OPERATORS MANUAL

BWS-2000
PORTABLE BORE WELDING SYSTEM

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

Model Number _____

Serial Number _____

Date of Purchase _____

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

BUG-O SYSTEMS

A DIVISION OF WELD TOOLING CORPORATION

CE

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LIT-BWS-IPM-O404

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1. <u>SAFETY INFORMATION.</u> Many accidents are caused by operation and maintenance, which disregard basic safety rules. Carefully read and adhere to the safety measures and precautions described in this instruction manual.

1.1. Machine Safety.

1.1.1. The **BWS-2000**, while designed to be durable, is not designed to be dropped. Should you do so, carefully inspect for damage. If any is found, repair or replace before continuing operation.

1.1.2. Never leave the machine running unattended. Overtravel can result in machine damage and workpiece damage.

1.1.3. Keep the machine clean. Failure to do so can result in premature wear.

1.1.4. Never remodel the machine.

1.1.5. Never use the machine outdoors when the weather is wet. This could cause failure of the machine and could cause a fatal accident by electric shock.

1.1.6. The input electrical power rating for operating the **BWS-2000** is 115 volts and 50 or 60 Hz. Input power voltage which varies more than 10% from the above rating will damage the unit. **Note:This refers to the electrical power to run the rotation function, not the welding power or electrical power required to run the welding power supply.**

1.1.7. The **BWS-2000** should only be powered from properly grounded three prong outlets. All electrical connections should only be made in accordance with the appropriate and applicable national and local electrical codes by a qualified electrician. **Note: When using the BWS-2000 in a location where the power requirements listed in 1.1.6. above are not available, a 150 (minimum) volt-ampere isolation transformer should be used to provide said requirements.**

1.2. Operator Safety.

1.2.1. Read this instruction manual before setting-up or operating the **BWS-2000**.

1.2.2. Always use a protective eye shield which conforms to ANSI Z87.1 standards when observing the machine in use. Observing the arc directly or its reflection, without the use of such a shield can result in permanent eye damage.

1.2.3. Always use approved safety glasses with side shields when setting up or running the **BWS-2000**.

1.2.4. Anyone being exposed to the arc or its reflection should wear protective clothing over as much exposed skin as possible. Other areas should use a “sun block” cream with an appropriate “SPF” value.

1.2.5. Anyone close to the welding operation should wear heavy flame resistant clothing for protection from sparks and flame.

1.2.6. The operator should not use loose clothing which might get wrapped around the rotating members of the **BWS-2000**.

1.2.7. Before connecting the power plug make sure that the enable switch is in the OFF position.

1.2.8. Removal of the machine cover without disconnecting the power may result in dangerous electrical shock.

1.2.9. Gases and fumes may be produced by the welding process which are dangerous to breathe and should be avoided. Only use the **BWS-2000** where there is adequate ventilation.

1.2.10. Do not contact electrically live parts. Dangerous electrical shock may result.

1.2.11. Do not operate the machine in damp areas or on metal floors without adequately insulating yourself from the ground, the machine or machine components, or the workpiece.

1.2.12. Make sure the **BWS-2000** is adequately secured before using - especially when using in an elevated location. Falling and striking the operator or others could cause serious injury.

1.2.13. Always wear a “hard hat” when using the **BWS-2000** in an elevated location or when near others working in an elevated location.

1.3. General Safety Requirements.

1.3.1. Keep the welding area neat and free from combustible materials - especially near locations where welding spatter might land.

1.3.2. A fire extinguisher should be readily available when welding.

1.3.3. Inspect all electrical cables and conduits for signs of wear and replace or repair as

required before use of the equipment.

1.4. Additional Safety Information. (1) Recommended reading for users in the USA: "Safety in Welding and Cutting", American National Standard ANSI Z49.1, which can be purchased from the American Welding Society, Inc., 550 NW Lejeune Road, Miami, FL 33126, USA. Telephone Number is 1-800-443-9353. (2) Users outside the USA refer to the relevant safety regulations promulgated by the appropriate competent authority for your location.

2. MAJOR COMPONENTS AND THEIR FUNCTIONS.

2.1. Conduit Assembly. Provides a connection between the power supply and torch, and allows the transmission of welding current, shielding gas, and welding wire. ***See Figure #1***.

- **2.1.1. Connector.** Connects the Conduit to the wirefeeder. Type: EuroConnector, also known as the Binzel KZ-2.
- **2.1.2. Conduit.** Flexible connection between the wirefeeder and the **BWS-2000**.
- **2.1.3. Extension Tube.** Allows the Torch to be extended to reach the bore to be welded.
- **2.1.4. Liners.** Liners extend from the wirefeeder to the welding Tip.
- **2.1.5. Torch Swivel.** Allows the Torch to be pivoted to reach the diameter to be welded.
- **2.1.6. Swivel Lock.** Locks the Torch in the desired angular position.
- **2.1.7. Welding Switch.** Allows the welding process to be turned ON and OFF.
- **2.1.8. Welding Switch Cord.** Allows the welding switch to be remotely operated.

2.2. Torch. Specially designed welding torch for the building up of bores. ***See Figure #2.***

- **2.2.1. Torch Body.** Attaches to the Torch Swivel, and provides an attachment location for the Diffuser and support of the liner. The body also conveys electric current, and shielding gas for welding.
- **2.2.2. Standard Torch Extender.** Can be inserted between the Torch Swivel and the Torch Body to allow greater diametric reach of the Torch.
- **2.2.3. Diffuser.** Attaches to the Torch Body, and provides for attachment of the Tip and Nozzle, and support and positioning of the end of the liner. It also conveys electric current, and shielding gas.
- **2.2.4. Tip.** Attaches to the Diffuser, and conveys wire for the welding process. It also transfers electric current to the wire.
- **2.2.5. Nozzle.** Attaches to the Diffuser and directs shielding gas to the welding location.
- **2.2.6. Torch Locking Nut.** Locks the Torch in the desired angular position.

2.3. Torch Mover. Provides the necessary motion and speed adjustment to allow the build up of bores of various sizes. ***See Figure #1.***

- **2.3.1. Housing.** The backbone of the Torch Mover. Encloses necessary electrical and mechanical components.
- **2.3.2. Spindle.** Supports the Extension Tube and provides the necessary motion for welding.
- **2.3.3. Tube Clamp.** Provides a rigid attachment to and telescoping of the Extension Tube, as well as an upper stop for the Spindle.
- **2.3.4. Spindle Collar.** Provides a lower stop for the Spindle and Spindle support and position when doing a single plane weld.
- **2.3.5. Clutch Lever.** Allows the Clutch to be disengaged for rapid positioning of the Spindle. The Clutch Lever can also be locked for single plane welding.
- **2.3.6. Rotation Direction Switch.** Determines the direction of rotation of the Spindle. This switch also has a center OFF position.
- **2.3.7. Rotation Speed Knob.** Determines the speed of rotation of the Spindle.
- **2.3.8. Cooling Gas Fitting.** Allows the introduction of cooling gas to allow the use of the **BWS-2000** in severe heat conditions.
- **2.3.9. Support Bracket.** Provides support to the Torch Mover at 8 positions around the centerline.
- **2.3.10. Power Cord.** Provides electrical power to the **BWS-2000** to drive the rotation motor. Required input is 115v, 50/60 Hz.
- **2.3.11. Receptacle.** Provides a fused connection for the Power Cord.

2.4. Other Support Components. Provide a connection between the Support Bracket and attachment to a rigid surface. ***See Figure #1.***

2.4.1. Support Rod. Provides support and axial adjustment for the **BWS-2000**.

2.4.2. Swivel Base. Supports and allows the Support Rod to be adjusted to be parallel to the bore axis. Anchor the Swivel Base by tack welding or clamping. Use the Swivel Base when aligning the **BWS-2000** with Centering Cones.

2.4.3. Tack Nut. Supports the Support Rod. Does not allow adjustment of the Support Rod once tack welded in place. Typically used when the attachment surface is known to be perpendicular to the axis of the bore, and when other means of support are not available or are not practical.

2.4.4. "T" Base. Supports the Support Rod and provides a simple means for manual parallelism and concentricity adjustment.

2.4.5. Base Extender. Is bolted to the "T" Base and extends the point of attachment of the Support Rod 3 inches toward the center of the bore, thereby allowing the welding of larger bores.

2.4.6. Radial Support. Attaches at one end to the Support Bracket and at the other end to the Support Rod. It projects the **BWS-2000** 4 inches from the Support Rod and allows the welding of larger diameter bores. It also allows the **BWS-2000** to be moved closer and farther from the point of attachment as required, thereby providing centering capabilities. An 8 inch Radial Support is also available.

2.4.7. Tack Plate. Supports, and provides an attachment location and alignment for the "T" Base. To be welded to a rigid support at an appropriate location to allow the **BWS-2000** to be centered over the bore to be built up.

2.4.8. Rod Collar. Provides support for the **BWS-2000** when the Support Bracket or Radial Support clamps are loosened. This is especially useful when setting up to weld a vertical axis bore.

2.5. Tools Provided.

2.5.1. Hex Wrench, 3/4". Use on the "T" Base Leveling Bolts and Clamping Nut.

2.5.2. Hex Wrench, 9/16". Use on the Support Ball clamp, and Machine and Radial Support clamp hex head cap screws.

2.5.3. Allen Wrench, 1/2". Use on the Base Extender bolts.

2.5.4. Allen Wrench, 1/4". Use on Support Plate socket head cap screws.

2.5.5. Allen Wrench, 3/16". Use on Tube Clamp, Spindle Collar and Support Rod Clamp socket head cap screws, and Center Cones socket set screws.

