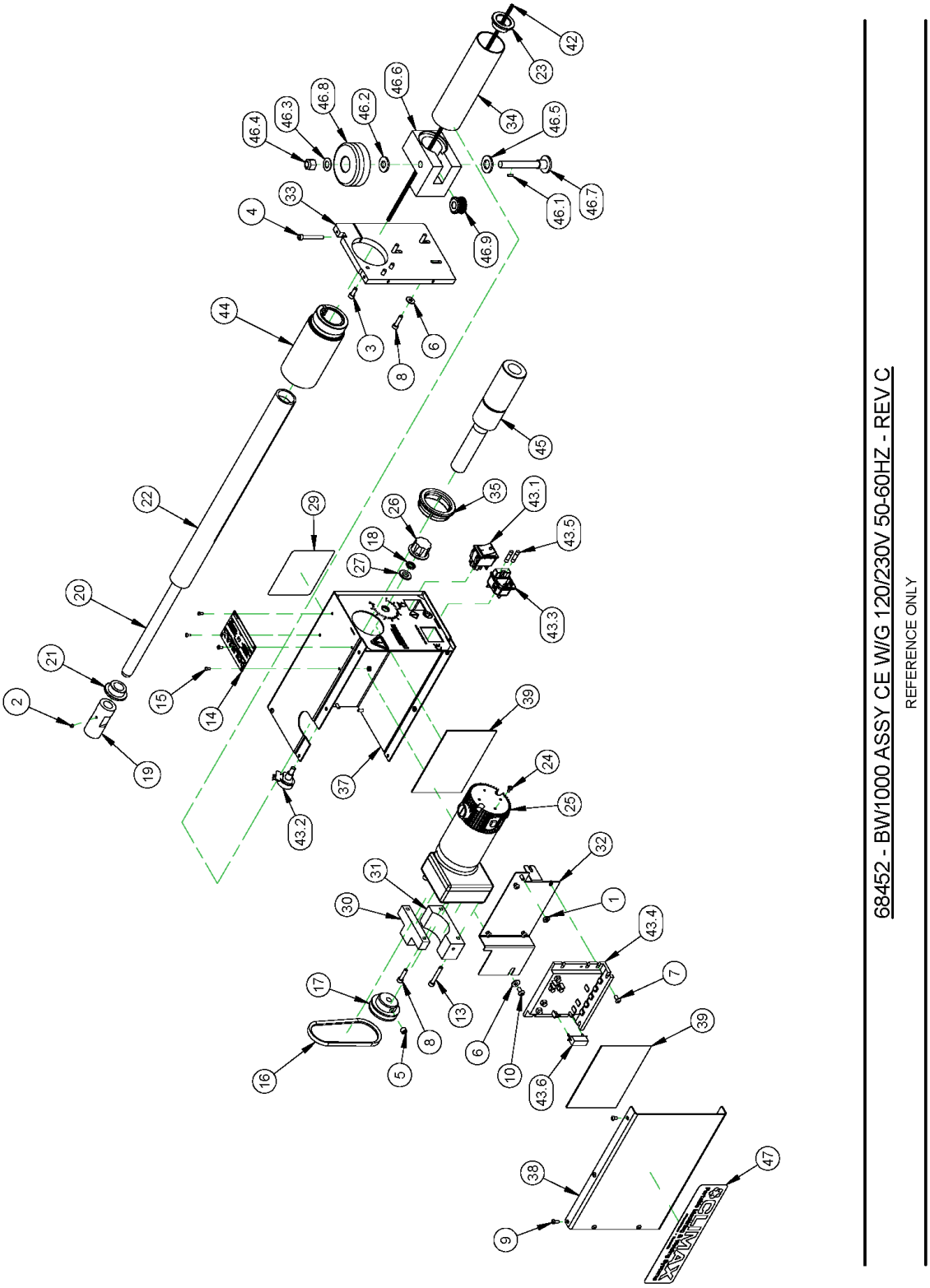
FOR REFERENCE ONLY

PARTS LIST			
ITEM	QTY	P/N:	DESCRIPTION
35.6	1	67143	RESISTOR HORSEPOWER PLC CONTROL DRIVES CE BW3000
36	1	69823	SPINDLE ASSEMBLY
36.2	1	40977	SHEATH TUBE SPINDLE PULLEY INTERMEDIATE
36.3	1	40978	PULLEY DRIVE SPINDLE
36.4	1	40979	SPINDLE KEY
36.5	1	40980	SCREW 6-32 X 3/8 SSSDPPL
36.6	1	44724	SEAL 1.500 X 1.874 X .250 MODIFIED
36.7	1	44725	SEAL 1.750 ID X 2.125 OD X .189
36.8	2	34740	BRG NEEDLE 1-1/2 ID X 1-7/8 X 1/2 OPEN
37.1	1	40973	BARREL SHEATH TUBE
37	1	70227	LABEL CLIMAX LOGO 2 X 8
38	12 in	70901	(NOT SHOWN) TUBING HEAT SHRINK .19 ID 2:1 SHRINK RATIO
39	1	80019	BW1 POWER SWIVEL COUPLING
39.1	1	40481	SCREW 1/4-20 X 1/4 SSSCP
39.2	1	33955	FITTING CONDUIT SPINDLE
39.3	1	63527	INSULATOR SWIVEL QUICK COUPLE FEMALE
39.4	1	63526	INSULATOR SWIVEL BODY CE
39.5	1	79114	POWER SWIVEL BODY 2ND
39.6	1	79117	STEM POWER SWIVEL 2ND
39.7	1	80016	SEAL FACE .43 OD X .275 ID .153 HIGH
39.8	2	19370	PIN DOWEL 3/16 DIA X 7/8
39.9	1	55031	O-RING 3/32 X 1 ID X 1-3/16 OD 70 DURO DASH 120
40	1	81074	WORM GEAR ASSEMBLY
