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OPERATING MANUAL

A7 TIG Orbital System

300

KEMPPI

CONTENTS

OPERATING MANUAL

1. INTRODUCTION

1.1 General

Congratulations on choosing A7 TIG Orbital System 300 welding equipment. Used correctly, Kemppi products can significantly increase the productivity of your welding and provide years of economical service.

This operating manual contains important information on the use, maintenance and safety of your Kemppi product. The technical specifications of the equipment can be found at the end of the manual.

Please read the operating manual and the safety instructions booklet carefully before using the equipment for the first time. For your own safety and that of your working environment, pay particular attention to the safety instructions in the manual.

For more information on Kemppi products, contact Kemppi Oy, consult an authorised Kemppi dealer, or visit the Kemppi website at www.kemppi.com.

The specifications presented in this manual are subject to change without prior notice.

Important notes

Items in the manual that require particular attention in order to minimise damage and harm are indicated with below symbols. Read these sections carefully and follow their instructions.

Note: Gives the user a useful piece of information.

Caution: Describes a situation that may result in damage to the equipment or system.

Warning: Describes a potentially dangerous situation. If not avoided, it will result in personal damage or fatal injury.

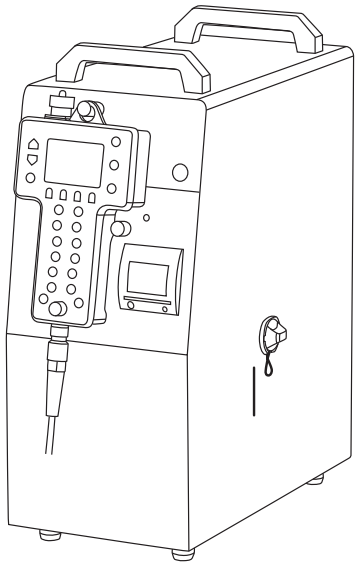
Disclaimer

While every effort has been made to ensure that the information contained in this guide is accurate and complete, no liability can be accepted for any errors or omissions. Kemppi reserves the right to change the specification of the product described at any time without prior notice. Do not copy, record, reproduce or transmit the contents of this guide without prior permission from Kemppi.

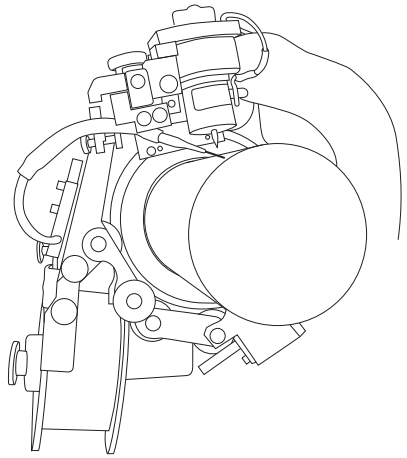
1.2 About the product

TIG orbital welding is a semi-automatic welding method where the arc moves automatically and without interruption around tubes creating single pass or multi-layer welds. Its pulse technology produces consistently high-quality welding seam.

With this method, it is easy to produce high-quality joints even with low-level knowledge of welding. A7 TIG Orbital System 300 consists of a controller unit, weld head, remote control, and interconnecting cables.



The controller unit is a digital power source designed to be used with the 300-series of weld heads including a water cooler unit, internal memory, and a USB port for program transfer. The unit is operated by a remote pendant that contains all controls.

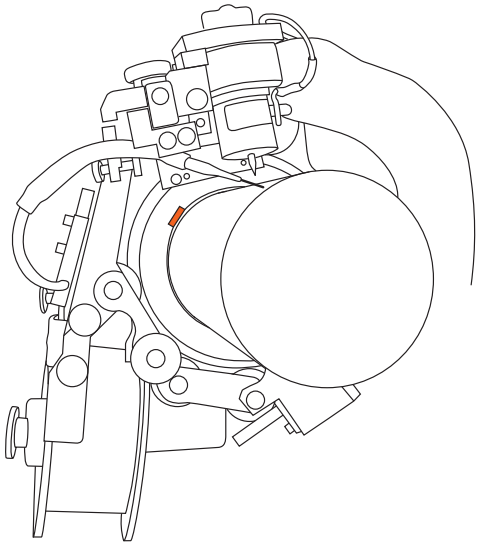


The weld heads are primarily for in-place welding of tubes and pipes. They can be used for:

- tube-to-tube welding
- pipe-to-pipe welding
- tube/pipe-to-fitting welding by interchanging the standard electrode holder to a fillet weld kit or an angled AGC kit.

The weld heads allow use in a fabrication facility or in field construction/maintenance applications.

1.3 Weld head



The A7 TIG Orbital System 300 includes an open-type weld head to be fastened on the tube with a guide ring. Insertion kits can be used in guide rings to adapt them to smaller pipe diameters. The weld head also accommodates a filler wire spool.

1.3.1 General specifications

Travel

Torch speed in the forward direction is adjustable from 0 to 250 mm/min.

Wire

The 300 series of weld heads has been designed to carry a 1 kg spool (100 mm) of 0.8 mm diameter welding wire with the feed rate adjustable from 0 to 2.54 m/min. Special spool is available to low profile applications.

Please consult Kemppi when using other wire diameters.

Oscillation

Oscillation stroke is adjustable from 0 to 16 mm at torch speeds up to 1520 mm per minute.

Arc gap control

Arc gap control stroke measures 13 mm. The AGC motion is produced by a rack-and-pinion mechanism driven by a DC motor.

Dimensional considerations

Standard pipe sizes range from 1 to 14" (25–356 mm). You can accommodate smaller diameters using the Guide Ring Insert Kit. Guide rings for standard tubing sizes are also available. A linear modification is available on request.

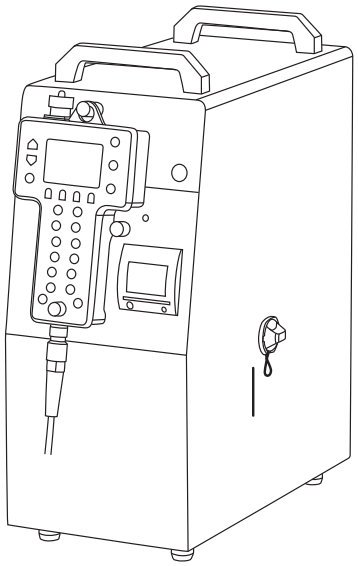
Radial clearance for standard pipe sizes is 63.5 mm (51 mm with the Low Profile Package). For pipe sizes smaller than 48.3 mm, minimum radial clearance from the pipe centre is 88.9 mm (75 mm with the Low Profile Package).

Axial clearance from the weld line to the rear of the machine is 21 6mm and from the weld line forward 10 mm.

Torch and umbilical

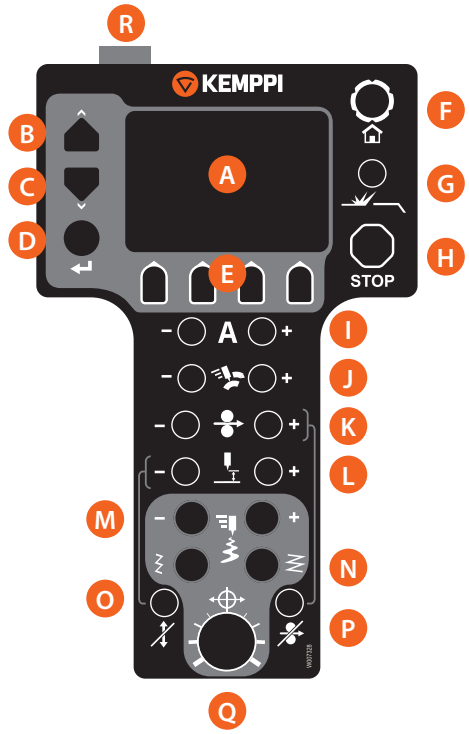
The water-cooled torch is rated at 200 amps. The torch body has been designed to accept standard consumables, both gas lens and spud type. All services as well as the electrical control of the weld head are supplied in the umbilical. The standard length is 7.6 m. However, umbilicals of 15 m are available on request. Extension cables are available for systems requiring greater distances between the controller and the weld head.

1.4 Controller unit



A7 TIG Orbital System 300 power source and cooling unit are integrated inside its controller unit. This unit also includes a printer to print welding parameters on paper. The parameters can be saved on a memory stick through the USB port. Programs can be stored in internal memory (100) and saved on a memory stick.

1.4.1 Remote control



All the functions of A7 TIG Orbital System 300 are accessible via one handheld device. The remote control includes an easy-to-use graphical user interface and clear colour display.

You can create, modify and manage welding programs. Use adaptive auto programming for automatic calculation of welding parameters. You can fine-adjust welding values and electrode movements during welding. The system automatically offers to adapt the welding program according to changes.

A. LCD: A colour display for information. The microprocessor requires approximately 12 seconds to properly boot when power is first applied. During this time, the display remains blank.
B. Cursor Up: move the cursor up the display.
C. Cursor Down: move the cursor down the display.
D. Enter: enter the item highlighted by the cursor.
E. Soft keys (4): select menu items.

These items/functions change depending on the operation mode (e.g. setup, programming, operation). During programmed and welding modes, the four soft keys adjust the inner and outer dwell times. Oscillation dwell is the time that the torch remains stationary at either stroke end points. ("Inner" refers to the location where the torch is closer to the weld head body, "Outer" the reverse.)

F. Home Position: To rotate the weld head until it reaches a home position, at which point rotation ceases.

(Home position for the 300-series head is one of 6 locations 60° apart around the guide ring.) Active only when no arc is present, this button causes the weld head to move forward until one of the position notches on the guide ring is found. When using Autorewind, the weld head rotates in reverse until it finds home location.

G. Start Weld/Start Downslope: start a weld or to initiate downslope if a weld is in progress.
H. Emergency Stop: immediately terminate the weld cycle and all the weld head functions.

In non-welding operation, use this button as an "Escape" back to the Start Up screen/Main Menu.

Functions

The following -/+ perform multiple functions depending on the operating conditions:

- During programming, these serve to directly input the desired parameter values.
- During "Run Program" mode, these serve as JOG switches when no arc is present.
- During welding, they serve as override switches for each function, within the pre-set limits of the % override screen.

I. Current: decrease/increase welding current level in both programming and welding modes.

J. Travel: decrease/increase welding travel (rotation) speed in both programming and welding modes.

K. Wire: decrease/increase welding wire speed in both programming and welding modes.

L. Arc Length: decrease/increase welding arc length (and therefore arc voltage) in both programming and welding modes.

M. Oscillation Speed: decrease/increase welding oscillation speed in both programming and welding modes.

N. Oscillation Amplitude: decrease/increase oscillation amplitude (torch weave width) during both programming and welding modes.

O. AGC Stop: primarily used in weld repairs; causes the AGC operation to cease. While the AGC is disabled, a warning indicator is displayed on the LCD. Pressing the button a second time causes the function to reactivate. When the AGC Stop is on, the two AGC buttons can be used to jog the torch up/down.

P. Wire Stop: operation is similar to AGC Stop above, except that the function interrupted is wire feed. Pressing this button causes the filler wire feed to interrupt until pressed for a second time. A warning indicator is displayed. When the Wire Stop is actuated, the two wire buttons can be used to jog wire.

Q. Control knob: increase/decrease any parameter that has been selected during programming. During welding, the encoder is used to "steer" the torch in the seam and adjust the centre point of the oscillation strokes.

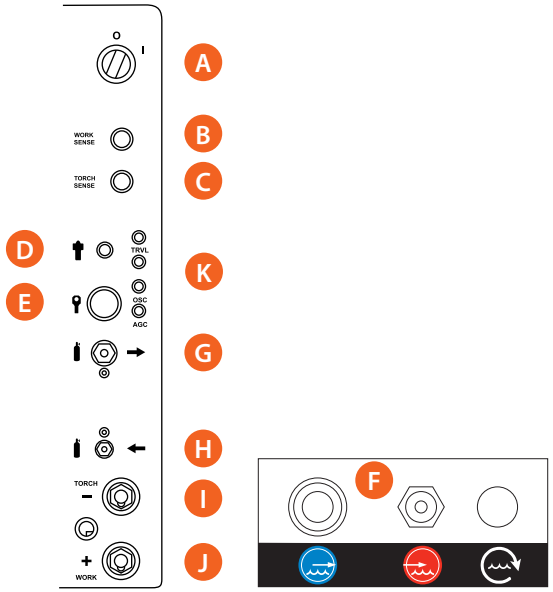
R. USB Port (on top): to connect a standard digital memory stick. This allows program transfer between power sources, program archiving, and QC data downloading. Weld parameters can be downloaded for subsequent print-out on a PC equipped with a printer.

1.5 Compatibility

The A7 TIG Orbital System 300 controller is compatible with A7 TIG Orbital System150 weld heads using an adapter cable.

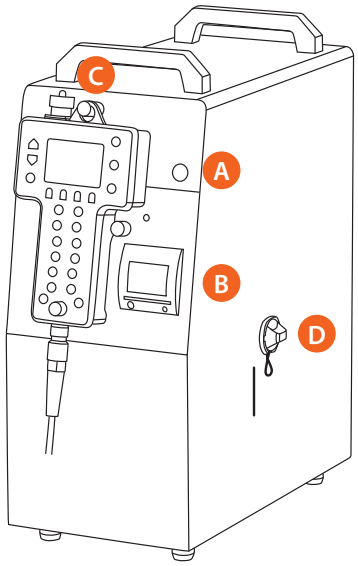
2. INSTALLATION

2.1 Controller connections



All controller connections are located on the rear of the controller unit:

A. Power ON/OFF
B. Sensing cable to workpiece (WORK)
C. Sensing cable to weld head (TORCH)
D. Pendant control cable
E. Weld head control cable
F. Cooling hoses
G. Gas Out (to weld head)
H. Gas In (from cylinder)
I. Welding power connector (–)
J. Earth return connector (+)
K. Resettable fuses
   TRVL = travel motor, WIRE = Wire feed motor, OSC = oscillation (weave), AGC = Automatic gap control



The front of the controller unit:

A. Equipment Stop
B. Printer
C. Remote control in holder
D. Water cooler filling hole

2.2 Water cooler

The controller unit includes an integrated water cooler. The water flow is factory calibrated, and interruption in, or insufficient water flow (less than 0.5 LPM), will result in termination of welding and a warning message on the display.

2.2.1 Filling water cooler with coolant

Cooling and heat-balancing requires that cooling water is pure. However, the degree of water purity as well as the temperature of the environment determine if you need to apply additives and/or otherwise take care of the water supply. You can fill the water tanks with normal tap water.

When employing TIG system at temperatures below +8 °C, add an anti-freeze medium.

1. Fill the water tank with 3.5 liters of Kemppi torch coolant fluid or equivalent (Monopropylenglycol).
2. Use max. 40 % of coolant fluid added to water. This will provide freezing protection to -25 °C.