2.5.6. Allen Wrench, 5/64". Use on Liner end socket set screws.

2.5.7. Support Rod Tightener. Use to tighten Support Rod.

3. SPECIFICATIONS.

3.1. Weight (Positioner and Torch). 11.4 kg (25 lb.)

3.2. Diameter Range.

3.2.1. Standard ID Torch. 32 to 204 mm (1.25 to 8 in.)

3.2.2. Standard ID Torch w/Extender. 32 to 280 mm (1.25 to 11 in.)

3.2.3. Large ID Torch w/Extenders. 200 to 610 mm (8 to 24 in.)

3.2.4. Standard OD Torch. 0 to 305 mm (0 to 12 in.)

3.3. Torch Reach (ID) – w/Extender. 1070 mm (42 in.)

3.4. Torch Reach (OD; Minimum) – 204 mm (8 in.)

3.5. Maximum Uninterrupted Axial Weld Length. 170 mm (6.7 in.)

3.6. Maximum Continuous Welding Current - Standard. 140A

3.7. Welding Process. MIG (GMAW)

3.8. Welding Wire Diameter Range. .8 to 1.2 mm (.030 to .045 in.). Note: The recommended wire diameter for welding steel is .8 mm (.030 in.).

3.9. Operating Conditions. Complies with Standards EN60204-1/EN60974-1.

3.10. Housing Cooling with Compressed Air. Recommended when working for sustained periods in environments with temperatures greater than 200 degrees Fahrenheit. Attach air line to BWS-2000 using 1/8 NPT.

4. ALIGNMENT OF THE BWS-2000 TO THE BORE BEING WELDED. Alignment is comprised of three major factors: (1) Parallelism - Positioning the axis of the **BWS-2000** parallel with the axis of the bore being welded, (2) Concentricity - Positioning the axis of the **BWS-2000** directly in-line with the axis of the bore, and (3) Axial Positioning - Positioning the torch in a beginning axial location where it can weld as much of the bore as possible without stopping. ***See Figures #4, 5, 8 & 9.***

4.1. Parallelism. The **BWS-2000** is designed to allow parallelism alignment in several ways: (1) Unassisted, (2) Use of the Centering Cones, (3) Alignment directly from a boring bar, and (4) Attachment to an aligned boring bar adapter.

4.1.1. Unassisted.

4.1.1.1. Weld the Tack Plate on a rigid support so that the Anchor Bolt is the appropriate distance from the center of the bore to be welded, and the surface of the Tack Plate is within 5° of being perpendicular to the axis of the bore. *Notes: (1) See **Figures #9 & 10** in order to determine the Anchor Bolt to bore-center distance, as well as appropriate support components for the size of bore to be welded. (2) The Support Bracket can be attached to the **BWS-2000** in any one of 8 angular positions around the Spindle centerline in order to facilitate the ease of attachment and use of the **BWS-2000**. This feature is particularly important when space is limited.*

4.1.1.2. Attach the "T" Base to the Tack Plate by setting the Base over the Anchor Bolt so that the Anchor Bolt protrudes through the Base slot, installing a ½ inch Flat Washer, 4 Spring Washers, and locking it into place with a ½-13NC Clamping Nut. ***See Figure #8.***

4.1.1.3. Screw the Support Rod into the "T" Base.

4.1.1.4. Adjust the Leveling Screws until the Support Rod is parallel to the bore axis. This can most easily be accomplished by adjusting the 2 Screws at the top of the "T", first to get one plane of adjustment aligned with the bore, and then the single Screw at the bottom of the "T" to get the perpendicular plane of adjustment aligned with the bore. See Figure #8.

4.1.1.5. Adequate parallelism in each of these planes of adjustment can be judged by inserting a straight edge into the bore, aligning it parallel to the bore axis, and sighting or measuring the distance between the Support Rod and straight edge for each plane.

4.1.1.6. A level can also be used to achieve parallelism if the axis of the bore is known to be either horizontal or vertical.

4.1.2. Centering Cones. The use of centering cones is a good choice when there are two or more in-line bores to be welded. The use of centering cones as described below achieves not only parallelism, but also concentricity. See Figure #6.

4.1.2.1. Slide a 31.75 mm (1.25 in.) diameter tube or rod of sufficient length to reach into at least two of the bores to be welded.

4.1.2.2. Slide two Centering Cones onto the tube - one onto each end. Lock one of the cones onto the tube and then slide the other cone into the bore until it forces the tube and opposite-end cone to the center of the bore. Once so centered, lock the second cone into position.

4.1.2.3. Slide the **BWS-2000** - minus the Conduit Assembly - over the centering tube. (The tube will now extend through the Spindle.)

4.1.2.4. Weld or clamp the Swivel Base or Tack Nut while attached to the **BWS-2000** to an appropriate rigid support.

4.1.2.5. After tightening all support clamping screws, the Centering Cones and tube can be removed and the Conduit Assembly inserted in the Spindle for welding.

Note: An alternative but similar method involves the use of bushings instead of cones. In this instance, bushings with OD's nearly as large as the bores and ID's 1.25 inches in diameter, are inserted into the bores. A 1.25 inch diameter tube or rod is then inserted through the ID's of the bushings. The tube/rod is now centered in the bore. Proceed as in 4.1.2 above.

4.1.3. Alignment from Boring Bar. If the boring bar is to be set-up before welding the bore, this method is preferred over alternatives due to its speed and accuracy.

4.1.3.1. If a 31.75 mm (1.25 in.) diameter boring bar is used, slip the **BWS-2000**, with the Torch Assembly removed, on the boring bar at the axial location desired. If a larger diameter boring bar is used, remove the boring bar, install bushings in the boring bar bearing ID's, insert a 31.75 mm (1.25 in.) diameter tube in the bushings, and slip the **BWS-2000** on the tube.

4.1.3.2. Weld or clamp the Swivel Base or Tack Nut while attached to the **BWS-2000**, to an appropriate rigid support.

4.1.3.3. Remove the boring bar and insert the Conduit Assembly in the Spindle for welding. *Note: It may be necessary to remove the boring bar, bearing insert or the entire bearing in order to allow the torch to have adequate radial reach.*

4.1.4. Boring Bar Adapter. Several manufacturers of popular boring bars offer adapters which allow attachment of the Support Rod and assure its alignment. Once so aligned, the Support Bracket can be directly attached to the rod and the **BWS-2000's** axis will be reasonably parallel to the bore to be welded.

4.2. Concentricity. Use of centering cones, as described above, provides concentricity of the **BWS-2000** as well as parallelism. However, unassisted set up or use of a boring bar adapter generally requires some additional adjustment in order to achieve concentricity. This adjustment is done after parallelism adjustments have been completed.

4.2.1. Unassisted. Achieving concentricity when doing an unassisted set up will typically require the adjustment of two axes. ***See Figure #8.***

4.2.1.1. By using the attached Support Bracket, set the **BWS-2000** on the Support Rod at an appropriate axial location. *Note:If the axis of the bore to be welded is vertical or nearly vertical, the use of a 1 ¼ inch diameter locking Rod Collar located under the radial support is recommended. Use of this collar when locked into the appropriate position on the Support Rod, allows the free rotation of the Radial Support without the nuisance of it sliding down the Support Rod.*

4.2.1.2. If not already in place, insert the Conduit Assembly in the Spindle and clamp. Also, install the Torch.

4.2.1.3. Attach the Power Cord to the **BWS-2000** and energize with 115v, 50 or 60 Hz electrical power. The Spindle should now be capable of rotating when the Rotation Direction Switch is in either of its active positions.

4.2.1.4. Extend the Torch into the bore to be welded either by disengaging the Clutch and manually moving the Spindle, or by unclamping the Tube Clamp and extending the Extension Tube.

4.2.1.5. Once into the bore, rotate the Torch until the Nozzle is pointing toward, and then directly away from the Support Rod. Note the distance from the end of the Nozzle to the bore wall for both of these positions. If these distances are not equal, loosen the Anchor Nut and slide the "T" Base until the distances are equal. Retighten the Anchor Nut. *This completes the centering process for one axis.*

4.2.1.6. Rotate the Torch 90 degrees from the positions just used in order to achieve the first axis of centering, ie., perpendicular to a line running between the bore center and the Support Rod.

4.2.1.7. Note the distance of the Nozzle from the bore wall and again rotate the Torch 180 degrees and compare the Nozzle/wall distance.

4.2.1.8. Adjust the Nozzle/wall distances by unclamping the Support Bracket from the Support Rod, and swiveling the BWS-2000 around the Support Rod until the Nozzle/wall distance is equal at both positions. Reclamp the Support Bracket to the Support Rod.

4.2.1.9. The Torch should now be centered in the bore and the centerlines of the bore and the **BWS-2000** parallel. Rotate the Torch 360° at the top and bottom of the bore to confirm. Note: Nozzle to wall distance consistency of from 1 to 1.2 mm (.04 to .05 in.) is generally adequate.

4.2.2. Boring Bar Adapter Assisted. Use of a boring bar adapter generally provides the first axis of centering and does not require the use of the Radial Support. Follow the instructions above from 4.2.1.6. thru 4.2.1.9. in order to achieve second axis centering.