40.1	1	63514	WASHER FIBER 3/8 ID X 7/8 OD X .11
40.2	1	63516	WASHER SPRING BELLEVILLE .380 ID X .750 OD X .034
40.3	1	63517	NUT 3/8-24 NYLON INSERT LOCKING GRADE 5
40.4	1	64257	WASHER FIBER 17/32 ID X 1 OD X .11
40.5	1	64258	BLOCK WORM GEAR CE
40.6	1	80853	SHAFT GEAR WG 3/32" SQUARE KEY
40.7	1	80855	GEAR WORM SPECIAL 3/32" SQUARE KEY
40.8	1	80854	KNOB ADJUSTMENT WORM GEAR SPINDLE 3/32" SQUARE KEY
40.9	2	29385	KEY 3/32 SQ X 11/32 SQ BOTH ENDS
41	1	103142	GEARMOTOR 90 VDC 6.6 RPM 189 IN-LBS TORQUE 776.76:1
42	1	103276	PLATE BASE MOTOR MOUNT (MMP)
43	1	103280	BRACKET MOTOR DRIVE (MMP)
44	1	103281	PULLEY ROTATION MOTOR STD (MMP)
45	1	103283	BLOCK MOTOR MOUNT BW2600 / BW1000 (MMP)
46	1	103284	CLAMP LOOP VIBRATION DAMPENING 1-1/2 ID
47	1	103285	NUT CLIP ON 8-32 0.04IN MAX THICKNESS
48	1	103632	SCREW 8-32 X 1 BHSCS
49	1	103633	STUD PARTIALLY THREADED M4 X 0.70 X 12MM LG STEEL

103269 - BW1000 ASSY CE W/G 120/230V 50-60HZ - REV B

FOR REFERENCE ONLY

Notice: The P/N 68452 exploded views only apply to Borewelders with serial number 22001029 or earlier.