Do not use distilled or demineralized water. Zinc deficiency causes corrosion and a risk of leakage.

Even if the temperature stays above +8 °C, use a small quantity (ca. 10 %) of anti-freeze additive. It prevents adverse algal growth in warm water.

The amount of cooling fluid required depends on the cable length of the weld head. Normally, 3.5 litres is sufficient. Check the level of coolant after several minutes of first turning on power to top off the coolant level as required.

2.2.2 Operating the water flow

The water flow switch has a factory pre-set trip point that is not adjustable. If there is inadequate water flow to actuate the switch, a welding arc cannot be initiated. Pressing Start Weld causes pre-purge to occur. When the arc should be initiated, the starting sequence is interrupted and a warning displays.

2.3 Weld head set-up

2.3.1 Assemblies

The series 300 weld head assembly consists of the following assemblies.

Machine package including:

A. Torch mounting
B. Torch oscillation and electronic cross-seam adjustment capability
C. Arc gap control (AGC) and torch height adjustment
D. Wire drive and spool mount assembly
E. Torch and cable assembly
F. Weld head
G. Guide ring (optional, size according to the pipe size)
H. Roller chain and tensioner (included in the guide ring kit)

The vulnerable mechanisms of the machine package assembly are completely enclosed in an aluminium housing. Permanent magnet DC gear motors inside the housing provides both axial and vertical torch motion. The arc gap control (torch up/down motion) is powered by a DC motor rotating a splined shaft which in turn moves the torch using a geared slide assembly.

Axial torch motion cross-seam (oscillation) is provided by a second motor through a helical cam and follower assembly. A linear potentiometer provides axial position feedback for both oscillation and cross seam adjustment.

Wire-drive and spool-mount assembly

- The wire-drive assembly mounts on a link arm adjacent to the machine package that consists of a motor, bevel gear set, and drum-and-roller-beam assembly.
- The roller presses the wire into a U-groove on the rotating drum, driving the wire by friction.
- The wire-spool mount attaches to the link arm on a swing-out bracket to facilitate changing wire spools.
- Hand-tighten the knurled knob used to retain the wire spools to automatically apply a pre-set drag to the spool.

Torch and cable assembly

- Three hoses and an electrical control cable encased in a fiberglass-reinforced silicone sheath with the torch permanently mounted on one end.
- The control cable is terminated in a small connector that mates inside the tractor assembly.
- The machine package is cooled by interrupting the line carrying water to the torch.
- The electrode cable is located inside the water return line.
- A voltage sensing lead is directly attached to the torch and provides the arc voltage signal used for arc gap control (AGC) operation.

Weld head

The tractor propels the machine package around the pipe.

1. Attach the tractor to the machine package by a pair of hinge pins and a link.
2. Change the link for each pipe or guide ring size to maintain the minimum radial profile for any pipe size.

The tractor consists of:

- A permanent magnet gear motor driving a sprocket that engages a chain on the guide ring for the traction
- Aluminium housing
- A cavity where the control cable plug is mated with the in-line receptacle to provide control power to the tractor, machine package, and wire drive.

Use only the correct link for a given guide ring to ensure proper engagement of the drive sprocket teeth in the guide ring chain. The links are labelled with the pipe or tube size. Use them with the same size pipe or tube guide ring.

Guide ring

The guide ring consists of:

- Two hinged segments closed around the pipe and latch
- Two fixed stainless steel "pads" mounted in one-half of the guide ring that provide a "Vee-block" to square the guide ring relative to the pipe axis
- Pads dimensioned so that the guide ring is centred on the pipe as long as the pipe is within nominal outer diameter (OD) size range.

If the pipe is either under or oversized, do one of the following:

- Shorten the pads.
- Use longer pads to maintain concentricity.
- Substitute pads with alternate pads to allow a guide ring designed for a larger pipe size to be mounted concentrically on a smaller pipe size.

Clamp the guide ring rigidly on the pipe using setscrew(s) on the other half of the ring.

Guide rings for 8" and larger pipes are supplied as two-piece units that are bolted together by two recessed captive socket-head screws.

To specify guide ring kit P/N (see related charts):

- The part number for the 300-series weld head guide rings also indicates the workpiece diameter in inches. For example, a 2" pipe is 2.375" OD .
- If radial clearance is important for an application, use appropriate size guide ring for the minimum radial clearance.
- Or use a guide ring for the next smaller size down by replacing the insert pads.

To specify guide ring insert kit P/N (see related chart):

- To use a guide ring on a smaller size pipe or tube, substitute different steel pad "inserts" for the those supplied standard. The last 3 digits of the part number indicate the height of insert pad in inches.
- Example: To weld a pipe 0.5" (12.7 mm) smaller in OD. than nominal pipe size of guide ring, 0.5"/2 = 0.25" radial clearance between new pipe OD. and guide ring. Insert should be 0.25" in height. Therefore P/N is 102222-250 (250 standing for .250).

A longer setscrew may be required depending on the length of the insert. This is provided if required as part of the insert kit.

To position the guide ring:

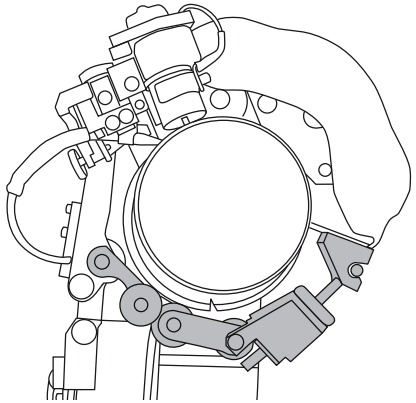
- Place the guide ring approximately 60.00 mm +/- 1 mm from the weld joint in order to eliminate the need for mechanical adjustments of the head.
- Place the ring as square as possible to the weld joint to minimize the need for torch cross seam adjustment during the weld.
- If the guide ring is substantially misaligned ("cocked"), it may result in rubbing the bottom surface of the head on the pipe.

Always loosen the setscrew before unlatching the guide ring. Mount the guide ring fairly concentrically with the pipe OD. The arc gap control system will compensate for variations in mounting eccentricity. Remember that the 12 mm AGC stroke must be preserved to allow automatic torch-to-workpiece corrections both within and between passes.

Roller chain and tensioner

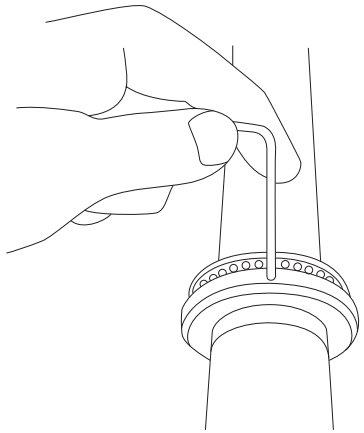
Roller chain and tensioner hold the 300-series weld head on the guide ring. Roller chain changes for each pipe size and is supplied as part of the guide ring kit with the link that improves the rigidity of the hinge.

- The roller chain and tensioner assembly circles the guide ring reaching from the machine package to the tractor.
- The latch/tensioner mechanism is located at the tractor end.
- Rollers on the flexible chain minimize friction and facilitate motion around the pipe.
- An integral spring in the tensioner compensates for expansion of the guide ring caused by heating.
- Because of the positive drive properties of the sprocket/chain system, the cylindrical tensioning collar only requires finger tightening.



Drilled holes are provided for removal with a special pin in special cases; do not use them during normal installation and removal.

2.4 Installing guide ring on tube



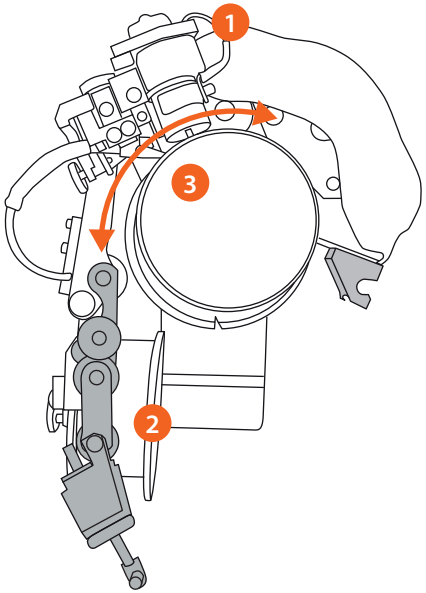
1. Manually tack the two pipes together.
2. Install the guide ring with the notched side away from the weld joint.
3. Locate the guide ring 60 ±1 mm from the centre of the weld joint.

The guide ring must be parallel to the weld joint because accurate torch tracking depends on its position.

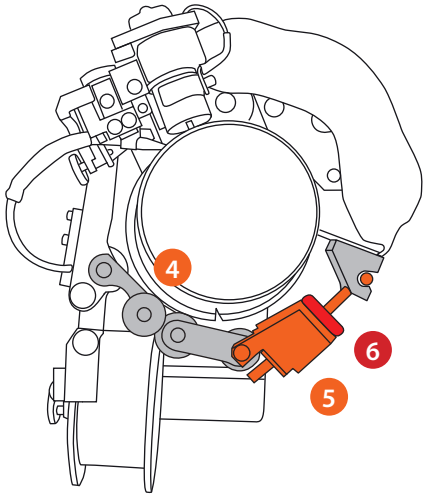
Mount the guide ring parallel to the weld joint because accurate torch tracking is dependent upon the guide ring position. For repetitive welds, do the following:

A. Make an alignment fixture to slip over the pipe to be welded and locate from the pipe bevel.
B. Make the end of the fixture square and hold the guide ring tightly against it.
C. Tighten the guide ring against the pipe.

2.5 Mounting the weld head

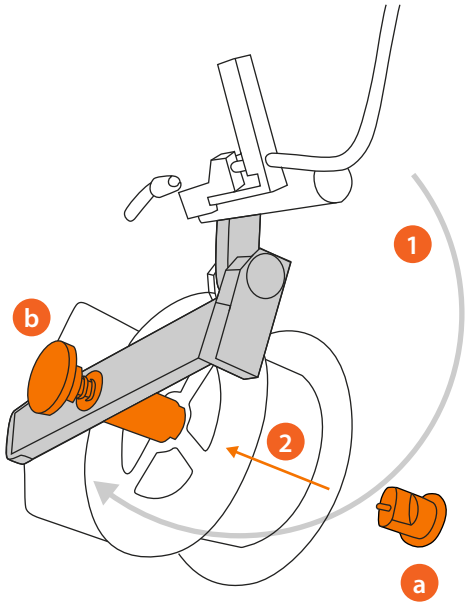


1. Place the weld head on top of the pipe.
2. Aim the guide rollers over guide ring and leave the roller chain and tensioner hanging down to one side.
3. Rock the machine lightly to ensure that drive sprocket is properly meshed with the chain.



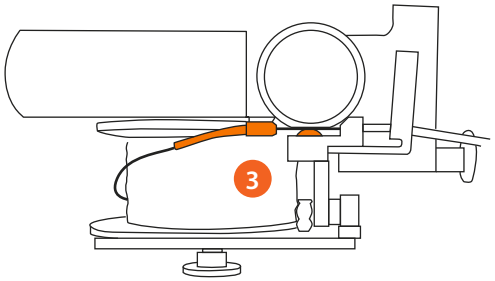
4. Hold the weld head in its position and pull the tensioner and latch assembly to the mating attachment.
5. Check that all guide rollers and chain rollers are in place and the guide rollers are properly in place.
6. Adjust tensioner length as required and tighten with moderate finger force only.

2.6 Wire spool

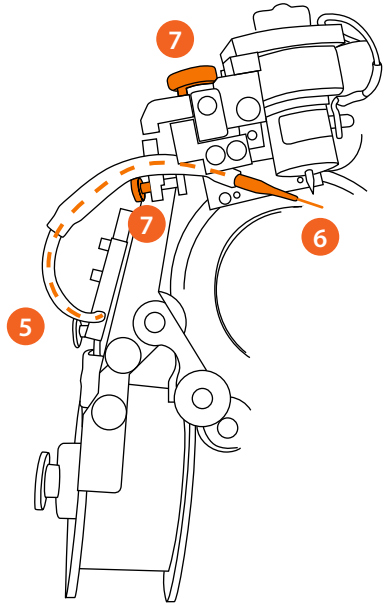


Swing the wire spool mounting bracket away from the pipe to accommodate easy spool installation.

1. Install the wire spool on the mounting bracket.
   a. Be sure to align anti-rotation pin in the sleeve with the slot in the nylon nut.
   b. Tighten the knurled knob to prevent accidental unwinding.
2. Swing the mounting bracket back to its original position.



3. Push the wire through the guide tube and insert into groove on the lower feed roll.
4. Jog motor forward so that the wire passes the feed roll.



5. Guide the wire into the liner and jog the motor until wire end comes through nozzle.
6. Release about 10 cm and cut at the nozzle.
7. Adjust the position of the nozzle with knurled adjustment screws.

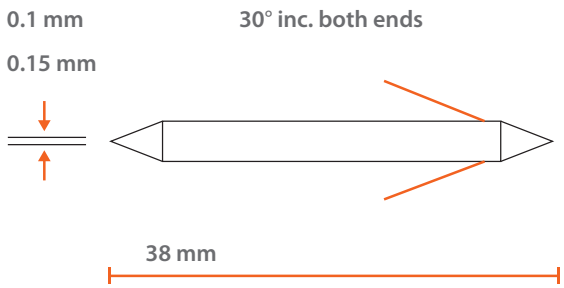
If the wire slips within the wire feed mechanism, adjust it for more positive feeding:

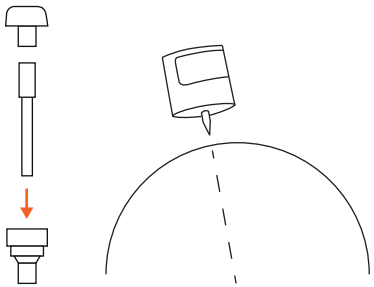
1. Loosen the two retaining screws on the roller arm.
2. Using an adjustable wrench or pliers, gently rotate the tensioning arm to increase the spring force on the drive roller.
3. Tighten both screws. This adjustment should not be made with wire in the mechanism

2.7 Electrode

Almost all welding can be done with the tungsten electrode ground to a 30° included angle. The tungsten electrode should have a 0.15 mm flat to avoid tungsten "spitting". The greater the included angle of the tungsten, the greater the penetration capability. Changing the included angle also affects weld bead width. Oscillation width needs to be changed accordingly. See recommended tungsten electrode geometry.

If tungsten electrode is sharpened at both ends, you can change direction after one end has worn off.