4.3. Axial Positioning. Several factors can affect the axial position of the various components, and therefore the axial range of the welding process. They include the: (1) Location of attachment of the Tack Plate or Swivel Base, (2) Position of attachment on the Support Rod, (3) Axial position of the Spindle, and (4) Axial position of the Extension Tube. ***See Figure #4.***

4.3.1. Location of Tack Plate or Swivel Base. For most welding situations there is only one logical mounting surface - adjacent to one of the bores to be welded, and at about the same plane as on end. When several in-line bores are to be welded, it might be desirable to attach the Tack Plate or Swivel Base between the bores, thereby allowing an easy reach to bores on either side. This is possible because the Extension Tube can be inserted in the Spindle with the torch coming out of either end of the **BWS-2000**. The only change that has to be made to accommodate reversing the position of the torch is swapping the locations of the Spindle Collar and the Tube Clamp. ***See Figure #5.***

4.3.2. Position of the **BWS-2000** on the Support Rod. The Support Rod is 560 mm (22 in.) long. The Radial Support or Support Bracket can be positioned along the rod wherever necessary.

4.3.3. Axial Position of the Spindle. The axial position of the Spindle determines the length of stroke available for welding before repositioning is necessary. It should be considered along with other axial position contributors, and the length of the bore when determining the best combination. The axial position of the Spindle is changed by disengaging the Clutch and manually sliding the Spindle to the desired location.

4.3.4. Axial Position of the Extension Tube. The position of the Extension Tube and Spindle allows bores located approximately 1000 mm (40 in.) away from the Tack Plate mounting surface to be welded. This extension capability allows the quick movement of the torch from bore to bore. The position of the Extension Tube is changed by loosening the Tube Clamp and manually extending or retracting the Extension Tube to the desired location. *Note: In order to maintain stability of the Torch, the Extension Tube should not protrude beyond the end of the Tube Clamp more than 530 mm (22 in.).*

5. <u>WELDING TORCHES.</u> The **BWS-2000** has the capability of welding inside diameters from 32 to 940 mm (1.25 to 37 in.) and outside diameters up to 305mm (12 in.). Welding this range of diameters is achieved by using either the Standard, Large Diameter or OD Torch, using the appropriate nozzle, tip, diffuser and extender, and by pivoting the torch to the proper radial location. ***See Figures #2, 3 & 4.*** *Note: (1) In order to keep weight and electrical resistance to a minimum, many of the Torch components are manufactured out of aluminum. T<u>ake care not to overtighten these components as damage to the threads may result.</u>* ***(2) The ID Torches are coated to prevent accidental arcing to the torch bodies. Take care not to wear off the coating.***

5.1. Liner Stick-Out. Proper Liner stick-out from the end of the Torch before installing a Diffuser is a follows: (1) Standard Diffuser – 29 mm (1.15 in.); (2) Mini Diffuser – 6 mm (.25 in.). ***See Figure #2.***

5.2. Liner Stick-Out Adjustment. The Liner stick-out can be adjusted by loosening the Torch Attachment Locknut and screwing the Torch either in or out as necessary to provide proper stick-out. Following adjustment, the Torch Attachment Locknut should be retightened. ***See Figure #2.***

5.3. Mini Components. Use the Standard Torch with these components in order to weld bore diameters from 32 to 50 mm (1.25 to 2 in.). ***See Figure #2.***

5.3.1. Diffuser, Mini (PN. 1093). Screws into the Standard Torch Body and contains the end of the liner. It also supports the tip and nozzle, and transfers electrical power to the tip.

5.3.2. Tip, Stub (PN. 1058). Screws into the diffuser and provides transfer of electrical power from the diffuser to the welding wire.

5.3.3. Nozzle, Mini (PN. 1092). Screws onto the diffuser and directs the shielding gas.

5.4. Stub Components. These components, when used with the Standard Torch, allow the welding of diameters as small as 45 mm (1.8 in.). They are capable of being used to weld diameters as large as 145 mm (5.7 in.). ***See Figure #2.***

5.4.1. Diffuser (PN. 1057). Screws into the torch body and contains the end of the liner. It also

supports the tip and nozzle. ***Note: Attach only Diffuser numbers 1057 or 1093 to the Standard Torch. Use of other diffusers may cause damage to the liner and torch threads.***

5.4.2. Tip, Stub (PN. 1058). Screws into the diffuser and provides transfer of electrical power from the diffuser to the welding wire.

5.4.3. Nozzle, Stub (PN. 1066). Screws onto the diffuser and directs the shielding gas. This nozzle is electrically isolated.

5.5. Standard Components. When used with the Standard Torch, these components allow the welding of diameters from 70 mm to 204 mm (2.75 to 8 in.). ***See Figure #2.***

5.5.1. Diffuser (PN. 1057). Same use as above.

5.5.2. Tip, Standard (PN. 1061). Same use as above.

5.5.3. Nozzle, Standard (PN. 1067). Same use as above. *Note: Only use Nozzles number 1066 and 1067 when attaching directly to the Standard Torch. Other Nozzles may lose their electrical isolation when used with this torch.*

5.5.4. Standard Torch Extender. Use of the Standard Torch Extender extends the length of the Standard Torch by 100 mm (4 in.). Its use increases the diameter capability of the above components by approximately 75 mm (3 in.). It is attached at the swivel end of the Standard Torch, and requires use of a liner segment about 4 inches longer than is used without it. ***See Figure #2.***

5.6. Large Diameter Components. The use of the Large Diameter Torch allows the welding of bores from 200 to 380 mm (8 to 15 in.). Use the same Diffuser, Tip, and Nozzle as are listed under Standard Components. If Torch Extenders are also used, the maximum diameter capability is extended to a maximum of 610 mm (24 in.). ***See Figure #3.***

5.6.1. Liner With Attached Tubular Liner Aligner. The Liner protruding from the Torch is extended by slipping the Liner Aligner over the Torch Liner.

5.6.2. Torch Extenders. Thread the lengthened liner through the Torch Extender(s) and screw the Extender(s) on the Large Diameter Torch. The Liner should now protrude approximately 29 mm (1.15 in.) beyond the end of the Extender - cut as necessary. Installation of the Diffuser should now place the Liner in its proper orientation relative to the Tip. Any of the Tips, Diffusers, or Nozzles listed above can be used with the Large Diameter Torch. *Note: When using the Large Diameter Torch,, Tweco Diffuser number 35-50, and Nozzle number 21-62 are acceptable.*

5.7. Outside Diameter Components. The use of the OD Torch, allows the build-up of outside diameters from 0 to 305 mm (0 to 12 in.) for a minimum length of 204 mm (8 in.). Special torch bodies can be provided to accommodate diameter and length requirements outside of the ranges listed above. All Tips, Diffusers, and Nozzles that are used with the ID Torches, can be used with the OD Torch. ***See Figure #3.***

5.8. Attachment of the Welding Torch. ***See Figure #2 & 3.***

5.8.1. Remove the Nozzle and Diffuser from the torch. This allows the Liner to be manually deflected into the threaded diffuser-attachment-hole when it reaches that point during torch attachment.

5.8.2. Insert the end of the Liner coming out of the Conduit Assembly into the end of the Torch, and screw the Torch on the Torch Adapter.

5.8.3. Once adequate engagement is achieved, the liner is protruding through the diffuser-attachment-hole approximately 29 mm (1.15 in.) for the standard Diffuser and 6 mm (.25 in.) for the Mini Diffuser, and the diffuser-attachment-hole is pointing in the direction of Torch adjustment, screw the Torch Lock Nut until it tightens against the Torch, thereby locking the Torch into position.

5.9. Radial Adjustment of the Welding Torch. ***See Figure #2, 3 & 4.***

5.9.1. If tightly locked, loosen the Radial Adjustment Lock Nut.

5.9.2. Pivot the Torch until the closest point of the Nozzle is about 2 to 4 mm (.08 to .16 in.) from the inside of the bore (or outside of pin).

5.9.3. Lock the Torch in position by hand tightening the Radial Adjustment Lock Nut.

5.10. Axial Adjustment of the Welding Torch. (See 4.3. above.)

6. <u>CONDUIT ASSEMBLY INSTALLATION.</u> The Conduit Assembly extends all the way from the Wirefeed Connector to the Torch Adapter. See Figure #7.

6.1. Insert the Conduit Assembly into the Spindle, the Extension Tube end first. *Note: (1) If the Torch is attached, remove the Nozzle and Diffuser first. (2) Make sure that the Extension Tube is clean, by wiping it with a clean soft cloth to remove any loose dirt or buildup before installation. Failure to keep the Extension Tube clean could result in binding with the Spindle bore.*

6.2. Clamp the Extension Tube in position using the Tube Clamp. It can be clamped with the torch-attachment-end from 0 to 560 mm (0 to 22 in.) from the end of the Tube Clamp.

6.3. Attach the flexible end of the Conduit Assembly to the wirefeeder.

6.4. If possible, position the wirefeeder so that the Flexible Conduit is oriented in a "Stable Wire Feeding Setup" similar to those shown in **Figure #7**. Weld beads produced by a stable wire feeding setup will be straighter. Also, there will be much less likelihood of incomplete weld coverage of the bore.