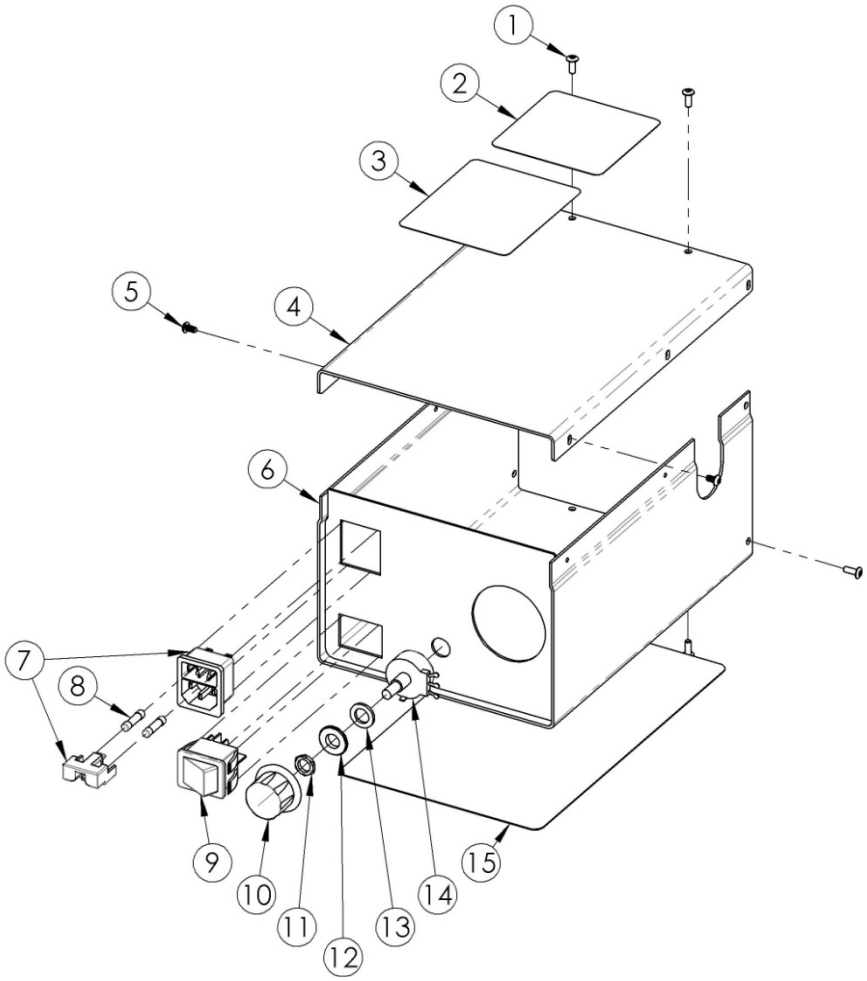


PARTS LIST			
ITEM	QTY	P/N:	DESCRIPTION
1	1	10343	NUT 8-32 STDN ZINC PLATED
2	1	10841	SCREW 8-32 X 3/16 SSSCP
3	3	10877	SCREW 10-32 X 1/2 SHCS
4	1	10936	SCREW 10-32 X 1 1/2 SHCS
5	1	11206	SCREW 5/16-18 X 5/16 SSSCP
6	4	11315	WASHER #10 FLTW BLACK OXIDE
7	4	11359	SCREW 8-32 X 3/8 BHSCS
8	5	11676	SCREW 10-32 X 3/4 SHCS
9	8	11677	SCREW 6-32 X 3/8 BHSCS
10	1	11678	SCREW 10-32 X 3/8 BHSCS
11	4	12599	SCREW 6-32 X 1/4 BHSCS
12	4	13243	(NOT SHOWN) WIRE TIE MEDIUM .14 X 8
13	2	17986	SCREW 10-32 X 1-1/4 SHCS
14	1	29154	PLATE SERIAL YEAR MODEL CE 2.0 X 3.0
15	4	37397	SCREW 4-40 X 1/4 BHSCS
16	1	40179	BELT V SPINDLE DRIVE GOODYEAR
17	1	40558	PULLEY ROTATION MOTOR STD
18	1	40965	NUT 3/8-32 NEF ELECTRICAL PANEL (REFERENCE ONLY, INCLUDED WITH P/N 61265)
19	1	40966	TORCH ADAPTER SPINDLE