To select a suitable electrode for the welding application and a suitable collet for the electrode:

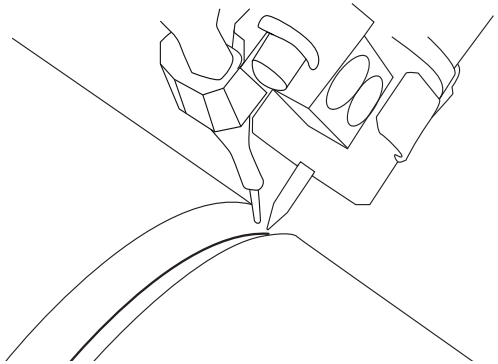
1. Insert the electrode through the collet and collet body.
2. Screw the body into the torch with the large end of collet upwards.
3. Ensure that the electrode extends to correct length without ceramic gas nozzle touching the pipe surface.
4. Tighten collet body with torch back-cap (minimal torque).
5. Use the adjustment screws to set the correct torch angle and position.

For most applications, the torch centreline should pass through the centre line of the pipe.

Replace the torch back cap with a back cap plug for minimal radial clearance:

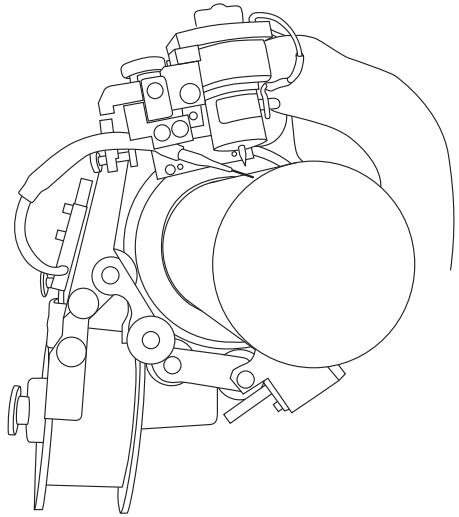
1. When you use the back cap plug, use collet wrench (supplied in the tool kit) to clamp the tungsten electrode in the torch.
2. Engage the "flats" of the collet around the "flats" of the collet body and rotate. Do not use excessive force.
3. Install the gas cup.

2.8 Torch centering



1. Centre torch weaving over the weld joint.
   a) Rotate the Cross-Seam Adjustment Encoder to the centre position.
   b) Ensure that the electrode is centered on the pipe joint. If necessary, loosen the clamp on the weaving shaft and move the torch and AGC mechanism to adjust the electrode position.
2. Use Wire inch button to run the wire until its end is just beyond the electrode.
3. Loosen the wire nozzle clamp and angle the nozzle to obtain desired entry angle for the filler wire into the weld pool (60 to 70 degrees).
4. Adjust the wire sideways, so that it's centred on the electrode.
5. Adjust the wire vertically to 1.5 mm gap.
6. Adjust the wire stick-out length so that it's not too close to electrode at arc start.
7. Press the Home button to rotate weld head to the next home position.
8. Lower the electrode to position about 1.5 mm above the work (if not using Touch Start mode).

2.9 Mechanical adjustments



Numerous adjustments are available for the torch and filler wire positioning according to pipe size, pipe wall thickness, and electrode extension:

- Torch angle pushing/pulling (± 5°)
- Torch lateral angle (10°)
- Vertical wire aimer (coarse or fine)
- Lateral wire aimer (coarse or fine)
- Wire nozzle angle
- Arc Gap Control (AGC); a setting that automatically controls the distance of the electrode from the work piece and maintains the correct arc length during welding.

3. OPERATION

3.1 Welding settings

3.1.1 Setting current level

Choose weld current after selecting RPM (tungsten speed). Use the following guidelines:

Carbon steel	1.3 amps per .025 mm of material to penetrate.
Stainless steel	1.0 amps per .025 mm of material to penetrate.
High alloy steel	0.75 amps per .025 mm of material to penetrate.

Above guidelines do not take into consideration filler wire addition, bevel geometry, or tungsten geometry. They are based on an electrode moving across a flat surface (typically at a speed of 76 mm/min). When making a 360° horizontal pipe weld (5G), some current programming may be needed to counteract the effect of heat buildup. In some cases, a given start position is mandatory to prevent concavity at 6 o'clock position.

To avoid current programming or to minimize programming requirements, use pulsed current technique. Pulsed current allows the weld puddle to chill and partially solidify between pulses and provides better control of the weld puddle. When pulsing, a minimum of 50 % overlap of the ID bead must be maintained for proper ID bead reinforcement. Pulse frequency is typically 1 to 10 Hz. A frequency of 1 Hz is typical for tungsten electrode speeds of 63 to 90 mm/min.

Increasing tungsten electrode speed above 90 mm/min requires an increase in pulse frequency to maintain an appropriate 50 % overlap of ID bead (the solidified bead from the previous pulse). To obtain high and low pulse current, use the following formula:

- Average current + (average current/3) = high-pulse current
- Average current - (average current/3) = low-pulse current

As a starting point, keep the high and low pulse times equal (0.3 seconds on, 0.3 seconds off).

Low pulse current is always programmed as a percentage of high pulse (rather than an actual value). If the weld current is reduced to compensate for heat buildup in the pipe, both high and low pulse levels go down proportionally.

- High pulse current programmed on remote control is actual amperage value.
- Low pulse current programmed on remote control is a percentage of high pulse current.

3.1.2 Pulsillation (synchronized pulsed current/ oscillation mode)

Pulsed current is automatically synchronized with torch oscillation whenever the two functions are switched on simultaneously. This "pulsillation" capability is useful in certain situations:

- The 2nd or "Hot Pass" can pose special difficulties.
- A current level too high will cause re-penetration of the root pass.
- A level too low will result in lack of sidewall fusion.

When using the pulsillation mode, the high and low pulse periods are controlled by the torch oscillator system. High pulse current occurs during both oscillation stroke end point "dwell" periods. Low pulse current occurs as the torch moves laterally across the weld joint. The high and low pulse controls are not functional when the synchronized pulsed current/oscillation mode is selected.

3.1.3 Filler wire speed

Filler wire speeds for the root pass are determined by prep geometry. Typical values for a square butt or a "J" Prep are 25 to 76 cm/min. As the land thickness increases, wire speed should decrease. Fill-pass wire speeds range from 76 to 190 cm/min. For 360° orbital welding, the higher the wire speed, the you need to use pulsillation to control the weld puddle size.

Wire feed can be continuous, or you can select Step Mode. In Step Mode, two levels of wire feed are synchronized with pulsed current. Wire feed during the low current pulse period is set as a percentage (0–99 %) of the high pulse wire feed speed. This feature is useful to control weld puddle size and to maximize fill rate. It may not be possible to use the same wire feed speed for both high and low current pulse periods, but the amount of wire fed during low pulse can be tailored to optimize solidification rate and puddle control.

3.1.4 Root-pass procedure

Filler wire to tungsten electrode gap should be approximately 1.5 mm (rule of thumb is 2/3 the diameter of the electrode). When welding a "J" prep, the wire entry into the weld puddle is correct when it appears that the wire is standing still. Wire should feed smoothly into the front edge of the weld puddle. There should be no drip or drag of the wire. When welding a 37.5 degree bevel, the wire should push slightly into the work.

To make the wire enter the weld puddle directly under the tungsten electrode:

1. Adjust arc length so that wire entry is correct. As the weld puddle partially solidifies during low current, the edge of the puddle freezes, forming a circular "chill mark".
2. Observe the chill marks on the weld bead surface. If the chill marks are closer than 0.8 * root land thickness, increase travel speed by 3 mm/min until you have reached the needed reinforcement.

- If the ID bead is almost solidified between current pulses, increase high-pulse heat input by doing one or more of the following:
  - Increase high pulse current.
  - Increase high pulse time (0.2 s minimum).
  - Decrease wire speed.
  - Decrease travel speed.
- If the ID bead is too fluid, reduce low pulse heat input by doing one or more of the following:
  - Reduce low pulse current (reduce % of high pulse).
  - Increase low pulse time.
  - Increase wire speed.
- If there is insufficient penetration on the I.D, observe the chill marks on the weld surface.
- If chill mark spacing is adequate, check that low pulse weld current is at least 50 % of the high pulse level and increase high-pulse weld current if necessary.
  - Record all changes.

3.1.5 Hot-pass procedure

1. Set wire to tungsten electrode distance and ensure that the wire is aimed laterally directly under the electrode.
2. Ensure that the hot pass is not causing the root bead to melt again as this may result in "suckback" or concavity of a previously acceptable root bead.
3. If the root pass melts, reduce weld current.
4. Ensure that the weld puddle is fusing into both sidewalls.
5. Check centering and increase oscillation width if necessary.
6. If the puddle runs ahead of the tungsten electrode on the downhill side, reduce wire speed.
7. If the puddle is sticking or making "wagon tracks" on the sidewalls, reduce travel speed.

When using the pulsillation technique, the lower amperage during torch excursion across the seam reduces the size of the weld puddle. The weld puddle must be large enough to ensure that the filler wire melts properly and does not "drag" on the unmelted solid surface of the joint. Set low-pulse amperage to approximately 70 % of high pulse.

3.1.6 Fill passes, oscillation (weave), and stringer bead techniques

The choice of a torch oscillation (weave) or stringer bead technique is affected by a number of factors, as both techniques have positive and negative features.

Oscillation

- High deposition rate, faster weld-out time
- Lower number of passes generally
- Higher heat input
- High alertness of welder required to monitor torch centering
- Filler wire positioning more critical to ensure that wire is not "dragging"
- Weld parameters require changing for each fill pass to increase oscillation stroke and maintain constant oscillation speed (requires multipass programming).

The maximum normal oscillation width is 9.5 mm bead width.

- You can use greater oscillation stroke widths, but oscillation speed and travel speed must be substantially reduced.
- Keep dwell times as short as possible because they also affect bead overlap.

When welding on the horizontal pipe (5G position), oscillation speed should equal the dwell times. This will keep the bead flat and the next pass will be easier to put in.

- If the weld bead is convex, the AGC will have to constantly correct arc length and the wire entry becomes critical (entry angle should be 15 to 30°).
- The flatter the entry angle, the more the wire will drag on the weld surface. If the entry angle is too steep, the wire pushes into the weld puddle.

When oscillating, you only want the spread to weld pool into the sidewalls without undercutting or "climbing" the walls.

- If the torch climbs the sidewalls, reduce the oscillation width.
- If the puddle is wetting into the sidewalls, but undercutting one wall, check that the torch is perpendicular.
- If undercutting is occurring on both walls, increase the flat on the tungsten electrode.

When using continuous current (one current value) in the oscillation mode during a 360° orbit, you may need to reduce weld current on the uphill side due to heat buildup.

- When the current is too high, the downhill side is concave and the uphill convex.
- Control the current to obtain a uniform flat bead or use the pulsillation technique.
- Adjust the dwell times to obtain uniformity in weld bead.

In the pulsillation mode, the molten weld puddle should solidify 3 mm (1/8") behind the electrode as it moves from dwell point to another.

Stringer Bead

- Lower deposition rate, inferior weld-out time
- Higher number of passes generally
- Lower input desirable for heat input sensitive materials
- Better weld puddle control with alloys having poor puddle fluidity (wetting)
- Lower level of welder attentiveness to monitor torch centering
- Filler wire positioning less critical
- Easier for inexperienced personnel
- Identical parameters on all fill passes possible.

Stringer beads are typically run at higher wire speeds. Typical wire speeds are 200 to 250 cm/min. Run stringer beads using continuous travel mode and continuous wire speed.

- When running stringer beads while wire is in the 13 to 25 cm/min range, do not use the Wire Step function unless background (two-level) wire speed is available.
- If the weld bead is flat on the downhill side and convex on the uphill side, you may use the Wire Step in conjunction with the Travel Step function to flatten the uphill side (wire speed 76–102 cm/min).

The Travel Step and Wire Step function are commonly used for single-pass square butt joints. Travel step can also be used with consumable inserts to control ID bead reinforcement in the horizontal pipes (5G position).

3.1.7 Shield gas effects

100 % argon is normally used for TIG welding. In certain cases it may be a good idea to use a mixed gas, such as 95 % argon and 5 % hydrogen.

- Use mixed gas for better control of the weld puddle and lower heat input.
- Add hydrogen or helium to increase the arc voltage and create a "stiffer" more focused arc column.
- Recommended for single-pass welds only (stainless steel), mixed gases increase the chance of cold cracking on multi-pass welds.

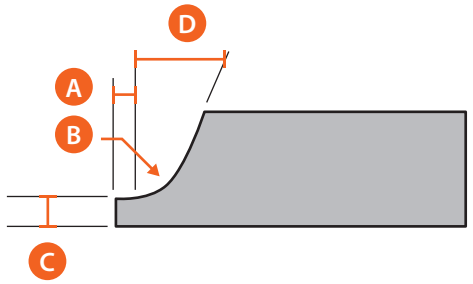
To reduce the possibility of cold cracking, use a mixture of argon/helium (65/35 %) for stainless steels and even higher amounts of helium for carbon steel. Increasing amounts of helium in the mixture will degrade arc starting.

3.2 Preparing the work piece

3.2.1 Groove preparation

Precise groove preparation is essential to achieve perfect welds. There are special tools available for creating precisely shaped grooves.

It is recommended to use a J-shaped groove with the geometry presented in the picture. Auto programming uses this groove as the default.



A. Extension: 0.8 mm ±0.1 mm
B. Radius: 2.4 mm ±0.4 mm
C. Root face: 1.5 mm +0.26 mm – - 0.13 mm
D. Bevel angle: 20° ±0.5°

If using counterbore, a 2 mm root face thickness is allowed.

3.2.2 Joint design and fit-up tolerance

Automatic welding requires repeatable fit-up within reasonable tolerances and consistent pipe end preparation. Mismatch should not exceed 1.5 mm. When pipe is out-of-round greater than 1.5 mm, you may need a counterbore. Use recommended joint design "J-Prep". See recommended J-groove geometry above.

Fit-up is much more critical than welding on a J-Prep. Hybrid bevel geometries can provide a solution when welding factory-beveled fittings to pipe ("J" with 2.5 mm land extension matched to "V" with 37.5° and with a 1.6 mm land).

3.2.3 Other preparations

1. Ensure that the tube ends (or fittings) are machined square-relative to their axis. The two ends are very tightly together.
2. Ensure there is no gap between tube ends resulting from lack of squareness or burrs left from the machining process.
3. Once the tube end is faced off, check for burrs. Carefully remove any burrs with a hand de-burring tool.
4. If the tube wall thickness variation exceeds 10 %, create a 5° chamfer cut on the inside of the tube ends.