7. <u>FINAL PREPARATION FOR WELDING.</u>

7.1. Adjust the radial position of the Torch as specified above.

7.2. Adjust the axial position of the Torch - using techniques specified above - to the desired starting position so that the welding can proceed from the end of the bore farthest from the **BWS-2000** toward the **BWS-2000**. Generally an initial wire contact position of about 2 to 3 mm (.08 to .12 in.) from the start end of the bore is about right. *Note: It is advisable - especially in vertical welding applications - to attach the conduit to the Radial Support, Support Rod or other stationary object so that the conduit forms a large radius when exiting the Extension Tube or Spindle. This causes less friction for the welding wire traveling through the Conduit and less friction between the Conduit and Extension Tube or Spindle.* ***See Figure #4.***

7.3. Set the Rotation Speed Knob to the proper setting based on the diameter to be welded. An approximate setting can be read from the chart on the side of the **BWS-2000**. This chart is based on welding speeds of 500 mm (20 in.) per minute. Note: Rotation speeds will vary due to differences in supply voltage and electrical components. To check the actual welding speed divide circumference of the bore by the time in minutes required to traverse one full revolution. ***See Appendix A, paragraph #1.***

7.4. Check to make sure that the Welding Switch at the end of the welding cord is in the ***Off position***. ***Note: If the Welding Switch is not in the Off position dangerous welding flash may result when the power supply is energized.***

7.5. Energize the welding power supply.

7.6. With the ground (-) and/or positive (+) welding leads <u>disconnected</u>, jog the welding wire through the Conduit Assembly and Torch by depressing the "Jog Button" on your wirefeeder, or if your wirefeeder does not have a "Jog Button", move the Weld Switch to the "On" position. Once the welding wire is through the Conduit Assembly and Torch, move the Weld Switch to the "Off" position. Cut the wire to an appropriate stick-out length. ***Notes: (1) If the welding leads are not disconnected, a dangerous welding flash may result when the welding wire exits the torch.*** *(2) The Diffuser may have to be removed in order for the wire to get around the Liner bend just before the Diffuser attachment point. Once the wire is through the Liner, the Diffuser (and Tip) can be reinstalled.*

7.7. Connect the welding current ground (-) lead to the part being welded. *Note: Make sure that the ground is connected to clean solid metal. A poor ground will adversely affect weld quality.*

7.8. Make sure the power supply is set for Constant Voltage operation.

7.9. Make sure that the bore to be welded is clean, ie., free from rust, dirt, oil, grease, etc. A dirty bore will cause poor weld quality, and excessive spatter.

7.10. Connect shielding gas. For mild steel welding, use an argon/CO2 mixture with an argon content of from 75 to 92 percent. Set the flow rate to about 1 m3/hour (35 cfh or 16 litres/minute).

7.11. Purge air from the system by depressing the purge button - typically located on the wirefeeder - for approximately 10 seconds. This should be the last step before welding to assure that no air has infiltrated the gas feed system.

8. WELDING.

8.1. Make sure that all of the safety precautions mentioned in the Safety Information section of this manual are being complied with before beginning welding.

8.2. Move the Rotation Direction Switch in the axial direction that the torch is supposed to travel. This will start the rotary and axial motion.

8.3. At the same time that the Rotation Direction Switch is activated, the Weld Switch can be activated. *Note: At this time, the Clutch can be locked in the "disengaged" position for one Torch revolution to allow a single plane of weld to be deposited before axial motion begins. This generally gives more complete buildup at the start of the weld.*

8.4. Normal weld settings for mild steel are: Voltage - 16 to 17.5; Amperage - 100 to 135, although successful welding can be done outside of these settings.

8.5. Adjust the rotation speed, voltage and wire speed settings as necessary to achieve the desired results. Be especially careful that the arc is "playing" at the intersection of the previous bead and the base metal. If the arc is "playing" on the previous bead or in the molten weld puddle, poor fusion to the base metal may result.

8.6. When approaching an area where weld should not be deposited - such as a keyway - move the Weld Switch toggle to the "Off" position to stop welding. Rotation will continue. Once the far side of the area is reached, move the Weld Switch to the "On" position to continue welding.

8.7. The **BWS-2000** is designed to be "manned" when in use in order to make adjustments when necessary, and to be available when the build up of the bore is completed or the end of the stroke is reached. *Note: The **BWS-2000** does not automatically shut off when the end of its stroke has been reached. The Clutch will disengage briefly each revolution as the Spindle attempts to move axially. While no damage is likely for considerable time, such disengagement does cause excessive wear, and if occurring during welding will leave a substantial deposit of weld at one location.*

8.8. Once the build up is completed, shut off the Welding and the Rotation Switches.

8.9. To continue welding the same bore or another in-line bore, reposition as indicated above, purge the system, and begin as described earlier in this section.

9. SPECIAL SITUATIONS.

9.1. Welding in High Temperature Environments. It is suggested that when welding for extended periods in environments with temperatures of 93° Celsius (200° Fahrenheit) or greater, that the **BWS-2000** housing be cooled by supplying compressed air to the housing interior through the Cooling Fitting. The air supplied should be dry, and regulated down to a pressure of about 35 Kilonewton per square meter (5 psi). The Cooling Fitting can be attached to by removing the Cooling Fitting Plug, and screwing in a 1/8 NPT male fitting. When the air cooling is not in use, the Cooling Fitting Plug should be reinstalled to keep foreign matter out of the **BWS-2000** housing.

9.2. Single Plane Welding. The **BWS-2000** clutch can be locked in the disengaged position by moving the clutch lever to the detent location. If disengaged, the spindle will not move axially when rotated, thereby allowing face or fillet welding. It also allows a single plane of weld to be deposited on a cylindrical surface before axial motion begins. Moving the clutch lever out of the detent position while welding is taking place will allow axial motion to take place during the next revolution. *Note: When single plane welding, it is generally desirable to move the Spindle Collar to make contact with the Top Bushing, thereby maintaining the desired Spindle position.*

10. MAINTENANCE.

Very little maintenance is required except regular cleaning.

10.1. Spindle. The Spindle should be wiped down with a clean soft cloth after each use or more frequently if in an excessively dirty environment. It can be moved from stop to stop so that most of its length - including the threads - can be cleaned. **No lubrication is necessary.**

10.2. Extension Tube. There is minimal clearance between the Spindle ID and the Extension Tube OD. If the Extension Tube is not kept clean by regular wiping with a clean soft cloth, binding

between the two can occur. Should movement of the Extension Tube become inhibited, remove it entirely from the Spindle and clean thoroughly. Also clean the ID of the Spindle at the same time. It is suggested that this procedure be done on a daily basis during periods of normal use.

10.3. Remaining Components. All remaining components should be wiped clean on a daily basis. These include the housing, mounting components, torches, cords, and conduits.

11. **CARE.** The **BWS-2000** is designed to be used in an industrial environment, but like any tool requires reasonable care in order to function as intended.

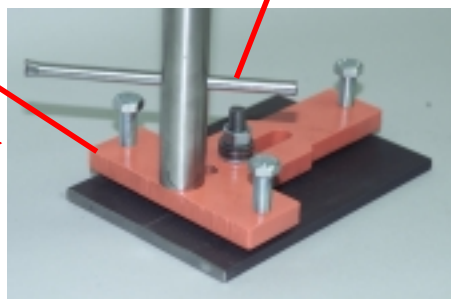
11.1. The **BWS-2000** is designed to be corrosion resistant in order to function properly in humid environments. It is not however, designed to be used in the rain or to be immersed in water. Should the unit accidentally get wet, thoroughly dry before using. **Using the BWS-2000 wet could damage the unit as well as create a hazardous situation.**

11.2. The **BWS-2000** should not be dropped or struck with any object. Should this happen, thoroughly examine it - especially the Spindle threads and surface - for damage. Repair or replace any damaged components before use.