20	1	40967	DRAWBAR 5/8 DIA
21	1	40968	ISOLATOR TORCH END SPINDLE TUBE
22	1	40969	SPINDLE MAIN BW1000
23	1	40991	BUSHING ISOLATOR SWIVEL
24	1	48582	SCREW 6-32 X 1/4 PPHSTS SELF TAPPING BLACK OXIDE
25	1	61210	GEARMOTOR PAINTED BW3000 90 VDC 7 RPM TENV
26	1	61266	KNOB VOLT SPEED
27	1	61268	WASHER SHLDR SPACER 3/8 BLACK NYLON
28	4	62478	NUT 4-40 NYLON INSERT LOCKNUT
29	1	63504	LABEL WARNING
30	1	63519	T-BLOCK MOTOR CE
31	1	63520	BLOCK MOTOR MOUNT WORM GEAR BW1000
32	1	64254	PLATE MOUNTING MOTOR CE BISON
33	1	64259	PLATE BASE MOTOR MOUNT WG
34	1	64260	TUBE FINGER 1.625 ID X 1.750 OD X .063 WALL WORM GEAR CE
35	1	64262	BUSHING PANEL ISOLATOR TUBE BW1000
36	1	64263	WASHER, 3/8 ID X 5/8 OD X .06 PHENOLIC CE
37	1	65191	SHROUD WORM GEAR BW1000 CE
38	1	65192	COVER SHROUD WORM GEAR BW1000 CE
39	2	66867	INSULATION SHEET HIGH TEMPERATURE BW1000 220V CE