After the tube has been machined, clean it properly following this procedure:

1. Wipe the tube end with a lint free towel dipped in a solvent, such as acetone or denatured alcohol.
2. Immediately dry with a second clean cloth before the solvent has a chance to dry.
3. Use an abrasive cloth to remove any surface oxides or contaminants. Clean the tube end back to approximately 12 mm.
4. Ensure that the tube ID is similarly cleaned

3.2.4 Developing weld procedures/process parameters

Use the following information to develop process parameters that meet the most economical weld quality requirements and procedures/parameters that are as "forgiving" as possible to real-world tolerances in variations such as:

- Joint fit-up
- Bevel geometry tolerances
- Gravity position
- Torch tracking errors
- Specific problems associated with the workpiece alloy

3.3 Controller unit menus

3.3.1 Main Menu

When the controller unit is first turned on, the main display remains off except for backlighting. After approximately 12 seconds the model, S/N, software release date, and last calibration date appear on the display.

The main menu options of A7 TIG Orbital System are Library, Help, Menu, and New.

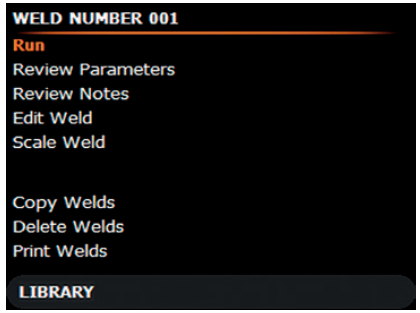
- Library: access to library of existing procedures
- Help: detailed explanation of highlighted item
- Menu: access to various functions and system configuration
- New: create a new weld program.

3.3.1.1 Library

The Library view includes a list of all welds currently saved in the system. Press Enter to select one to work with.

Programs are listed. Use the up/down cursor to scroll through the programs. Select program by using the Select soft key. The following choices are displayed:

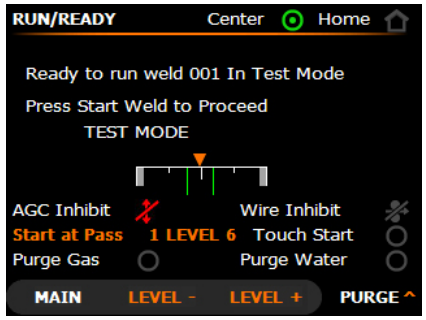
- Weld Number
- Run
- Review Parameters
- Review Notes
- Edit Weld
- Scale Weld
- Copy Welds
- Delete Welds
- Print Welds



Scroll through the list again. Make your selection.

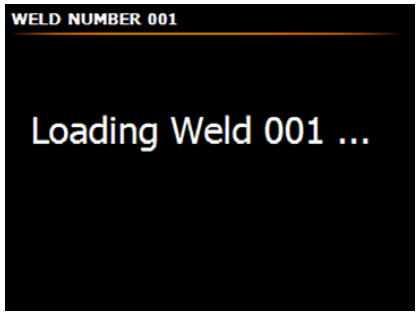
To run a weld

1. Move cursor to Run (now highlighted in red). Press Select (soft key).

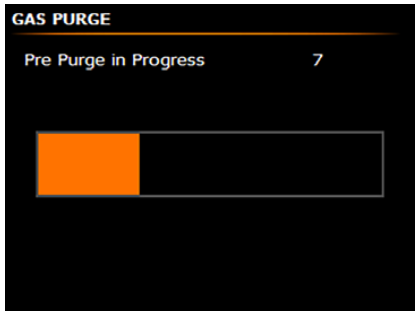


   - Screen shows the status of the weld head position, AGC inhibit, and wire inhibit.
   - Screen allows purging of backing gas and coolant.
2. Press Start Weld to initiate weld or press Purge to purge gas lines when first connecting a weld head to power source.

Weld in Progress



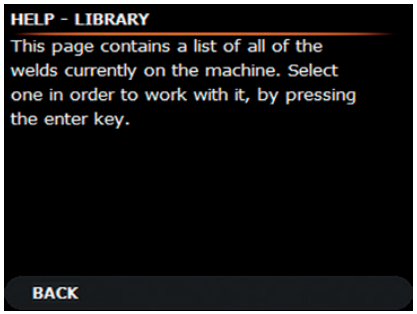
Pre-Purge



Upslope

These screens will change with the start of each new level and pass according to the program used.

3.3.1.2 Help

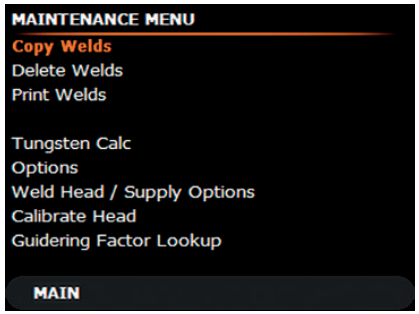


The A7 TIG Orbital System 300 contains a context-sensitive help that shows information and instructions about the screen and line currently selected. This view provides explanation or assistance on an item highlighted by the cursor.

3.3.2 Maintenance Menu

The Maintenance menu contains functions for general maintenance tasks.

- Copy Welds
- Delete Welds
- Print Welds
- Tungsten Calc
- Options
- Weld Head / Supply Options
- Calibrate head
- Guide Ring Factor Lookup



In the Main Menu screen, press Menu. This will open the Maintenance Menu screen. Most functions are password-protected if this option is selected.

Copy Welds (power source internal memory)

You may want copy an existing weld program as a starting point for creating a new weld program for a different tube size using the editing feature.

1. In the Maintenance Menu screen, select Copy Welds and press Enter.
2. Enter the program numbers for source weld and destination weld, then press Copy.

The Copy function allows you to copy a weld program within the power source's internal memory. (For example, an existing weld number 2 could be copied to weld number 10, assuming no program number 10 exists.)

The program will not be deleted from weld number 2; two copies of the program now exist.

When performing a Copy or Transfer to a destination program of the same number, the new file does not write over the existing file. You may delete the existing file or select an unused destination program number.

Weld numbers 1–99 are files stored in the internal memory of the power source.

Delete welds

The Delete function is used to remove unwanted programs from memory.

1. In the Maintenance Menu, select Delete Welds and press Enter.
2. Use the control knob to select a weld program.
3. Press Delete.

You can also use this feature to delete welds from a memory stick if it has been installed and initialized. Program on the stick is numbered 100 and higher.

Only existing weld programs are displayed in the Delete screen.

Print welds

On the Print Weld Files screen you can print to the built-in paper tape printer and/or an internal memory location. Printing to the printer provides an immediate hard copy of the weld program. You can print weld programs to memory one or more times over a period of time and then download them to a memory stick for storage or transfer them to other electronic media. The contents of memory will be deleted.

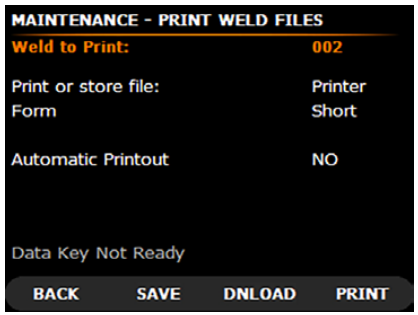
1. On the Maintenance Menu, select Print Welds.
2. Select Weld To Print.
3. Using the control knob, enter the weld number to print.
4. Select Print or Store File.
5. Use the control knob to select: Memory, Printer, or Both.
6. Select Short Form (parameters only) or Long Form (parameters, as well as all procedure information and notes).
7. To save the settings that have been changed on the Maintenance / Print Weld Files screen, press Save.

Memory	Internal memory
Print	Transfer files for printing to integrated printer or transfer to memory stick for printing using a PC.
Automatic Printout	If set to Yes, the printout automatically occurs following each weld.

Transferring print files to memory stick

You can use a memory stick to transfer or move files to a standard PC equipped with a printer for later printout.

1. Select the weld number to transfer and use the control knob to select Print to Memory, Print, or Both.
2. Press Print. A screen will state that the weld has been successfully saved to memory.
3. Save one or more welds to print later. (The memory stick does not have to be installed at this time.)



To transfer a weld program from internal memory to a memory stick:

1. Place the stick in the USB port in the front panel.
2. The stick will require approximately 1 minute to initialize, at which time the LCD on the side of the key will slowly pulse.
3. When the stick is ready, the LCD blinks rapidly 5 times.
4. If no stick is installed or it has not yet finished initializing, an error message displays.
5. Press Dnload to download all stored print files to the stick.

Dnload will delete these programs from memory.

You can open the print files saved on a memory stick in any text editor, such as Microsoft® Word, Microsoft® Notepad, or Microsoft® Excel.

In case you see an error message, return to Main Menu and re-enter the print screen. "Error" will change to "Dnload". If a memory stick is installed and initialized prior to entering the print screen, this step is not required.

Printout (300 and 150 series weld heads only)

At weld completion, the 300-series provides an immediate unambiguous report that indicates whether a weld was made. It is not a complex data-logging program, and it does not require interpretation of chart/graphical printouts of the entire weld.

The following information is printed out:

- Weld ID number
- Date
- Time
- Operator's name
- Welding parameters from each layer

Printable information can also be stored on a memory stick via the USB connector on the remote control.

3.3.3 Options Menu

Any changes made on this screen become active immediately but are lost when the power is switched off. To maintain changes, press Save after all changes are made on the screen.

Setting the weld counter

At completion of each weld, the system stores the actual parameters run and related weld ID number, operator name, and time and date to print out if necessary. The weld number sequentially increases by one digit per weld. You can set/reset the weld counter at any specific number using the control knob.

Setting the password

Press Enter. Password screen appears. Press Enter. An alphanumeric pop-up field appears. Enter a password up to 10 characters using the technique described in section Alphanumeric labeling. To confirm password, press Save.

Entering operator's name

Enter operator's name using the technique described in section Alphanumeric labeling.

Setting date and time

Press Enter to select the Date/Time field and set date and time.

Setting the language

Use the control knob to scroll through the alternatives.

Setting the units of measure

The control knob lets you scroll between Standard and Metric.

Using the test mode

If you need to use the test mode, use the control knob to select Yes.

This mode allows simulation of an actual weld with sequencing through the weld program and simultaneous rotation of the weld head. By using this function You can observe the rotation of the tungsten electrode while changing the various levels of the program on the display. It is a useful diagnostic tool if you suspect malfunction during the weld mode. A service technician can operate the system in a simulated weld mode without the need to worry about the arc. In the test mode, the contactor signal to the power supply is disabled, preventing initiation of high frequency and a welding arc.

1. Exit the Options menu.
2. Select a program to run. TEST MODE appears on the screen.
3. Press Start Weld.

Following the pre-purge and current upslope time interval, the rotation motor on the weld head becomes operational. It will continue operation until current downslope is over. If the Auto Rewind function has been programmed to occur, it follows after the completion of the simulated weld. The gas solenoid is pulled in during pre-purge, welding, and post-purge.

For weld head models equipped with a filler wire feeder, the filler wire feed motor is disabled during the test mode.

3.3.4 Compatible weld head models

The 300-series TIG orbital controller can use a 300-series weld head. You can also use 150-series closed weld heads with an adapter cable.

3.3.5 Calibrate head

To calibrate the weld head, press Menu in the Main menu to enter the Maintenance menu. Once in the Calibrate Head menu, do the following:

1. Select the model of the weld head to be calibrated.
2. Use Up/Down to navigate within the menu and Enter to make a selection.
3. If this is the first time calibrating a particular weld head or you see "Calibration Out of Range" error message, press Default after selecting the weld head to install the factory setting for the correction factor.
4. Select Travel Speed to calibrate.
5. For travel calibrations, choose the Distance to Travel or Desired RPM by rotating the dial and press Enter.
6. For wire calibrations, adjust the Amount to Run by rotating the dial and press Enter.
7. Press Run and measure the actual amount traveled or actual run time (or the length of wire).
8. Enter the measured value and press Save.
9. Repeat this process until you have achieved desired accuracy, then press Back to return to the Maintenance menu.

3.3.6 300-head guide ring speed factors

1. Use torch rotation speeds of 6 to 9 cm/min for most welding applications.
2. Select torch rotation speed as the first parameter. Carriage speed refers to the speed at which the weld head moves around the guide ring.

The weld head rotates on the guide ring, not the pipe surface, and the tungsten electrode is extended inward to the pipe surface.

3. Actual tungsten electrode speed is slower than carriage speed. Correct this difference with the guide ring factor that can you can calculate when the guide ring and pipe are set, or you can take the factor from the table below.

Correction factor = diameter ratio between tractor rotation diameter and tungsten electrode tip rotation diameter.

The weld head rotates on the guide ring OD, not the pipe OD. Although this error is small on large pipes, it can become significant with small diameters when modifying a pre-established weld procedure to a new pipe size.

4. For heavy wall pipe welding, correct for the change in diameter as the weld bevel is progressively filled and the tungsten is retracted outward (closer to the guide ring diameter).

This correction factor is 17 mm* + Groove depth for given pass.

*This value is the radial height of the guide ring.

5. To determine actual tungsten electrode speed from carriage speed:

$$\text{Electrode Speed (E.S.)} = \frac{\text{T.S. mm/min} \times \text{Pipe OD mm}}{\text{Pipe OD mm} + 17\ \text{mm}}$$

- T.S. = Carriage speed (speed that the tractor has to move for the desired tungsten speed)
- E.S. = Desired tungsten electrode speed

6. Rotation speed can be continuous, or you can select Step mode. In Step mode, two levels of rotation speed are synchronized with pulsed current. Rotation speed during high current pulse is set as a percentage (0–99 %) of low pulse rotation speed.

The Travel Step is often used for root pass welding on materials with poor thermal conductivity, as the torch can be momentarily stopped during high pulse current, increasing the arc force available to penetrate the bevel "land". This feature is also useful when welding thin wall material that can be welded in a single pass.

The guide ring factor is marked on the face of each guide ring.

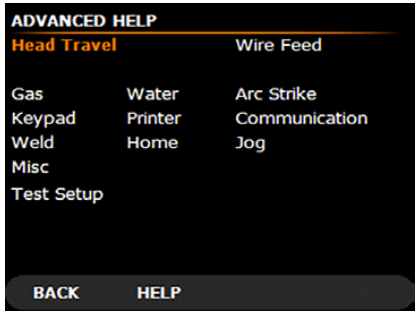
Table: Guide ring factors

Guide ring size	Pipe/tube nom. OD	Guide ring factor
1 ¾"	Tube 1.750" (44.5 mm)	7.5
1 ½"	Pipe 1.900" (48.3 mm)	8.0
2"	Tube 2.000" (50.4 mm)	8.5
2 1/8"	Tube 2.125" (54.0 mm)	9.0
2"	Pipe 2.375" (60.3 mm)	9.5
2 ½"	Tube 2.500" (63.5 mm)	10.0
2 ½"	Pipe 2.875" (73.0 mm)	11.0
3"	Tube 3.000" (76.2 mm)	11.5
3 ¼"	Special 3.250" (82.6 mm)	12.5
3"	Pipe 3.500" (88.9 mm)	13.0
3 ½"	Pipe 4.000" (101.6 mm)	14.5
4"	Pipe 4.500" (114.3 mm)	16.0
4 ½"	Pipe 5.000" (127.0 mm)	18.0
5"	Pipe 5.563" (141.3 mm)	19.5
6"	Pipe 6.625" (168.3 mm)	23.0
7 5/8"	Tube 7.625" (193.7 mm)	26.5
8"	Pipe 8.625" (219.1 mm)	29.5
10"	Pipe 10.750" (273.1 mm)	36.0
12"	Pipe 12.750" (323.9 mm)	42.5
14"	Pipe 14.000" (355.6 mm)	46.5

See calculation of guide ring factor.