11.3. Inspect all electrical cords for damage. Repair or replace them before use.

11.4. Be careful not to expose the **BWS-2000** to excessive heat or damage will occur.

Torch Mover And Support Components
Figure #1



Use Of Standard Torch

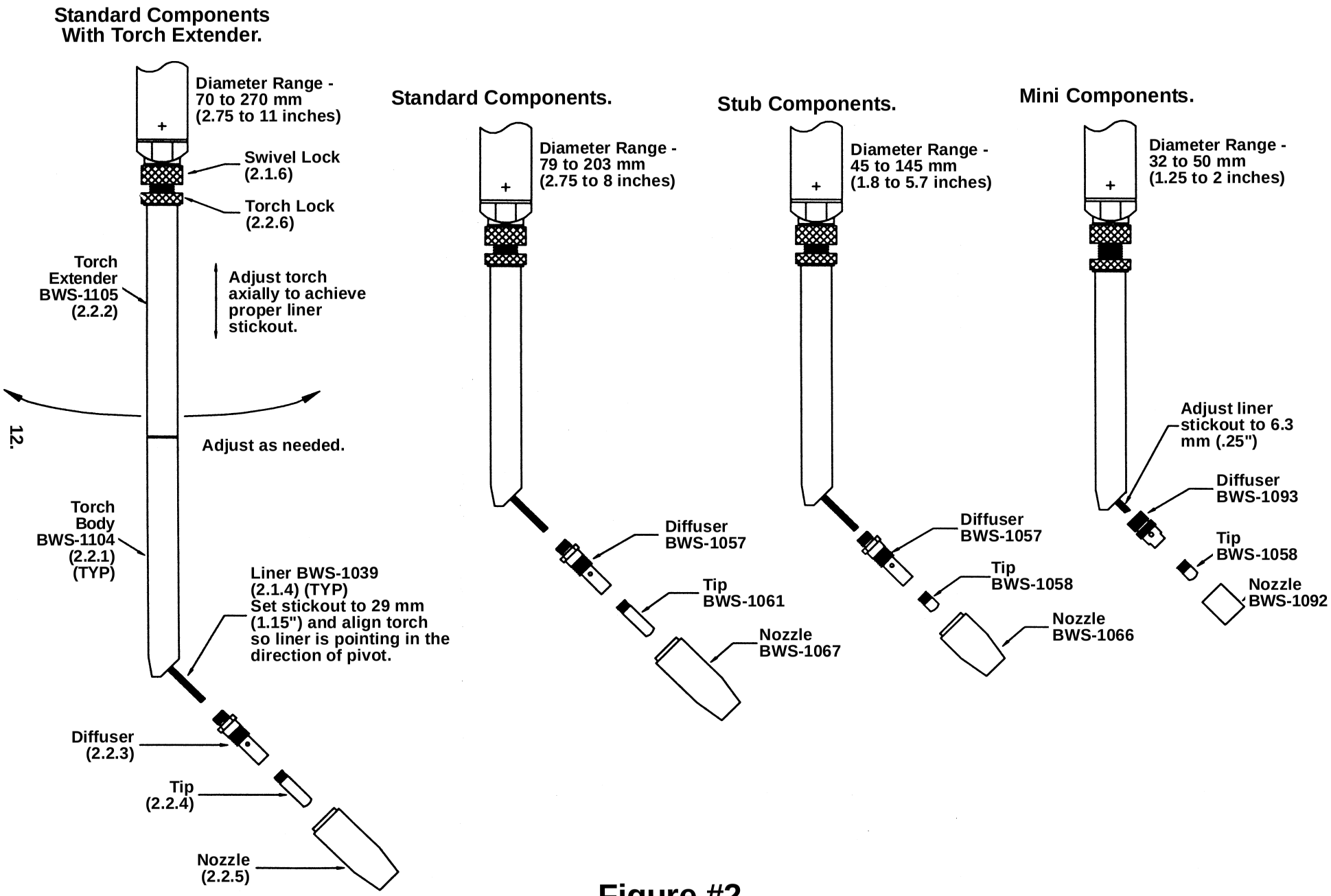


Figure #2

Use Of Large Diameter and OD Torch

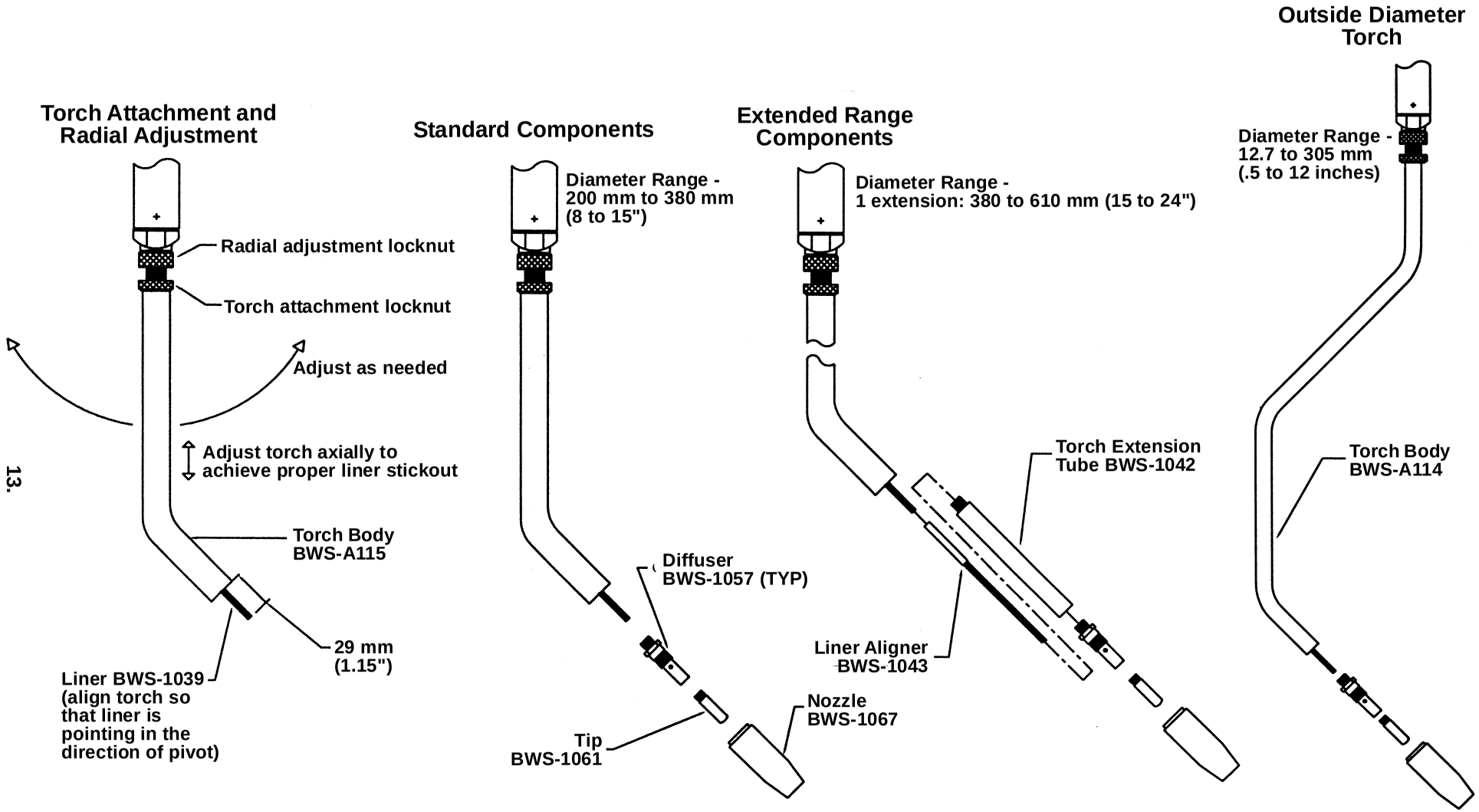


Figure #3

General Setup Information

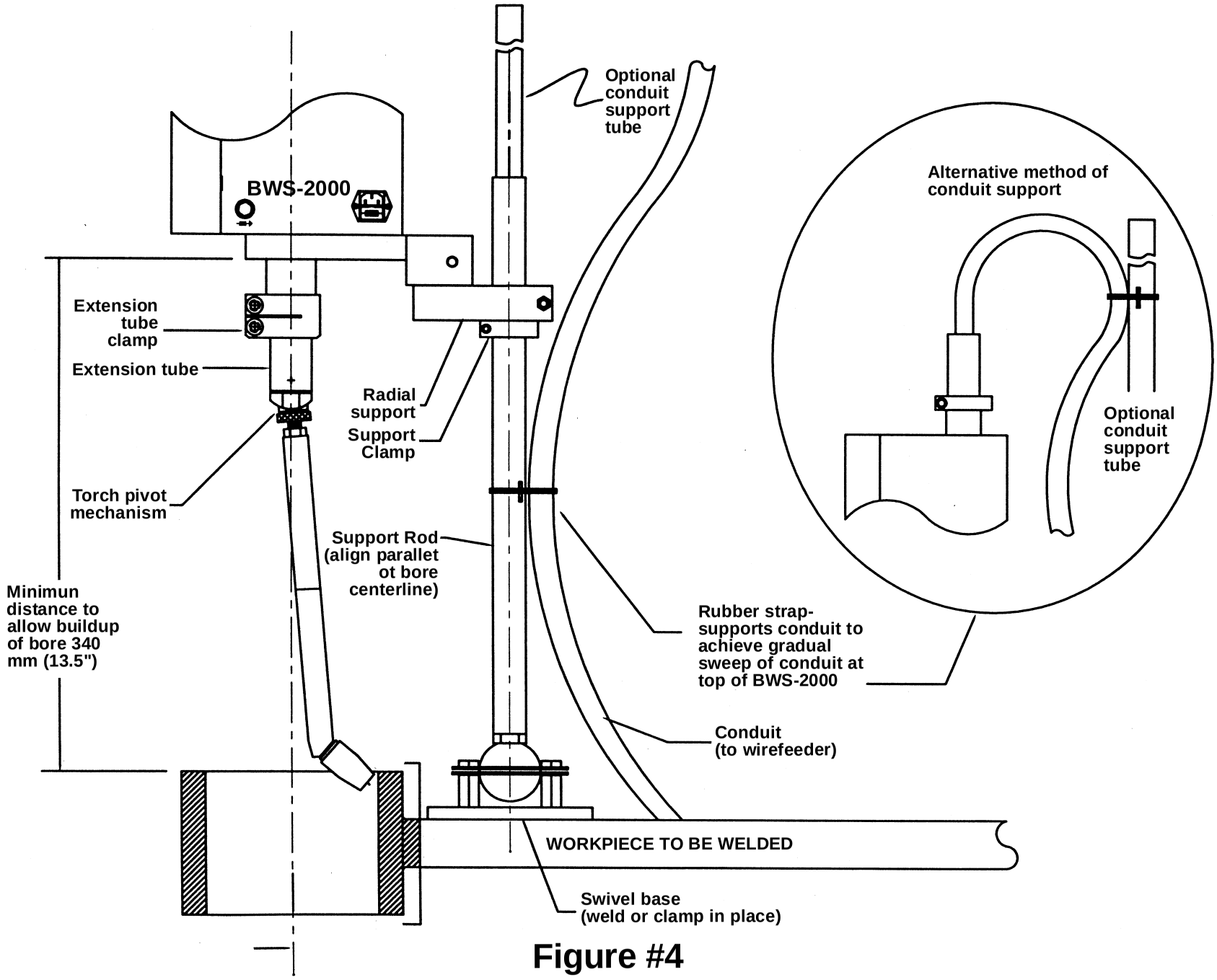


Figure #4

In-Line Bore Set-Ups

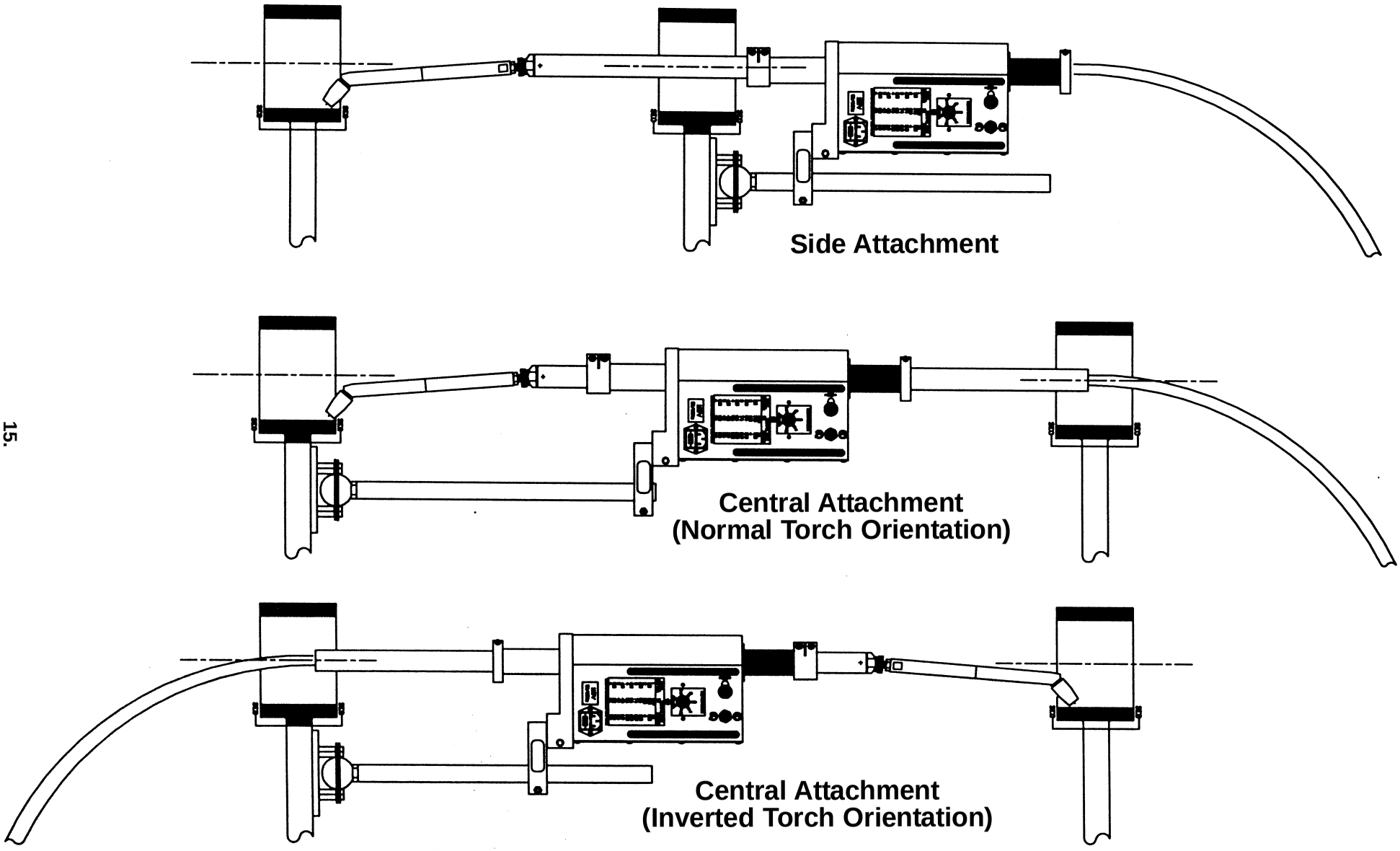