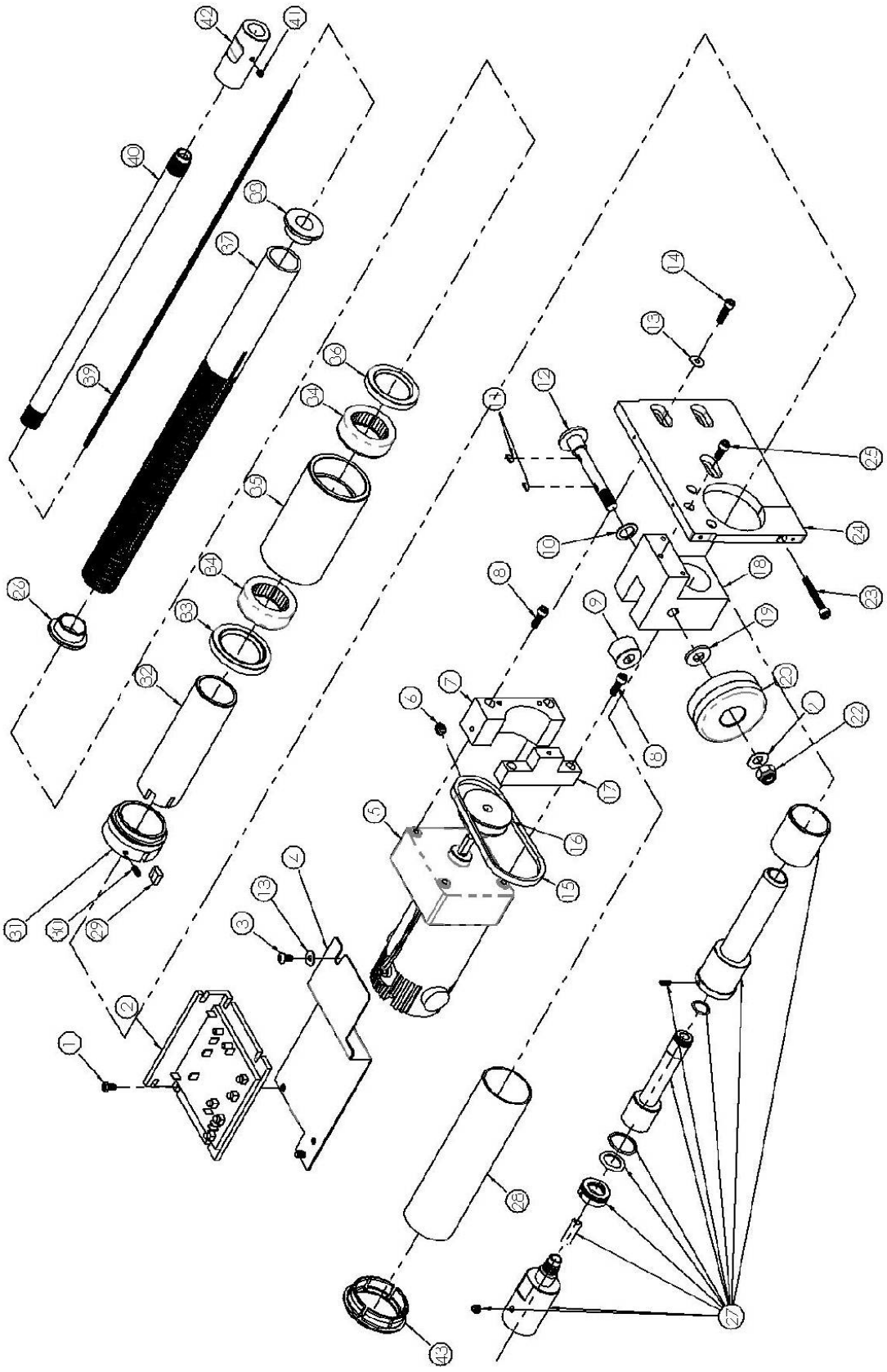
68452 - BW1000 ASSY CE W/G 120/230V 50-60HZ - REV C