3.3.7 Advanced Help

Advanced Help allows you to diagnose problems which may result from an external situation (e.g. an empty gas bottle) or an internal situation (e.g. the weld head control cable is damaged or not connected). Advanced Help provides assistance for the operator as well as for a competent electric repair technician.



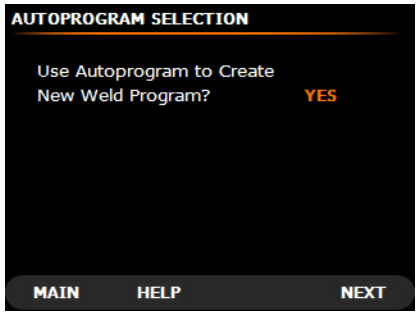
3.3.8 Autotack

Tack welding is useful when welding larger diameter tubes, for which Autotack automatically generates a tack-welding program. Select 4 or 8 equally spaced tacks. Tacking parameters penetrate approximately 70% of the tube wall. If the intention is to make the weld to immediately follow tacking, set the welding program as the "Next Weld to Run" and the program is loaded automatically.

3.3.9 Autoprogram

Autoprogram for 300-series weld heads always uses position-based programming. Each pass is divided into six levels. Certain defaults are automatically selected (for example, Prepurge is always 5 seconds). To change these defaults, edit the weld program after it has been generated.

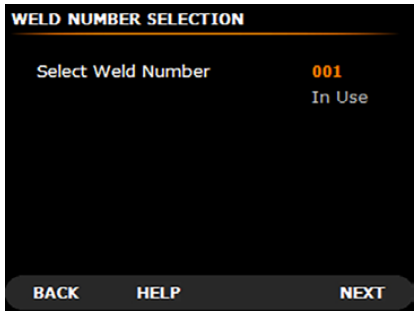
The Autoprogram feature only creates a maximum of 5 passes (rotations around the pipe), which should allow weld thicknesses up to 12.7 mm (0.5") to be programmed. For heavier walls, create a new weld program and slightly increase Pass 5 oscillation parameters for each subsequent pass.



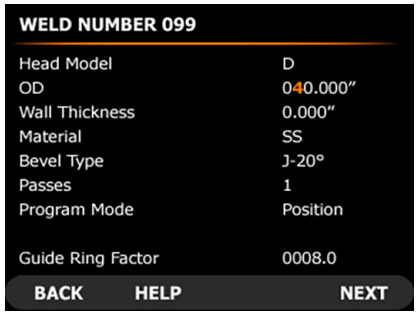
If password protection has been applied, you will be asked for your password to continue. Select New Weld Number using the control knob. Press Next when finished. Use Back to move to prior screen.

To create a new program using Autoprogram:

1. Select Yes. (If password protection has been applied, you will be asked for your password to continue.)



2. Select weld number.



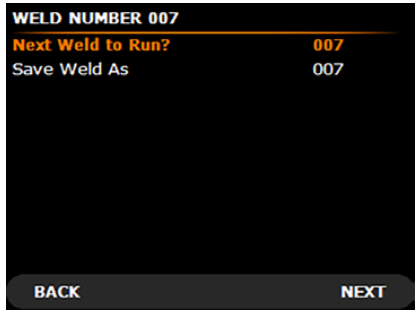
3. Feed the parameters of the welding task: head, OD, wall thickness, material, bevel type, number of passes, program mode, and guide ring factor.

Once you enter the OD, wall thickness, and material, the system automatically chooses the correct guide ring factor (GRF) based on the OD. If the OD is not a standard tube or pipe size, e.g. 2.333" instead of 3.375, the system will default to 8.0 for the GRF.

If your OD is not standard or you are using an oversized guide ring (with guide ring insertion kit), you must change the GRF to obtain correct travel speed. You should always check that GFR in the program matches with the GFR of your guide ring.

Next Weld to Run (two choices)

1. Repeat the weld program. At the completion of a weld, the same program is automatically loaded, eliminating the need to enter the Weld Number again.
2. Run a different weld program to create readymade work cycles. Press Next when finished.

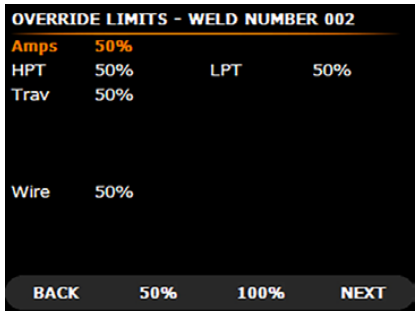


You can chain several programs, or if you use the same welds repeatedly, return automatically to the beginning of the program.

Override Limit

You may override any of the pre-programmed values, but only within the limits that may be defined during programming.

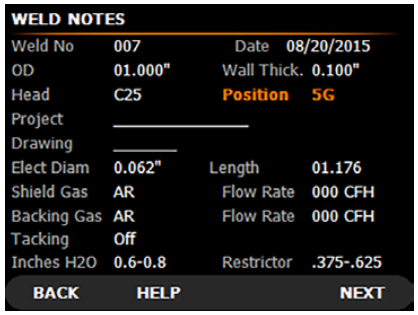
- You can individually program the percentage of override limits for each parameter between 0–100% of the programmed value.
- You may obtain sufficient override capacity to compensate for tube fit variations, for example, but avoid modifying the original program outside of specified heat input limitations.
- The override limits are saved with each weld to allow different override values based on which a weld is being run.



Use cursor to select line, control knob to modify.

Weld Notes

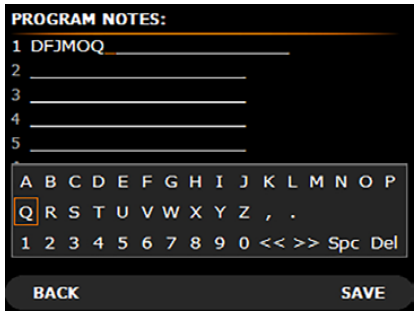
Use cursor to select line, control knob to modify.



Certain items have been previously selected and cannot be changed (e.g. Weld No, Data, OD). The cursor will pass these items.

Program Notes

1. Use cursor to select the line for additional notes.
2. Save if all program selections have been completed (or use Back to make corrections).



Completion of programming

3. Press Main to exit the Main Menu.

Autoprogram for the 150-series weld heads operates similarly to the 300-series weld heads. The main difference is that programming is time-based and each program is created on 4 levels.

4. The system automatically creates a new program.

To create a new program manually:

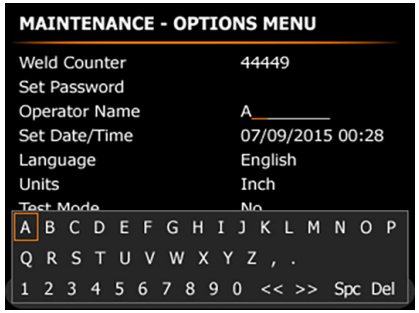
1. Select No.
2. Enter all parameters manually.

Autoprogram is designed only for predefined J grooves.

1. To complete programming, press Main to exit to Main Menu.

3.4 Alphanumeric labelling

Use the floating keyboard.



The keyboard is accessible any time the currently highlighted line requires keyboard input; such as the Password Entry screen, the Program Notes screen, or any other text entry line.

Use the cursor to select the item to be labelled.

To enter text

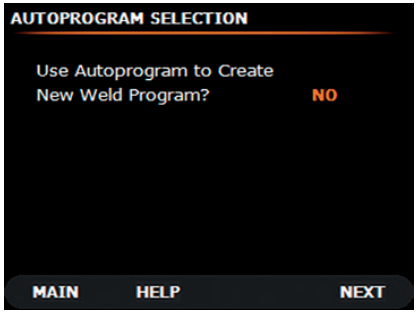
- Press Enter on a text entry line to display the floating keyboard.
- Use the control knob to select the a letter or number.
- Press Enter again to insert the selected number into the line.

The left (shown as <<) and right (shown as >>) keys move the highlighted character to the left or right along the line.

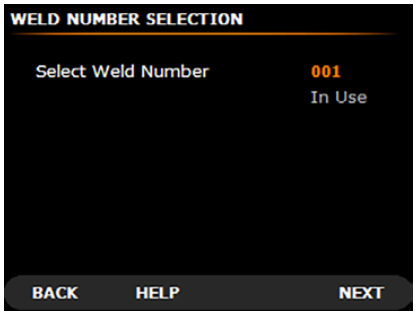
- To replace a letter, move the highlighted character (cursor) to the letter and use the control knob and Enter.
- Use the Delete key (shown as Del) to erase a line. The last character of the line is deleted and deletion only works if the selected character is the final character in the line.
- Press Del on the last character of the line to erase it.
- To end text entry and move to the next line on the screen, press either the Up or Down key.

3.5 Manual programming

Use in the same way as Auto program but select each parameter and technique that you want to use. If password protection has been applied, you will need to submit password to continue.

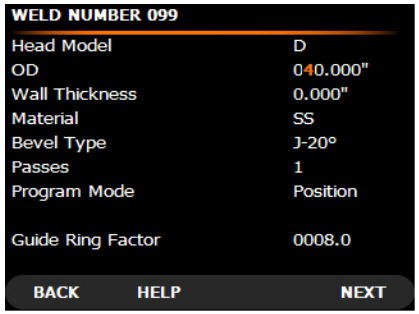


1. Select No with the control knob. Press Next.
2. Select Weld Number with control knob. Press Next.



3. Input all information as in auto program but select the number of passes and levels.
4. Move the cursor to the desired line and use the control knob or Enter plus control knob for OD and Wall Thickness. Turn on auto program if required using the control knob. Press Next.

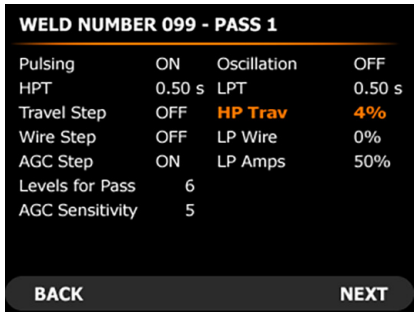
Pulsing levels



Pass Screen

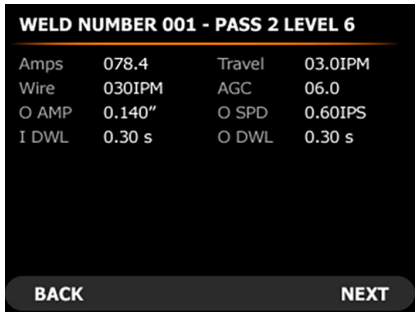
Select the functions to be used during this pass for all levels.

This screen will appear before each new pass.



- Pulsing levels: select either pulsed or non-pulsed current. Pulsing varies the current between high and low values.
- Oscillation: select On/Off, depending whether using a stringer bead or oscillated (weave) pass.
- Travel Step: index of torch rotation with pulsed current. When turned on, torch will rotate forward during lower pulse time period and stop (or travel at a lower % speed).
- HP Travel: percentage of low pulse travel speed to be used during high pulse current period. (O = Off)
- Wire Step: index of wire feed with pulsed current. When operational, wire feed can either be turned off during low pulse, or set to some lower percentage of high pulse wire speed.
- LP Wire: percentage of high pulse travel speed to be used during low pulse current Period (O = Off).
- AGC Step: Arc gap control step function indexes operation with pulsed current. When off, the function is operational during both high and low pulse periods. When on, the function operates during high pulse and is disabled during low pulse time period.
- LP Amps: low pulse current, shown as a percentage of high pulse current (peak).
- Levels for Pass: 6, using the 300-Head, 6 levels are always used in position programming mode.

Pass 1, level 1



Move the cursor and enter values with the control knob.

- Amps: current at each level (using pulsed current, this is high pulse current).
- Wire: Filler Wire Feed Rate (in IPM or CM per minute, function not available).
- RPM: Rotation Speed
- LP Amps: Low Pulse Amperage, shown as percentage of high pulse current.
- HPT: High Pulse Time Period, in seconds.
- LPT: Low Pulse Time Period, in seconds.
- HP RPM: rotation speed on high current pulse (shown only when RPM STEP is turned ON). Can be set at any percentage from 0–99 of the low pulse speed listed RPM.
- LP Wire: Wire Step Function, index of wire feed with pulsed current (not available).
- Level Time: the time during which these parameters will be active in seconds.
- Time Remaining: as the tube size is input, selection of RPM automatically calculates Total (weld) Time.
- Time Remaining: automatically calculated once Level Time is entered.
- Total Time: total time for weld in seconds. Enter values and press Next soft key to go to Level 2.

Automatic parameters carry down through levels.

You can copy parameters from one level to the next by pressing Next. Be careful when changing parameters at one specific level so as not to impact other levels.

Example: You wish to change the amperage originally programmed in Level 4 of a one pass weld. However, other parameter changes occur in a subsequent level, such as level 5 or 6. If you make the change in amperage in Level 4 and press Next, you will automatically copy all of the Program Level 4 values into Level 5. Therefore, it is necessary to note any other changes that are occurring in subsequent levels within the pass before modifying any parameter in that pass. Please note that this is only true for Level parameters within any given pass. For a multi-pass weld, once you move to a subsequent pass, the parameters will not be copied from the previous pass.

Pass 1, level 2

Move the cursor, enter values with the control knob and press Next; or if no change is necessary, press Next.

Pass 1, level 3 to final level

Continue moving through the screens for each level and change parameters as needed.

Downslope screen

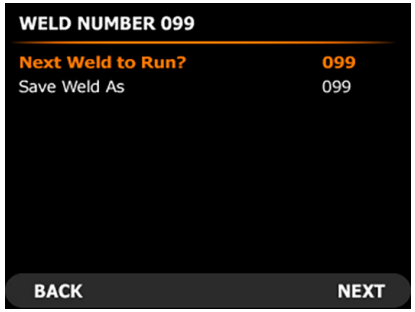
Move the cursor and enter values with the control knob. Press Next when complete.