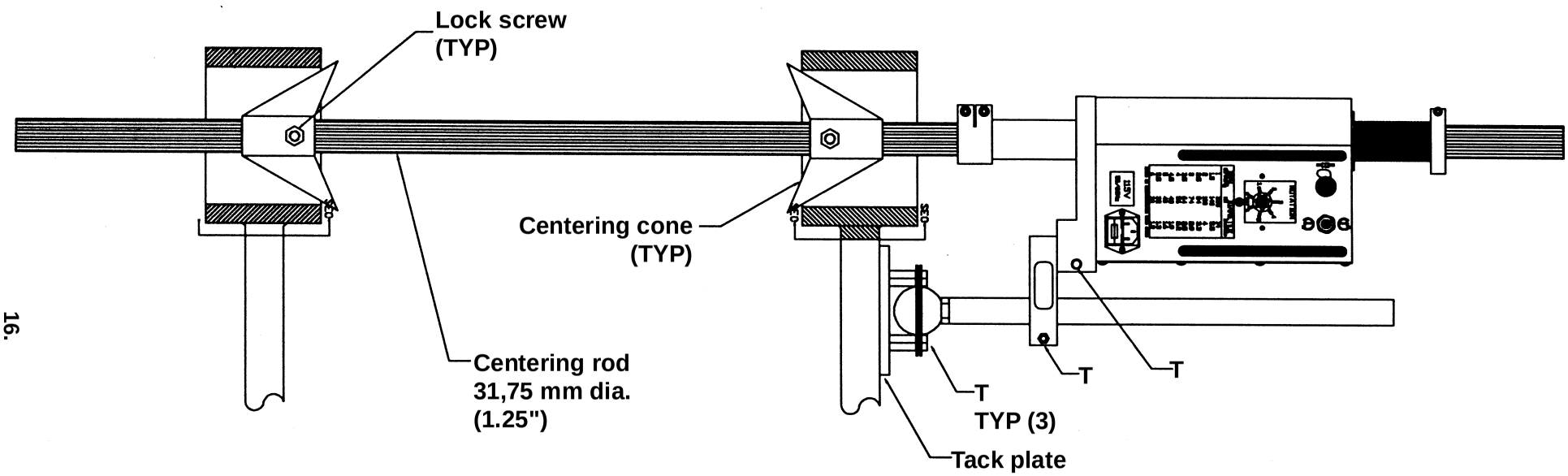


Figure #5

Using Cones For Alignment



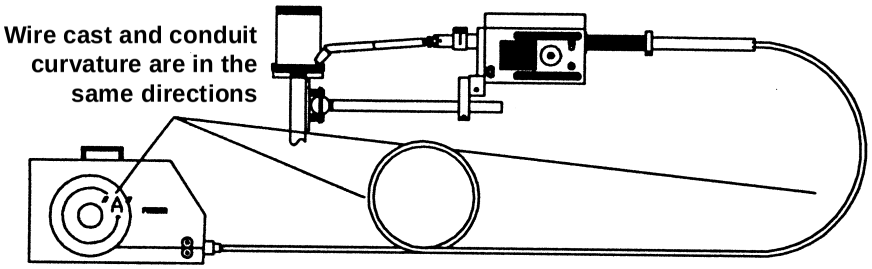
NOTE: Weld or clamp Tack Plate in place and tighten all screws or nuts labeled “T” before removing Centering Rod.

Figure #6

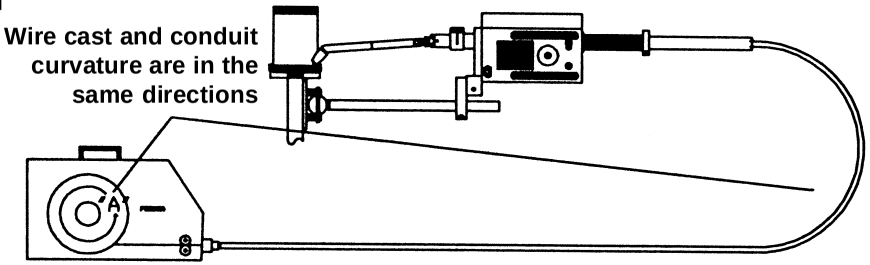
Wire Stability

Stable Wire Feeding Setups

Wire cast and conduit curvature are in the same directions

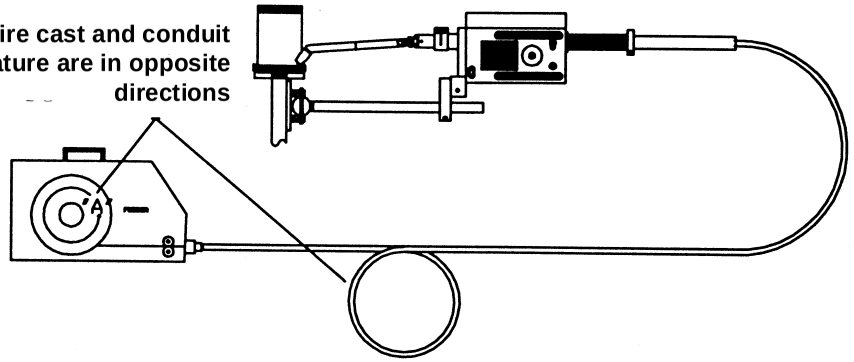


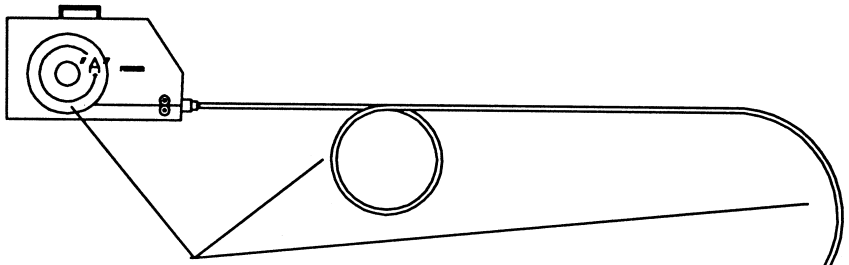
Wire cast and conduit curvature are in the same directions