FOR REFERENCE ONLY

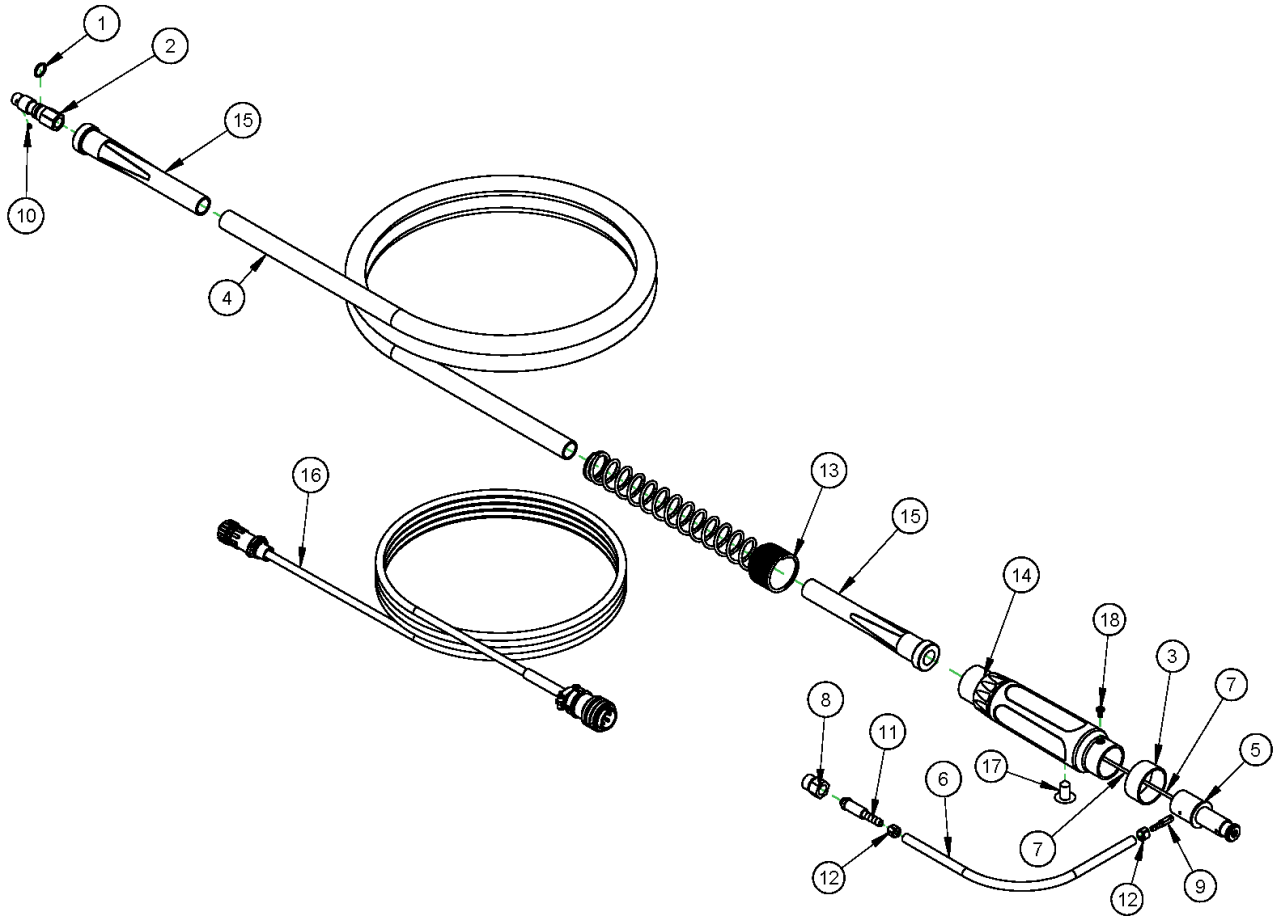
PARTS LIST			
ITEM	QTY	P/N:	DESCRIPTION
40	1	66870	PANEL OVERLAY BW1000 CLIMAX CE
41	2	66872	(NOT SHOWN) TERMINAL SPADE 90 DEG 22-18 AWG FULL INSULATED RED
42	17.6in	67162	LINER BOREWELDER SPINDLE .065 ID X .188 OD
43	1	69822	KIT ELECTRICAL PARTS BW1000
43.1	1	42753	SWITCH ROCKER DPST 20A 125V
43.2	1	61265	POTENTIOMETER 5K
43.3	1	63491	RECEPTACLE POWER INLET FUSED 250V CE
43.4	1	63525	DRIVE MOTOR CONTROL 115/230VAC
43.5	2	64264	FUSE 5A 20MM X 5 MM FAST ACTING CE
43.6	1	67143	RESISTOR HORSEPOWER PLC CONTROL DRIVES CE BW3000
44	1	69823	SPINDLE ASSEMBLY
45	1	80019	BW1 POWER SWIVEL COUPLING
46	1	81074	WORM GEAR ASSEMBLY
46.2	1	63514	WASHER FIBER 3/8 ID X 7/8 OD X .11
46.3	1	63516	WASHER SPRING BELLEVILLE .380 ID X .750 OD X .034
46.4	1	63517	NUT 3/8-24 NYLON INSERT LOCKING GRADE 5
46.5	1	64257	WASHER FIBER 17/32 ID X 1 OD X .11
46.6	1	64258	BLOCK WORM GEAR CE
46.7	1	80853	SHAFT GEAR WG 3/32" SQUARE KEY
46.9	1	80855	GEAR WORM SPECIAL 3/32" SQUARE KEY
46.8	1	80854	KNOB ADJUSTMENT WORM GEAR SPINDLE 3/32" SQUARE KEY
46.1	2	29385	KEY 3/32 SQ X 11/32 SQ BOTH ENDS