- Downslope Delay: downslope of weld current will occur immediately at the tie-in of the start location. If you want an overlap of the weld bead, set the seconds of downslope delay.
- Downslope: downslope or current taper time period in seconds.
- Wire Stop Delay: (for use with weld heads with wire feeders only) wire feed is normally terminated at the initiation of downslope. The wire stop delay feature delays the termination of wire feed for an adjustable period (in seconds) after downslope is initiated. It is useful when welding crack-sensitive materials such as alloys with high nickel content.
- Pulsing Downslope: choice of pulse current or steady-state current during downslope period (Yes or No)
- Final Amps: weld current level just prior to arc termination
- Post-purge: period gas flows after arc termination (seconds)
- Auto Rewind: if "switched on" (by selecting Yes on the display), the weld head automatically rewinds at completion of a weld and comes to a halt at the starting rotational position. Post-purge occurs simultaneously with auto rewind.
- AGC Stop Delay: AGC operation normally turns off at the initiation of downslope. This feature delays the termination of AGC for an adjustable period (seconds) after downslope as been initiated.

Save Weld/Next Weld

Use cursor to select item, control knob to modify. You have two alternatives:

1. Repeat the weld program. At the completion of a weld, the same program is automatically loaded so that you do not need to re-enter the weld number.
2. Run a different weld program to create readymade work cycles. Press Next when finished.



3.6 Prepurge – Upslope

Move the cursor and enter values with the control knob. Press Next when finished.

- Prepurge: Time period gas flows at weld start before arc ignition (seconds).
- Upslope: Time period in seconds that weld current ramps up from start amps value to level 1 value.
- Travel Delay: Period (seconds) beginning at end of upslope before rotation begins. Used to establish penetration.
- Start Amps: Current level at which arc is initiated.
- Start Delay: Arc gap control (AGC) operation start delay (in seconds after arc initiated).
- Wire Start Delay: Wire feed operation start delay (in seconds after arc initiated).
- Pulsing: Upslope, choice of pulsed current (Yes) or stated current during upslope period (No).

Downslope At Home: If this function is OFF, program downslope occurs at the time out (completion) of the final level. If this function is turned ON with the control knob, program downslope will begin exactly as the Home position switch is actuated. Because there are 4 possible Home positions, welding always starts at one of them. After a full 360° revolution, downslope will occur at 360° Home.

3.7 Programmed oscillation width (without striking an arc)

- Test Mode: If a program has already been written, running the program in Test Mode will cause the oscillator to move the torch at the programmed width as it cycles through the program.
- Run Ready Mode:
  a) For an existing program, cycle the program to a level in which oscillation is being used and has a programmed value.
  b) Press the oscillation width "+" key one time. This will cause the oscillator to weave at the programmed value.
  c) To terminate oscillation, press the "+" key a second time, which will center the torch.

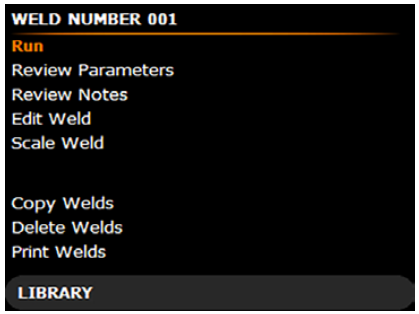
If you attempt to do the above in a level where there is no oscillation being used (i.e. the root pass), nothing happens when you hit the "+" key. However, the system will be attempting to oscillate with a 0 value. If you attempt to do anything else at this point, it will appear as if the system has "locked up". Press the "+" key a second time to exit/ terminate this oscillation width observation mode.

- All other modes of operation: The oscillation width "+" key cannot be used in most other modes of operation (for example, when writing a program) as it will increase the programmed value.
  a) To test the oscillation width in these modes, press once the AGC Inhibit key in the left-hand bottom corner of the remote control. This will oscillate the torch for any level in which oscillation is being used.
  b) Press the AGC Inhibit key a second time to turn off the oscillator and re-center the torch.

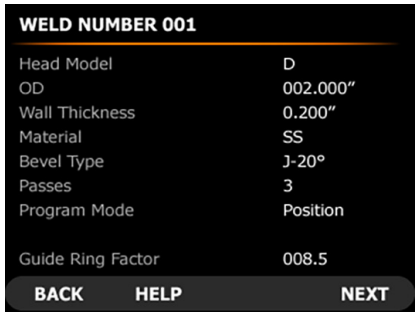
3.8 Editing a weld program

To select weld number to edit:

1. Move cursor to Edit. Press Select.



2. Edit weld parameters. Use cursor to select an item. Modify with the control knob.

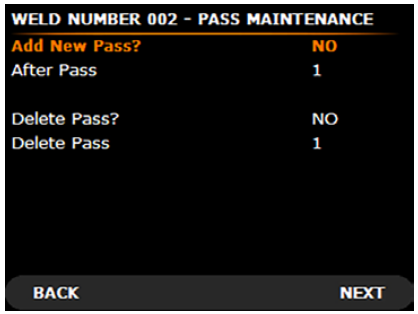


Certain items may not be modified. The cursor will pass these items.

3. Use Next to move through levels, editing them as you go.
4. Use Enter to copy one level parameters to the next, but remember that you will override the original parameters.

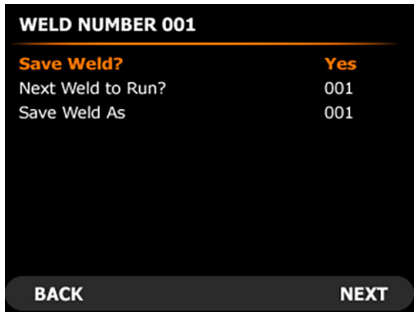
To add/remove a pass:

In Edit mode, proceed to the final pass/level. The next screen allows a pass to be added or removed anywhere in the program.



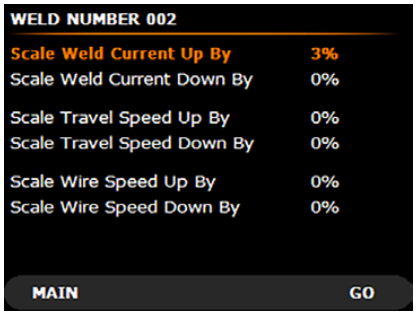
To save weld/next weld:

The edited weld will overwrite the original program if the same Weld Number is selected. To create a new program, select an unused program number.



To scale a weld:

Welds may be edited by scaling current or travel speed up/down by a percentage of programmed speed. This will scale programmed values in all passes and levels.



3.9 Completing the programming

Press Main to exit to Main Menu. Press Run to immediately weld with new program.

Editing a weld program

- Move cursor to Edit. Press Select.
- Use the cursor to select an item. Modify with the control knob.

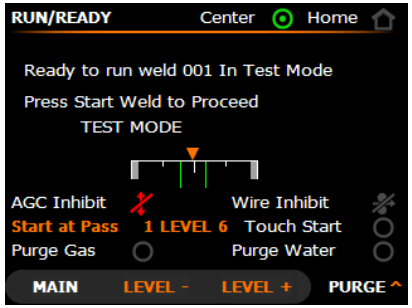
Certain items may not be modified. The cursor will bypass these items.

- Use Next to move through levels, editing them as you go. The edited weld will overwrite the original program if the same weld number is selected.

3.10 Updating software

The controller unit's application software can be updated. Updates are not done regularly, and they are recommended only when some new feature or bug fix is needed. Updating can be done via USB media. Consult Kemppi workshop service for detailed instructions when updating.

3.11 Welding



1. Create a new program or choose one from the library.
2. Activate the Run/Ready screen.

- Screen shows the status of the weld head position, AGC inhibit, and wire inhibit.
- Screen allows purge of backing gas and coolant.

Water and gas are purged with the same button. Make your selection pressing the arrow up. Text on the bottom right corner changes from purge to water and back to purge.

3. Start welding by pressing the Arc On button.

3.12 Travel speed correction

Compared with the electrode tip, the weld head rotates further away from the pipe surface. This makes the actual rotation speed of the electrode tip slower than that of the weld head.

- Correction factor = the weld head rotation diameter divided by the electrode tip rotation diameter

The factor may be small on large pipes, but it can become significant with small diameters, when modifying a pre-established program to new pipe size.

In heavy wall pipe welding, the groove progressively fills and electrode rotation diameter retracts closer to the guide ring diameter. In these cases, you may need to change the diameter in correction factor calculation. The correction factor should be 17 mm + groove depth for the given pass where 17 mm is the radial height of the guide ring.

3.13 Shielding gas

Select proper shield gas/gas mix for optimum results.

100% argon is normally used for TIG welding. In certain cases, you can benefit from using a mixed gas, such as 95% argon, 5% hydrogen. This mixed gas gives better control of the weld puddle and lower heat input. Adding hydrogen or helium increases the arc voltage and creates a "stiffer", more focused arc column.

Industrial grade inert gas is sufficient for most stainless steel welds. Use a higher purity grade for high quality welds on easily oxidizable alloys.

The purpose of purging is to replace unwanted air and other vapor contaminants from the root pass by a gas that prevents oxidation during welding. Oxidation can produce a variety of problems, such as root oxidation (sugar), incomplete fusion, porosity and changes in weld chemistry, which can affect weld mechanical and corrosion resistance properties adversely.

Purging is recommended when welding stainless steel, nickel alloys, and most nonferrous base metals. Argon is commonly used.

The gas regulator / flow meter should be set for 4 bar (60 PSI) and a suitable flow rate. Recommended gas flow rate is 3-5 l/min for backing gas and 5-10 l/min for shielding gas. Prepurge time is recommended to set so that backing gas volume is about 10 times the volume to be filled inside the tube.

You can apply separate backing gas for root protection. When using backing gas, also use dual flow meter regulator that allows having two independently regulated (shielding and backing gas) circuits from one gas bottle

3.13.1 Purging the pipe ID with inert gas

The purpose of purging is to replace unwanted air and other vapor contaminants from the root pass by a gas that prevents oxidation during welding. Oxidation can produce a variety of problems, such as root oxidation (sugar), incomplete fusion, porosity and changes in weld chemistry, which can affect weld mechanical and corrosion resistance properties adversely.

Purging is recommended when welding stainless steel, nickel alloys, and most nonferrous base metals. Argon is commonly used.

1. Isolate the weld root by means of dams or other suitable containment devices.
2. See that there are openings through which the purging gas can enter and exit the weld joint area at controlled rates.
3. When argon is used, locate the gas inlet lower than the exit opening to prevent entrapment of air to prevent excessive pressure buildup during welding.
4. Size the exit port equal to or greater than the size of the entry to prevent an increase in the gas pressure.
5. If the weld joints are pre-tacked in larger assemblies, tape each unwelded joint to prevent excessive loss of purge gas.

The purge flow rate is based on the volume to be purged.

- A general rule of thumb: purge at flow rates and times that produce 5 to 10 system volume changes prior to welding.
- Recommended maximum flow rate: the volume and shape to be purged. Typically, the purge rate should not exceed 40 l/min.
- You can estimate reasonable purge flow rates and times from calculations of the system volume and by applying time factors. Divide the system volume by the purging gas flow rate.
- Or determine purging adequacy by taking residual oxygen measurements by using an oxygen analyzer prior to welding to ensure a low oxygen level.

6. After purging is complete, reduce the flow of purge gas prior to welding until only a slight positive pressure exists to avoid a pressure buildup from heat due to welding. Excessive pressure can cause root concavity and porosity in the root pass. A purge gas flow rate of 4–12 l/min is typical for pipe welding in the 10 cm (4") size range.

Kemppi offers a purge plug kit that includes a selection of plugs ranging from 10 to 100 mm ID as well as an oxygen content meter for residual oxygen measurement.

4. ADDITIONAL DETAILS

4.1 Controller technical data

Property	*Value*
Mains connection voltage	230 VAC ± 10 %
Fuse (delayed)	16 A
Maximum output current	220 A @ 40 %, 170 A @ 100 %
Weld heads	300 series
Weight	33.2 kg
External dimensions (W x L x H)	273 x 501 x 670 mm
Degree of protection	IP 23
Auto-stop	yes
Operating temperature	-20…+40 °C

4.2 Weld head technical data

Property	*Value*
Application	Multi-pass orbital GTAW pipe-to-pipe, pipe-to-fitting
Pipe outer diameter (OD)	25–355 mm (1 – 14”)
Cable length	7.6 m standard; extension cables available
Carriage clamping	Ring for each pipe size
Welding positions	all
Filler-wire module	Wire size: 0.8, 0.9, 1.0 mm Max. wire speed: 2540 mm/min. Spool size: 1 kg std; 0.5 kg low profile
Oscillation module	Max. oscillation stroke amplitude: 16 mm Max. oscillation speed: 1520 mm/min Oscillation dwell: 0–1 sec. Cross-seam adjustment: ±6.4 mm
Arc-gap control module	13 mm stroke; additional mechanical adjustment allows welding heavier wall pipes
Torch propulsion module	250 mm maximum rotation speed
Water-cooled torch	200 A continuous capacity
Torch adjustment capability	Torch lead/lag adjustment: ±15° (manual) Torch tilt adjustment: ±10° (manual)
Weight	3,6 kg
Axial clearance	Torch C/L to rear extremity: 220 mm Torch C/L to front extremity: 10 mm
Radial clearance	64 mm (2.5”) with standard spool 51 mm (2.0”) with low profile spool

4.3 Ordering information

Kemppi uses ceriated tungsten which increases electrode life, arc starting, and stability. We recommend this for orbital use. 2% ceriated involves no radiation risk. These tungsten electrodes are commonly marked in grey color.

Ordering codes of standard length (175 mm) tungsten electrodes and electrode machining tools:

Product name	*Product code*
10 pcs. 1.0 mm diameter, 175 mm long	9873531
10 pcs. 1.6 mm diameter, 175 mm long	9873532
10 pcs. 2.4 mm diameter, 175 mm long	9873533
Ultima – TIG – cut, tungsten electrode cutting/sharpening machine	6270001
Neutrix, portable, tungsten electrode sharpening machine	6270002
Auto Grind, Tungsten electrode automated grinder.	6270003

Tungsten electrode cutting devices listed above can be used to prepare correct length and angle from standard tungsten electrodes.