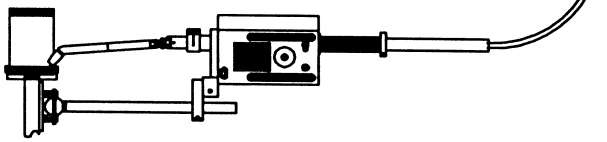
Unstable Wire Feeding Setups

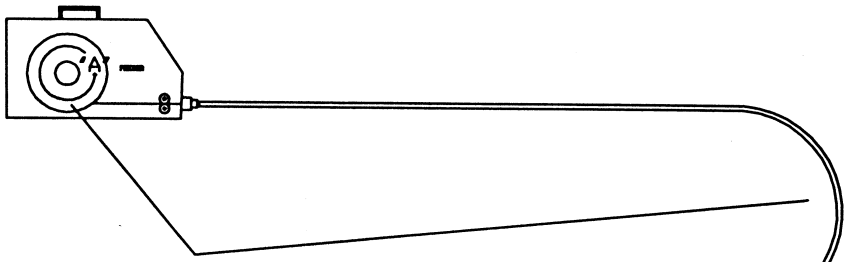
Wire cast and conduit curvature are in opposite directions



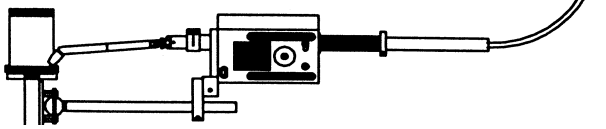


Wire cast and conduit curvature are in opposite directions





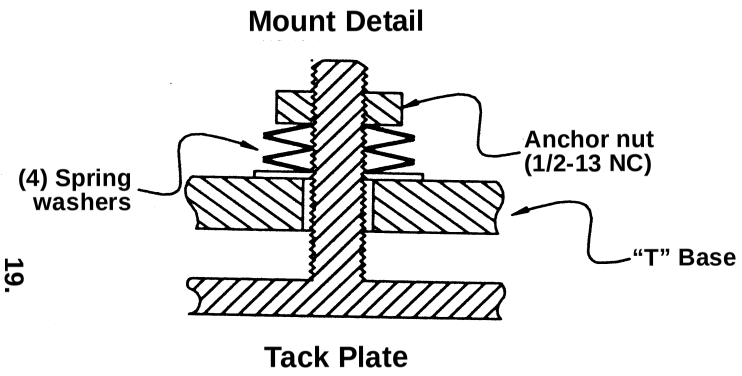
Wire cast and conduit curvature are in opposite directions

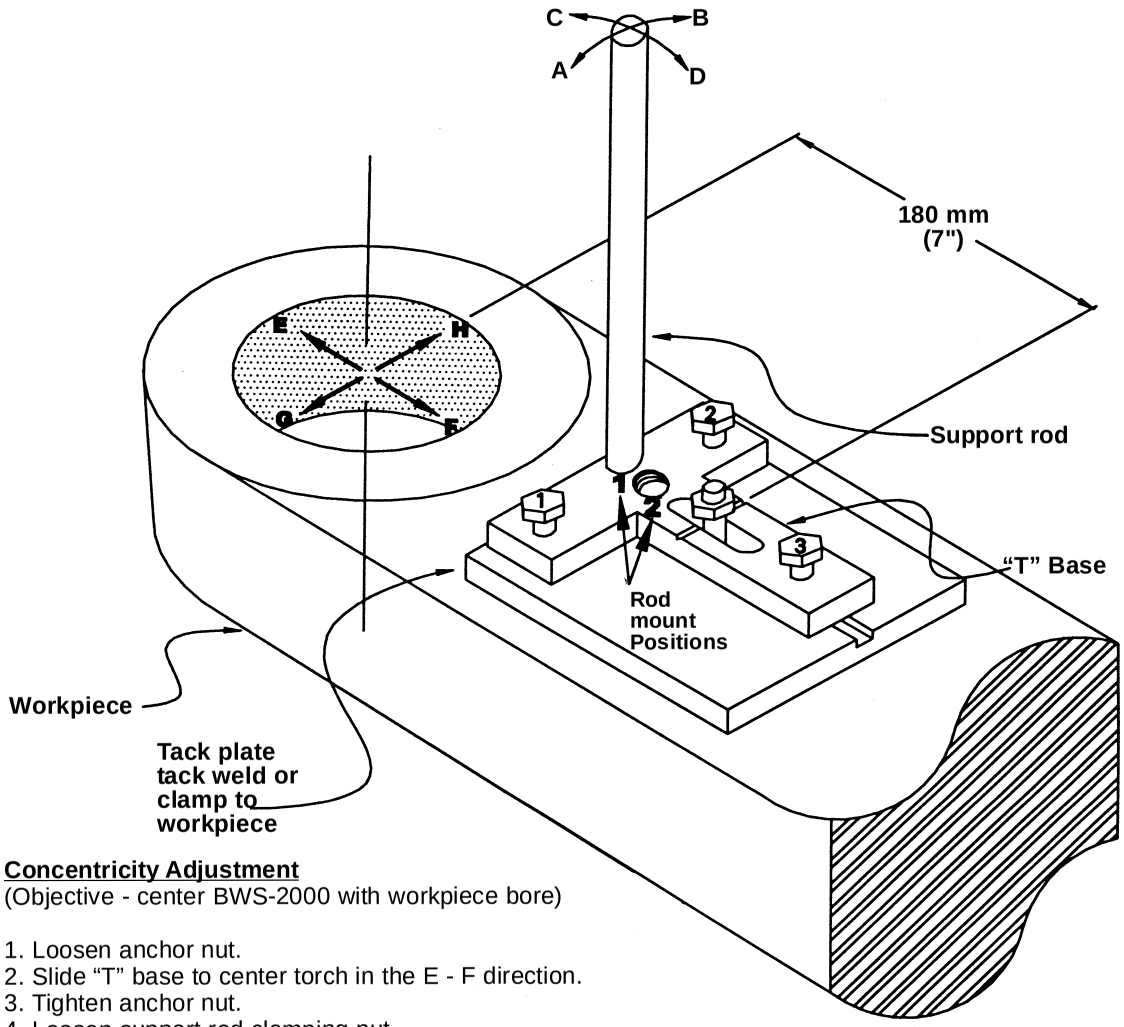


NOTE: Welding wire in not straight. The direction it curves is called the wire cast. "A" represents wire cast.

Figure #7

Use of the BSW “T” Base





Parallelism Adjustment
(Objective - align support rod parallel to bore centerling)

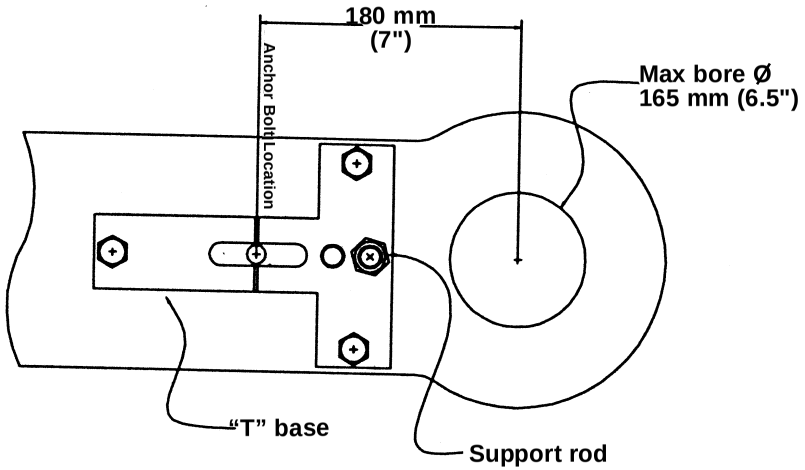
1. To adjust in directions A - B move screws 1 & 2.
2. To adjust in directions C - D move screw 3.
3. Loosen and retighten anchor nut as necessary to perform above adjustments.