Balloon No.	**Description**	QTY	**Climax P/N**
1	6-32x.375 BtnHd Cap Scr	8	38151
2	CLIMAX MODEL SERIAL TAG	1	65366
3	WARNING LABEL	1	63504
4	COVER, SHROUD	1	63487
5	6-32x.250 BtnHd Cap Scr	4	63497
6	SHROUD, DOZER- CE WG, BLUE	1	63489
7	POWER INLET MODULE	1	63491
8	FUSE, GLASS	2	64264
9	SWITCH	1	42753
10	KNOB	1	61266
11	THREADING NUT, 0.34 ID	1	40965
12	WASHER, SHOULDER, ELEC. ISOLATION	1	61268
13	PHENOLIC WASHER	1	64263
14	BODY, POTENTIOMETER, 5k	1	61265
15	CLIMAX DOZER LABEL	1	65367



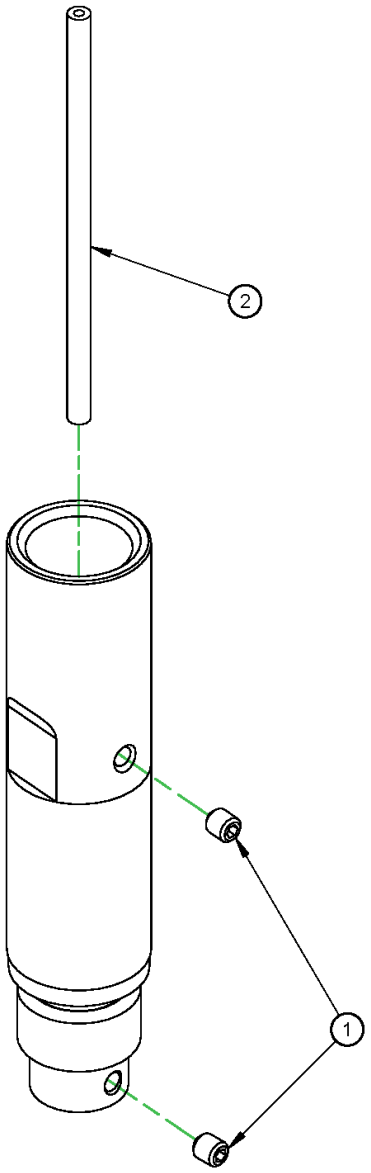
Balloon No.	Description	QTY	Climax P/N
1	SCR,8-32X.375 BTNHD CAP	4	11359
2	SCR Motor Control115/230vac	1	63525
3	SCR, 10-32X.375 BTNHD CAP	1	62483
4	Bracket Dozer CE, BISON Motor	1	64254
5	Motor Gearbox Assembly	1	61210
6	5/16-18x.31Soc Set Scr- CP	1	62497
7	Motor Block,Double	1	63520
8	SOC ND CAP SCR 10-32 x .75	4	64256
9	Worm Gear	1	63513
10	Washer, Inner Friction WG	1	64257
11	Key Way, Woodruff, #2025	2	63511
12	Shaft, Worm Drive	1	63510
13	#10 Flat Washer	4	11315
14	10-32x.75 Soc Hd Cap Scr	3	11676
15	VBelt	1	40179
16	Pulley, Motor	1	40558
17	Motor Block,"T"	1	63519
18	Gearblock, CE, Worm Gear	1	64258
19	Washer, Friction, Outer Worm Gear	1	63514
20	Handknob, spindle drive	1	63515
21	Spring Washer, Handknob, Spindle Drive	1	63516
22	Nut, Nylock, 3/8-24	1	63517
23	10-32x1.5 Soc Hd Cap Scr	1	10936
24	Base Plate, CE, WG	1	64259
25	10-32x.5 Soc Hd Cap Scr	3	10877
26	Busing, Isolator,Swivel End	1	40991
27	Torch, Sub-Assembly, CE-WG, Dozer	1	43278
28	Finger Tube, CE	1	64260
29	Spnidle Key	1	40979
30	Set Screw, Flat Point, #6-32 x 0.38, SOC. HD	1	64261
31	Pulley, Spindle Drive	1	40978
32	Intermediate Tube, Spindle Drive	1	40977
33	Seal, 1.75x2.13	1	44725
34	Needle bearing	2	40971
35	Barrel	1	40973
37	Spindle Tube	1	40969
37	Seal, 1.5x1.88	1	63509
38	Isolator, Spindle Tube Torch End	1	40968
39	Liner, Weld Wire	1	62489
40	DrawBar	1	40967
41	Set Screw, Cup Pt, 8-32x.188 Soc SHCS	1	37237
42	Torch Adapter, Spindle	1	40966
43	Grommet, Dozer CE	1	64262
44	Screw, BTN, HD, CAP #6-32x 0.375L	4	38151



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 .06 - .787 THICK NYLON BLK
18	1	86565	SCREW M4 X 0.7 X 8MM PPHMS ZINC