Product name	*Product code*
A7 TIG Orbital Controller 300	6204300
A7 TIG remote control (pendant)	6204301
Tungsten electrode L = 175 mm, Ø = 1.0 mm, 10 pc	9873531
Tungsten electrode L = 175 mm, Ø = 1.6 mm, 10 pc	9873532
Tungsten electrode L = 175 mm, Ø = 2.4 mm, 10 pc	9873533
Orbital weld head 300	6206007
Orbital weld head 300 consumables	SP800684
Expendable kit for weld head 300	SP800685
Fillet weld kit for weld head 300 series	SP800686
Angled AGC kit for weld head 300 series (with torch cable)	SP800687
Wire size kit for 1.0 mm filler wires	SP800688

Product name	*Product code*
Extension cable kit, 300 series weld head, 15 m	SP800689
Extension cable kit, 300 series weld head, 7.5 m	SP800690
Cable assembly, remote control, Ethernet, 15 m	SP800691
Double flow meter gas regulator	SP800680
Ultima-TIG-cut for cutting and sharpening tungsten electrodes	6270001
Neutrix, a handheld machine for sharpening tungsten electrodes	6270002
Auto grind, tungsten electrode automated grinder.	6270003
Purge plug kit 10–100 mm*	6206009
Oxygen content meter 10–1000 ppm	6206008
Printer paper roll 58 mm	SP800692

*** Larger purge plug sizes on request.**

Guide ring kit ordering codes		
size [inch]	Ordering code	Item name
1.750″	103854-1750	GUIDE RING KIT, 300 (44.5 MM)
1.900″	103854-1900	GUIDE RING KIT, 300 (48.3 MM)
2.000″	103854-2000	GUIDE RING KIT, 300 (50.8 MM)
2.150″	103854-2150	GUIDE RING KIT, 300 (54.0 MM)
2.375″	103854-2375	GUIDE RING KIT, 300 (60.3 MM)
2.500″	103854-2500	GUIDE RING KIT, 300 (63.5 MM)
2.875″	103854-2875	GUIDE RING KIT, 300 (73.0 MM)
3.000″	103854-3000	GUIDE RING KIT, 300 (76.2 MM)
3.250″	103854-3250	GUIDE RING KIT, 300 (82.6 MM)
3.500″	103854-3500	GUIDE RING KIT, 300 (88.9 MM)
4.000″	103854-4000	GUIDE RING KIT, 300 (101.6 MM)
4.500″	103854-4500	GUIDE RING KIT, 300 (114.3 MM)
5.560″	103854-5563	GUIDE RING KIT, 300 (141.3 MM)
6.625″	103854-6625	GUIDE RING KIT, 300 (168.3 MM)
8.625″	103853-8625	GUIDE RING KIT, 300 (219.1 MM)
10.750″	103853-10750	GUIDE RING KIT, 300 (273.1 MM)
12.750″	103853-12750	GUIDE RING KIT, 300 (323.9 MM)
14.000″	103853-14000	GUIDE RING KIT, 300 (355.6 MM)

Guide ring kit ordering codes	
Ordering code	Item name
102222-012	GUIDE RING INSERTION KIT (0.30 MM)
102222-031	GUIDE RING INSERTION KIT (0.79 MM)
102222-045	GUIDE RING INSERTION KIT (1.14 MM)
102222-050	GUIDE RING INSERTION KIT (1.27 MM)
102222-0562	GUIDE RING INSERTION KIT (1.43 MM)
102222-062	GUIDE RING INSERTION KIT (1.57 MM)
102222-085	GUIDE RING INSERTION KIT (2.16 MM)
102222-116	GUIDE RING INSERTION KIT (2.95 MM)
102222-120	GUIDE RING INSERTION KIT (3.05 MM)
102222-121	GUIDE RING INSERTION KIT (3.07 MM)
102222-125	GUIDE RING INSERTION KIT (3.18 MM)
102222-146	GUIDE RING INSERTION KIT (3.71 MM)
102222-163	GUIDE RING INSERTION KIT (4.14 MM)
102222-170	GUIDE RING INSERTION KIT (4.32 MM)
102222-183	GUIDE RING INSERTION KIT (4.65 MM)
102222-187	GUIDE RING INSERTION KIT (4.75 MM)
102222-188	GUIDE RING INSERTION KIT (4.78 MM)
102222-200	GUIDE RING INSERTION KIT (5.08 MM)
102222-217	GUIDE RING INSERTION KIT (5.51 MM)
102222-237	GUIDE RING INSERTION KIT (6.02 MM)
102222-250	GUIDE RING INSERTION KIT (6.35 MM)
102222-259	GUIDE RING INSERTION KIT (6.58 MM)
102222-281	GUIDE RING INSERTION KIT (7.14 MM)
102222-285	GUIDE RING INSERTION KIT (7.34 MM)
102222-292	GUIDE RING INSERTION KIT (7.42 MM)
102222-298	GUIDE RING INSERTION KIT (7.57 MM)
102222-312	GUIDE RING INSERTION KIT (7.92 MM)
102222-312-L	GUIDE RING INSERTION KIT (7.92 MM)
102222-325	GUIDE RING INSERTION KIT (8.26 MM)
102222-337	GUIDE RING INSERTION KIT (8.56 MM)
102222-342	GUIDE RING INSERTION KIT (8.69 MM)
102222-350	GUIDE RING INSERTION KIT (8.89 MM)
102222-359	GUIDE RING INSERTION KIT (9.12 MM)
102222-375	GUIDE RING INSERTION KIT (9.53 MM)
102222-400	GUIDE RING INSERTION KIT (10.16 MM)
102222-425	GUIDE RING INSERTION KIT (10.80 MM)
102222-437	GUIDE RING INSERTION KIT (11.10 MM)
102222-437-L	GUIDE RING INSERTION KIT (11.10 MM)
102222-438	GUIDE RING INSERTION KIT (11.13 MM)
102222-450	GUIDE RING INSERTION KIT (11.43 MM)
102222-455	GUIDE RING INSERTION KIT (11.56 MM)
102222-457	GUIDE RING INSERTION KIT (11.61 MM)
102222-458	GUIDE RING INSERTION KIT (11.63 MM)
102222-474	GUIDE RING INSERTION KIT (12.04 MM)
102222-474-L	GUIDE RING INSERTION KIT (12.04 MM)
102222-478	GUIDE RING INSERTION KIT (12.14 MM)
102222-500	GUIDE RING INSERTION KIT (12.70 MM)
102222-500-L	GUIDE RING INSERTION KIT (12.70 MM)
102222-530	GUIDE RING INSERTION KIT (13.46 MM)
102222-557	GUIDE RING INSERTION KIT (14.15 MM)
102222-562	GUIDE RING INSERTION KIT (14.27 MM)
102222-562-L	GUIDE RING INSERTION KIT (14.27 MM)
102222-563	GUIDE RING INSERTION KIT (14.30 MM)
102222-573	GUIDE RING INSERTION KIT (14.55 MM)
102222-625	GUIDE RING INSERTION KIT (15.86 MM)
102222-625-L	GUIDE RING INSERTION KIT (15.86 MM)
102222-680	GUIDE RING INSERTION KIT (17.27 MM)
102222-687	GUIDE RING INSERTION KIT (17.45 MM)
102222-687-L	GUIDE RING INSERTION KIT (17.45 MM)
102222-750	GUIDE RING INSERTION KIT (19.05 MM)
102222-750-L	GUIDE RING INSERTION KIT (19.05 MM)
102222-751	GUIDE RING INSERTION KIT (19.08 MM)
102222-781	GUIDE RING INSERTION KIT (19.84 MM)
102222-781-L	GUIDE RING INSERTION KIT (19.84 MM)
102222-809	GUIDE RING INSERTION KIT (20.55 MM)
102222-812	GUIDE RING INSERTION KIT (20.62 MM)
102222-812-L	GUIDE RING INSERTION KIT (20.62 MM)
102222-813	GUIDE RING INSERTION KIT (20.65 MM)
102222-875	GUIDE RING INSERTION KIT (22.23 MM)
102222-875-L	GUIDE RING INSERTION KIT (22.23 MM)
102222-937	GUIDE RING INSERTION KIT (23.80 MM)
102222-937-L	GUIDE RING INSERTION KIT (23.80 MM)
102222-947	GUIDE RING INSERTION KIT (24.05 MM)
102222-1000	GUIDE RING INSERTION KIT (25.40 MM)
102222-1000-L	GUIDE RING INSERTION KIT (25.40 MM)
102222-1031	GUIDE RING INSERTION KIT (26.19 MM)
102222-1062	GUIDE RING INSERTION KIT (26.97 MM)
102222-1063	GUIDE RING INSERTION KIT (27.00 MM)
102222-1063-L	GUIDE RING INSERTION KIT (27.00 MM)
102222-1219	GUIDE RING INSERTION KIT (30.96 MM)
102222-1219-L	GUIDE RING INSERTION KIT (30.96 MM)
102222-1313	GUIDE RING INSERTION KIT (33.35 MM)
102222-1375	GUIDE RING INSERTION KIT (34.93 MM)
102222-1531	GUIDE RING INSERTION KIT (38.89 MM)
102222-1531-L	GUIDE RING INSERTION KIT (38.89 MM)
102222-1563	GUIDE RING INSERTION KIT (39.70 MM)
102222-1593	GUIDE RING INSERTION KIT (40.46 MM)

Guide ring insertion kits with –L extension on the ordering code are for guide rings larger than 8".

5. TROUBLESHOOTING

5.1 Operation problems

Should you experience a malfunction from your machine, please consult the trouble-shooting sections below first, and complete some basic checks.

If the machine malfunction cannot be corrected with these measures, contact your Kemppi maintenance service workshop.

The problems listed and the possible causes are not definitive but serve to suggest some standard and typical situations that may present during normal environmental use when using the A7 TIG Orbital System 300.

Problem:	*Check the following:*
Machine won't work	• Check that mains plug is connected correctly. • Check that mains power distribution is switched on. • Check the mains fuse and or circuit breaker. • Check that power source 0/I switch is ON.
Dirty, poor quality weld	• Check shielding gas supply. • Check and set gas flow rate. • Check gas type for application. • Check that correct welding program is selected.

5.2 Root-pass refinement for horizontal pipe (5G position)

The following information is meant as a general guideline for an inexperienced operator. These guidelines allow you to become familiar with the equipment and do limited weld development while developing your own technique. It is important to remember to record any and all changes made to the weld procedure.

Problem	*Possible solution*
Excessive reinforcement from 2 o'clock to 11 o'clock	• Increase wire speed 50 mm/min (2 inches/min) maximum increments at a time. • Increase travel speed 3 mm/min (0.125 inches/min) maximum increment at a time. • Decrease high pulse current if pulse technique is used alternately. • Decrease low pulse current (% of high pulse current) or increase low pulse time to 0.2 seconds maximum.
OD of root-pass bead excessively convex	• Decrease wire speed 50 mm/min (2 inches/min) maximum increments at a time. • Decrease travel speed 3 mm/min (0.125 inches/min) increment at a time. • Increase current. If using pulse mode, increase low pulse current (% of weld current) or decrease low pulse time 0.2 seconds max per change.
ID penetration is insufficient	• Decrease wire speed 50 mm/min (2 inches/min) maximum increments at a time. • Decrease travel speed 3 mm/min (0.125 inches/min) increment at a time. • Increase current. • Change prep geometry: As a last increase land extension length for J-Prep. Increase bevel geometry included angle for standard V-bevel (Increase 37.5º sidewall angle to 45º). • Change tungsten electrode geometry: Use a greater included angle tip geometry.
ID bead concave 360º around pipe	• Decrease current. • Increase wire speed. • Increase travel speed. • Change prep geometry. • Change tungsten geometry.
ID bead uniform except concavity at 5 o'clock to 7 o'clock	• Decrease arc length. • Increase wire speed. • Increase travel speed.
Consumable insert not completely consumed	• Increase current or high pulse current if using pulsing. • Decrease travel speed. • Increase low pulse current (increase % of high pulse current). • Increase high pulse time. • Decrease low pulse time.
Consumable insert ID bead not uniform	• Decrease current. • Increase travel speed. • Change tungsten geometry. • Change insert fit-up if possible.

5.3 Common weld defects: identification and prevention

Problem	*Possible solution*
High frequency but no weld current	Check for broken electrode or ground cable in the weld head, handle, or in the cable.
Defects in butt welds	
Lack of penetration with workpiece in horizontal (5G) or vertical (2G) positions	• Insufficient current • Rotation speed too high • Contaminated gas, insufficient gas or wrong gas • Arc gap too great, wrong tungsten tip configuration or Contaminated/worn tungsten electrode • Gas flow too high • Arc not on the joint • Tube wall dimensional variation • End of tube not square • Too much gas on I.D. or no I.D. purge • Tubes not cleaned
ID location	• Increase rotation delay or increase Level 1 amps • Increase weld current or decrease weld head speed • Use next weld level 2 to increase amps • Downslope starting too soon; increase time at last level or use Start position to initiate downslope.
Concavity (suck-back) or excessive penetration	All ID locations • Weld current too high • Rotation speed too low • Tubes not tightly butted together • Tubes ends not square • ID purge gas pressure too high; create larger gas exit hole
Over-penetration	General Over penetration is most common through the 12 o' clock position in horizontal (5G) welding. • Increase rotation speed • Decrease weld current • Contaminated or improper gas • Gas flow too high • Tungsten arc gap may have changed or tungsten configuration has changed • Weld head not in calibration • Tubes not tightly butted • Tube ends not square ID location • Rotation delay period too long, too much weld current or rotation to low • Increase speed or decrease current. • Current too high in weld level or may need to change to another level with reduction in current.
Porosity or improper gas coverage	• Contaminated gas or improper gas • Oil, dirt or other contaminant on tube ID/OD. • Hole in gas line aspirating air • Pre-purge/post-purge time too short • Poor welding tube alloy • Gas flow rate ID or OD too low

5.4 Warnings/error messages

Certain internal and external problems will result in error messages and in some cases further actions. For example:

- If you attempt to start a weld without the flow of shielding gas, pressing the start weld switch will result in an error message. The weld start sequence will be terminated.
- If gas flow is interrupted during the weld sequence, welding will be terminated and the indicated error message will say: "Weld Aborted: Check Gas Supply".

Message during welding	
1. Welding Aborted	Check gas supply
2. Welding Aborted	Check water cooler, hoses and connections.
3. Arc Strike failure	Reload when ready.
4. Arc failure	Reload when ready.
5. OSC Out of Limits	Comments shown in level screen during welding.
6. OSC Maybe Jammed	Comments shown in level screen during welding.
7. OSC Out of Limits and Jammed	Comments shown in level screen during welding.
8. Master Slave Comm Error	Check master slave board
9. Slave Reset Error	Check slave board

Communication Error between Pendant and Controller	
Communications failure	Press Main to try again or call Kemppi for help

Message during creating, editing, copying, deleting and setup	
1. Autoprogram Failure	Improper head selected; select 300-series weld head.
2. Autoprogram Failure	Wall thickness and OD must be greater than zero.
3. Autoprogram Failure	Wall thickness must be less than pipe radius.
4. Autoprogram Failure	OD and/or wall thickness is out of range for the selected weld head.
5. Program Failure	This weld head is not supported by current software.
6. New Weld Creation	Guide ring factor must be greater than zero with the selected weld head.
7. New Weld Creation	Guide ring factor must be less than 1638 with the selected weld head.
8. New Weld Creation	OD should be less than 163 inch with the selected weld head.
9. New Weld Creation	OD should be less than 4140 mm with the selected weld head.
10. Autotack Failure	Improper weld head selected; must be R or C head.