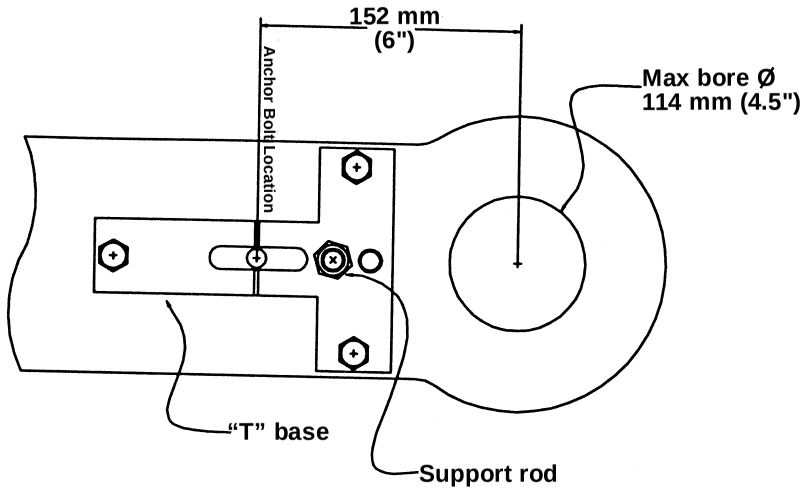
Concentricity Adjustment
(Objective - center BWS-2000 with workpiece bore)

1. Loosen anchor nut.
2. Slide “T” base to center torch in the E - F direction.
3. Tighten anchor nut.
4. Loosen support rod clamping nut.
5. Rotate BWS-2000 around support rod to center torch in the G - H direction.
6. Retighten support rod and clamping nut.

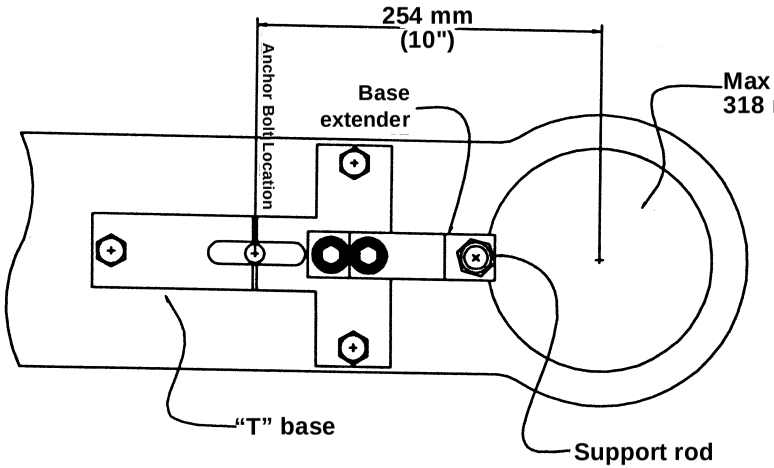
Figure #8

“T” Base Support Configurations

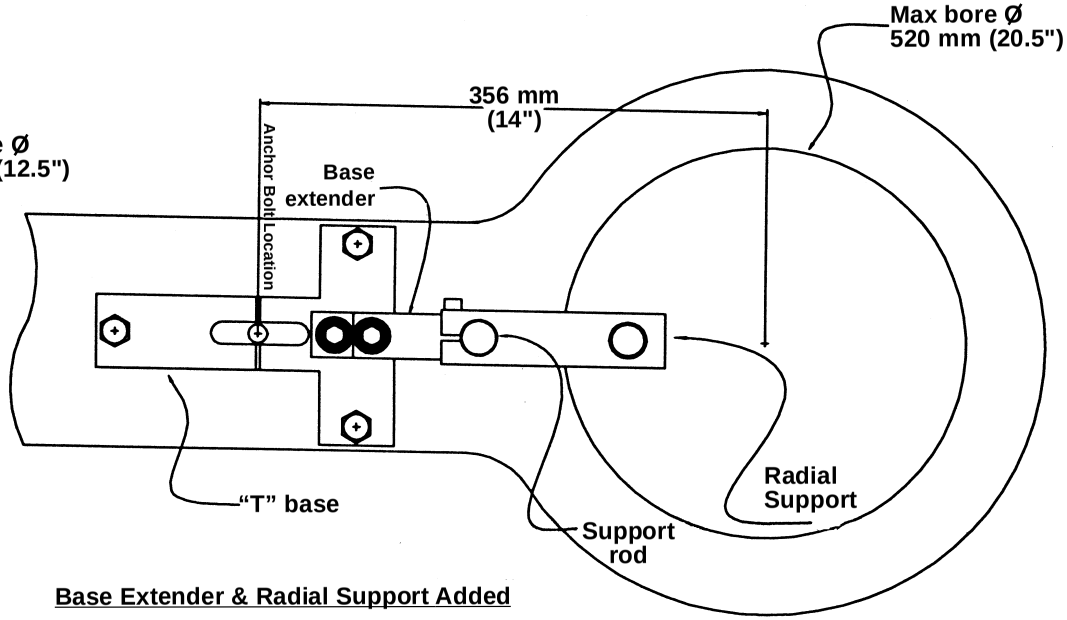




Support rod location #2



Base Extender Added



Base Extender & Radial Support Added

Figure #9

USEFUL INFORMATION
APPENDIX A

1. NORMAL TIME OF ONE REVOLUTION OF THE TORCH WHILE WELDING.
(Useful when setting up the BWS-2000)

Metric - Calculate by multiplying the diameter (mm) by .38.
Example: Diameter or bore = 180 mm.
Normal revolution time = 180 x .38 = 68 seconds

English - Calculate by multiplying the diameter (in.) by 10.
Example - Diameter of bore = 3.5 inches.
Normal revolution time = 3.5 x 10 = 35 seconds.

2. NORMAL TIME TO BUILD UP A BORE
(Useful when estimating job times.)

Metric - Calculate by multiplying the diameter (mm) by the length (mm) by .002.
Example: Diameter of bore = 65 mm; Length of bore = 110 mm.
Normal build up time = 65 x 110 x .002 = 14.3 minutes.

English - Calculate by multiplying the diameter (in.) by the length (in.) by 1.25.
Example: Diameter of bore = 4.2 inches; Length of bore = 3.6 inches.
Normal build up time = 4.2 x 3.6 x 1.25 = 18.9 minutes

3. WIRE DEPOSITION RATE.
(Useful when calculating anticipated wire usage.)

Metric - Calculate by multiplying the following:
For .8 mm wire - Multiply the wirefeed speed in mm/min. by .00022.
For .9 mm wire - Multiply the wirefeed speed in mm/min. by .00030.
Example: Wirefeed rate = 7400 mm/min.; Wire diameter = .8 mm.
Deposition rate = 7400 x .00022 = 1.63 kg/hr.

English - Calculate by multiplying the following;
For .030 in. wire - Multiply the wirefeed speed in in./min by .0123.
For .035 in. wire - Multiply the wirefeed speed in in./min. by .0167
For .045 in. wire - Multiply the wirefeed speed in in./min. by .0277
Example: Wirefeed rate = 320 in./min.; Wire diameter = .030 in.
Deposition rate = 320 x .0123 = 3.94 lb./hr.

BWS-2000 PORTABLE BORE WELDING SYSTEM COMPONENT LIST

WeldingTips

Stub Tips:
BWS-1058 .8mm (.030)
BWS-1059 .9mm (.035)
BWS-1060 1.2mm (.045)

Standard Tips:
BWS-1061 .8mm (.030)
BWS-1062 .9mm (.035)
BWS-1063 1.2mm (.045)

Welding Nozzles and Diffusers

Mini Nozzle:
BWS-1092 32-50mm (1.25-2")

Stub Nozzle:
BWS-1066 Use for small diameters

Standard Nozzle:
BWS-1067 Use for large diameters

Mini Diffuser:
BWS-1093 32-50mm (1.25-2")

Diffuser:
BWS-1057 Use with all torches

Welding Torches and Accessories

Standard Torch:
BWS-A113 32-204mm (1.25-8")

Large Diameter Torch:
BWS-A115 200-380mm (8-15")

Standard Torch Extender:
BWS-A116 Increase dia 76mm (3")

Torch Extension Tube:
BWS-1042
Diameter Ranges:
1 Tube - 380-580mm (15-23")
2 Tubes - 530-760mm (21-30")

OD Torch:
BWS-A114 0-305mm (0-12")

Hand held MIG gun and conduit:
BWS-1102 3.6m (12') conduit w/euro

Face Torch:
BWS-A127 0-610mm (0-24")

Support Components

Tack Nut:
BWS-1100 Non-adjustable support

“T” Base:
BWS-A110 Leveling & centering adjustments

Tack Plate:
BWS-1099 Weld/clamp to part & support “T”

Swivel Base:
BWS-A106 Use with centering cones & tube

Base Extender:
BWS-1097 Attach to “T” for large bore reach

Radial Support Extender 102mm (4")
BWS-A118 Extra reach for large bores

Radial Support Extender 203mm (8")
BWS-A119 Extra reach for large bores

Centering Components

Centering Cone Set:
BWS-A108 45-160mm (1.8-6.4")

Centering Tube:
BWS-1044 1.8m (72")

Miscellaneous

Liner:
BWS-1039 1.5m (60") for torches

Liner, Conduit Replacement
BWS-1038 4.5m (15')

Thru-Bar bore measuring tool kit: (46-305mm)(1.8-12")
BWS-A131 For use with boring bar

Liner Aligner:
BWS-1073 Use with torch extension tubes

Welding wire, large diameter cast 70S6
BWS-1103 30 lb. spool .8mm (.030")
BWS-1202 30 lb. spool .9mm (.035")

Auto-Skip Option:
BWS-A129 enables partial borewelds

Call factory for specials, boring bar systems and components or power supply wire feeder options.