85536 - CONDUIT ASSY FOR LINCOLN BW2600 - REV A

FOR REFERENCE ONLY



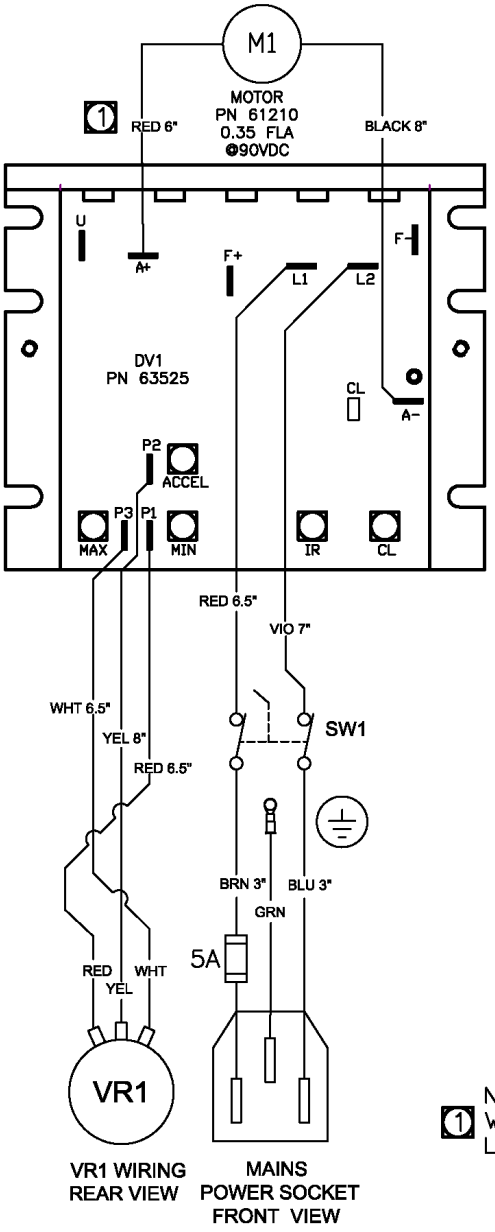
AVAILABLE CONFIGURATIONS	
PART NO	DESCRIPTION
29038	EXTENSION TORCH 3IN
29039	EXTENSION TORCH 6IN

PARTS LIST			
ITEM	QTY	P/N:	DESCRIPTION
1	2	10841	SCREW 8-32 X 3/16 SSSCP
2	3IN 6IN	62505	LINER STAINLESS STEEL .065 ID X .144 OD FOR .023/.045 WIRE

82155 - CHART EXTENSION TORCH 3" AND 6" - REV C

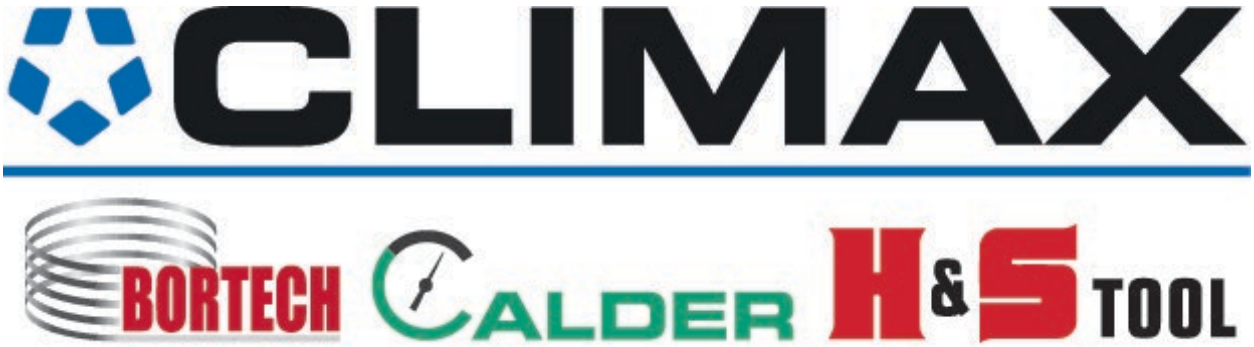
FOR REFERENCE ONLY

Schematics (P/N 68452)



DRIVE SETTINGS	
PARAMETER	VALUE
ACCEL	9:00
MAX SPD	12:00 (89-91V)
MIN SPD	10:00 (4.3-4.9V)
CL	10:00
IR COMP	9:00

NOTES:
1. WHEN USING MOTOR 103352 THERE IS A WHITE MOTOR LEAD IN LIEU OF RED.


CLIMAX
BORTECH
CALDER
H&S TOOL