Comment: creating or editing weld program	
11. Autotack Failure	Wall thickness and OD must be greater than zero.
12. Autotack Failure	Wall thickness must be less than pipe radius.
13. New Weld Creation	Amperage must be less or equal to 200.
Comment: creating or editing C, 150xx weld head welding program	
14. New Weld Creation	Amperage must be less or equal to xxx.
Comment: xxx is 200 for 300-series is the selected current.	
15. New Weld Creation	Travel Spd must be less than xxx IPM.
Comment: XXX is the maximum speed allowed for the selected weld head.	
16. New Weld Creation	Travel Spd must be less than xxx RPM.
Comment: XXX is the maximum speed allowed for the selected weld head.	
17. New Weld Creation	Wire Spd must be less than xxx IPM(### mm/m).

Comment: XXX or ### is the maximum speed allowed for the selected weld head.	
18. New Weld Creation	AGC must be less than 15.
Comment: If in AVC mode, message is "AVC must be less than 20".	
19. New Weld Creation	AGC must be greater than 1.
Comment: If in AVC mode, message is "AVC must be greater than 4".	
20. Error	To pulse downslope, last pass must have pulsing on.
21. New Weld Creation	Travel speed must be less than xxx IPM (### mm/m)
Comment: creating or editing general weld program for 300-series weld head	
22. New Weld Creation	OSC Amp must be greater than 1.01 mm.
23. New Weld Creation	OSC Amp must be less than 17.08 mm.
24. New Weld Creation	OSC Speed must be less than xxx IPS (### mm/m).

Comment: xxx/### is maximum OSC speed for the selected weld head.	
25. New Weld Creation	OSC Speed must be greater than xxxIPS (### mm/m).
Comment: xxx/### is maximum OSC speed for the selected weld head.	
26. Copying Weld Failure	Weld on USB can't copied to protection zone directly.
Comment: user sets protection zone for the weld program.	
27. Weld Counter Failure	Weld counter save fails; go back to try again (ECU01).
Comment: or ECU02	
28. Language Save Failure	Language save fails; go back to try again (S01).
Comment: save language option, code could be S02.	
29. Language Change	Language has changed; reboot machine.
30. Password Set Failure	Weld protection enabled; user password cannot be set.
Comment: weld password protection mode	
31. Data Save Failure	Calibration save fails; go back to save again (ECA01).

Comment: travel or wire calibration, code ECA02 for backup file	
32. Program Failure	Failure to save weld program under teach mode.
Comment: teach mode, save weld.	
33. Not applicable	
34. Operating Mode Change Fail	BEMF Mode is not supported for Slave2; go back to change selection.
Comment: Emergency mode for version 1.88 ~1.92	
35. Data Save Failure	Data save failure ESL02; go back to Main menu and try again.
Comment: save options	
36. Operating Mode Change	Operating mode has changed; reboot the machine.
Comment: BEMF or Encoder mode	
37. Weld Number xxx Pass Maintenance Error	You cannot add and delete at the same time.

Comment: add and delete pass.	
38. Weld Number xxx Pass Maintenance Error	Last pass cannot be deleted.
39. Weld Number xxx Pass Maintenance Error	No more passes to add
40. File Exists, unable to copy	
Comment: copy weld program	
41. File Copy Failed, file exists?	
Comment: copy weld program	
42. Delete Failed, file open?	
Comment: delete weld program.	
43. Load Failure	Load failed; no such weld xxx
Comment: when loading next weld program if the next weld program is set wrong.	
44. Load Failure	File format error

Comment: wrong format weld program; old weld program	
45. Load failure	Go to library, review and resave weld.
Comment: because of old weld program.	
46. Load Failure	Error, time out to get response ###e-4
Comment: ### is a weld program number	
47. Load Failure	Failure to send weld. Check cables(# xxxe-3).
Comment: xxx is a weld program number	
48. Load Failure	S controller not alive, error xxxe-5
Comment: xxx is a weld program number; controller is not completely run as slave1 in update state.	
49. Pendant Configuration Fail	Data save failure EPC02; go back to Main menu and try again.
Comment: code could be EPC03.	
50. Pendant Configuration Done	Remote control configuration has changed; reboot the machine.

5.5 Checking machine setup during booting

1. Master RCM3209 Set Fail	Master Rabbit is RCM3200 in controller; change and try again.
2. Master RCM3200 Set Fail	Master Rabbit is RCM3209 in controller; change and try again.
3. Not applicable	
4. Not applicable	
5. Wrong S2 BEMF Driver board	Remote configuration is BEMF & ENCODER; change and try again.
6. Wrong S2 BEMF Driver board	Remote configuration is ENCODER; change and try again.
7. Wrong S2 BEMF & ENCODER Driver board	Remote configuration is BEMF; change and try again.
8. Wrong S2 ENCODER Driver board	Remote configuration is BEMF; change and try again.
9. Data Load Failure	Check and set weld counter.
10. Data Load Failure	Language was reset to English; reselect language.
11. Data Load Failure	Calibration record was reset; contact Kemppi for support.
12. Data Load Failure	Calibration was reset; run travel and wire calibration again.
13. Data Load Failure	Test mode, unit or print set was reset; go to Option and Print Weld to check again.
14. Default Head Change	The default weld head was reset to D Head; press Next to continue.
15. Data Load Failure	Machine SN was reset to default; contact Kemppi for support.
16. Data Load Failure	Machine Data is reset to default; contact Kemppi for support.
17. Weld Counter Failure	Reboot machine and try again.
18. Wrong Arc Strike Method	Reboot machine and try again.

5.6 Machine system messages

1. Disk full warning	The space available on the disk is too small; download printed weld or QC file!
2. Update Failure	Memory stick is not ready; check and update again.
3. Update Failure	Wrong memory stick for the USB; check USB stick and update again.

5.7 Controller unit fault conditions

Certain fault conditions will cause the arc to be immediately terminated or prevent arc strike during weld initiation. Examples of faults that will cause this to occur are:

- Insufficient water flow
- Insufficient gas flow
- Arc voltage too high
- Arc voltage too low
- Contact of tungsten electrode with work piece
- Any arc outage

6. MAINTENANCE

When considering and planning routine maintenance, please consider the frequency of machine use and the working environment.

Correct operation of the machine and regular maintenance will help you avoid unnecessary downtime and equipment failure.

⚠ *Disconnect the machine from the mains before handling the electrical cables.*

6.1 Preventing tungsten electrode rotation not concentric to tube OD

To avoid inconsistent penetration and weld bead width, do the following:

- Maintain an equal gap ± 0.1mm Total Indicated Runout (TIR) as tungsten rotates around the workpiece.
- Specify collets to ± 0.5mm when ordering.

To avoid run out as the tungsten rotates around the tube ends, use external alignment clamp or extended collets.

6.2 Periodic maintenance

ⓘ *Periodic maintenance should only be carried out by a suitably qualified person. Disconnect the plug of the machine from the mains socket and wait about 2 minutes (capacitor charge) before removing any parts.*

Check at least every half year:

- Electric connectors of the machine – clean any oxidized parts and tighten loose connections.

ⓘ *Do not use compressed air for cleaning as there is a risk that the dirt will compact even more tightly into gaps of cooling profiles.*

ⓘ *Do not use pressure washing devices.*

ⓘ *Only an authorized trained electrician should carry out repairs to Kemppi machines.*

Calibration

Calibrate the system every twelve (12) months. Contact Kemppi service for detailed instructions.

6.3 Weld head maintenance

Field maintenance of the 300 series weld heads is minimal. There are no repetitive lubrication requirements within the weld head as all bearings are self-lubricated or dry. Gears are pre-lubricated at assembly or run dry due to low speeds and light loads.

Consult the factory if any apparent internal machine package problem develops. While field maintenance, such as motor replacement, is possible with standard hand tools, some complex sequences, techniques, and adjustments may require specific procedures. Contact Kemppi to provide rapid turn-around service for all equipment.

6.3.1 External maintenance

The roller chain uses sealed, permanently lubricated roller bearings, and no lubrication is required. Inspect and clean the oscillation shaft, on which the torch and AGC mechanism mount, to remove any debris or weld spatter.

6.3.2 Low profile kit installation

To achieve the minimum radial clearance of 51 mm (2"), you must change two components on the weld head.

- Filler wire spool mount; and
- Torch back cap.

The standard 1 kg. filler wire spool is mounted to the weld head with one socket head screw.

1. Remove the screw using the hex driver supplied in the tool kit.
2. Replace this with the special 0,5 kg. low profile spool mount.
3. Replace the torch back cap with Plug P/N 102727-1 to obtain a minimum radial clearance.

6.3.3 Torch cable replacement

You can replace the torch cable in the field if necessary. Exceedingly worn or damaged torch cables can be rebuilt by the factory.

1. Remove the grey PVC cover from the rear of the tractor housing by removing the Allen head screws retaining it in place.
2. Remove the round PVC cap from the back end of the tractor housing.
3. Also remove the small PVC retaining clamp from the forward end of the tractor housing.
4. Remove the torch and insulator block from the AGC bracket by removing the two flat socket head screws.
5. Disconnect the water inlet line where it enters the rear of the machine package housing by unthreading the brass collar.
6. Remove the hose off the barbed fitting.
7. Disconnect the hose where it exits the front end of the machine housing on its way to the torch. Use a flat bladed screwdriver to unscrew the brass fitting.
8. Gently pull the connector out of the cavity at the rear of the tractor housing.
9. Disconnect the connector.
10. Remove the old torch cable.
11. Reinstall the new torch cable by positioning the hoses in the appropriate machined grooves on the tractor housing and reversing the procedure outlined above.

6.3.4 Maintenance of the wire feed nozzle

Occasionally the wire feed nozzle can become clogged up by metal shavings and other debris brought in by the filler wire passing through it.

- Clean or replace the filler wire nozzle if this occurs.

The symptom of this problem is erratic wire exit from the wire nozzle, especially when using copper-coated wire as the coating can flake off under the pressure of the wire feeder drive roll.

Occasionally clogging results from the misalignment of the wire as it enters the ire feed mechanism.

1. Check to see that the short segment of filler wire conduit is properly lined up with the "V" machined in the drive roll.
2. If this is not the case, reposition the conduit by loosening the clamp retaining it and then retightening.

6.3.5 Water cooler maintenance/flushing procedure for the torch cable

- Flush the radiator-type water cooler used with this system periodically.
- Use algaecide to prevent growth occurring in the tank (in areas, where this is found problematic).

You can usually remove a blockage by reversing the inlet and outlet fittings of the torch cable and flushing the torch cable. The normal flow rate of water through a new torch cable is 0.6 l/min.

If reservoir water temperature is higher than normal or the body of the weld head feels hotter than normal, the water flow through the torch cable may have diminished. This may happen if algal growth has occurred in the reservoir or in some cases where the local water supply has an excess of soluble minerals. In severe cases:

- Return the torch cable to the service for replacement of the hoses.

6.3.6 Maintenance of torch components

- The torch is designed to accept standard expendable parts.
- The collet bodies, collets and gas cups are expendable components that must be periodically inspected and replaced.
- For proper operation of the Arc Gap Control System (AGC), the tungsten electrode must be gripped tightly within the torch.

When installing the tungsten electrode, tighten the collet body "snug" with the back-cap or a collet wrench. Excessive tightening will deform the collet, ultimately resulting in a poor contact between the tungsten and the collet.

- If the collet is deformed, replace it.
- Use a gas-lens-type collet body for all applications permitting the greater size gas cup as compared with the split-type collet bodies.
- The gas-lens-type collet bodies give better gas coverage of the weld, especially in drafty situations as compared to the spud type.

If weld spatter or oily residue locks the fine mesh screens of the gas-lens collet body, replace the collet body. Symptoms of a blocked collet body:

- weld porosity
- blackening of the tungsten or weld surface
- erratic AGC movement.

1. Thread up the ceramic gas cup over the collet body until it seats on the rubber surface of the torch body.

If the gas cup is not seated completely, this can result in aspiration of oxygen into the shielding gas and subsequent porosity in the weld. If weld spatter prevents easy threading of the gas cup, replace it.

When the torch back-cap cannot be used, use the collet wrench supplied in the tool kit to tighten the collet body. Finger-tight installation of the collet body is not enough for good electrical contact.

2. Use the collet body supplied as part of the tool kit (included in the weld head package) at all times when installing a tungsten electrode. Some manufacturers of collet bodies have removed the wrenching flats from the standard gas-lens collet bodies. If this is the case, you can purchase collet bodies with wrenching flats from Kemppi.

6.3.7 Cleaning the weld head

Clean weld head periodically to maintain maximum operating efficiency. Keep the unit free of moisture, debris, and other contaminants (oil, water, abrasives, etc.) that can affect normal operation and weld consistency.

- Clean insulating components with a soft brush and a fast drying solvent, such as acetone or denatured alcohol.
- Clean drive gear assemblies using a fine wire brush and solvent. Inspect the drive gear, bevel gear, and rotor assembly to insure that debris have not damaged the rotor sprocket lobes and affected the operation of the drive assembly. Use a fine jeweler's file to repair.
- Clean the body with a cloth or soft brush and solvent.
- Clean the collets with fine stainless steel wool or fine wire brush.

Only use stainless steel, as regular carbon steel will ruin the surface passivation. All parts must be completely dry before reassembly.

6.3.8 Internal arcing

Dirt and impurities in the weld head may cause internal arcing. This is a situation where the arc jumps from the tungsten electrode to the collet frame and the welding arc fails to ignite.

When internal arcing occurs, a track of carbon is left on the dielectric material, which may cause the same problem to occur again.

To prevent internal arcing, do the following:

- Periodically clean the weld head according to instructions given above in section "Cleaning the weld head".
- Maintain the tungsten electrode in good working condition at all times.

Remember that the collet frame and collets are connected to the ground cable and act as the ground contact for the electrical circuit.

If internal arcing does occur, do the following:

- Carefully scrape all burn marks from the plastic body with a razor blade or other sharp scraping tool.
- Remove all carbon and polish with a fine wire brush.
- Remove all carbon off the collet frame and collets with a fine wire brush.
- Remove the rotor gear and polish if necessary with a fine wire brush to remove any traces of arcing.
- Clean with alcohol or other suitable solvent and a lint free cloth before reassembling.

6.4 Printer operation and maintenance

The printer is mounted in the front panel of the controller unit allowing program parameters and other data to be printed. The printouts will remain stable for five (5) years, and they are suitable for archival purposes if they are suitably stored. This printer uses Thermal Paper SP800692.

6.4.1 Installing paper in the printer

To install paper in the printer, do the following:

1. Open the hinged plastic cover over the paper roll.
2. Remove the empty roll.
3. Replace with a new roll oriented so that the paper is feeding off the bottom of the roll.
4. Lower the plastic cover until it "clicks".

6.4.2 Cleaning the printer

- The surface of the printer can be cleaned using a soft dry cloth or a soft cloth with a neutral detergent.
- Do not clean using any solvents.
- Never wet the inside of the printer.

6.5 Service Workshop maintenance

Kemppi Service Workshops complete maintenance according to their Kemppi service agreement.

The major points in the maintenance procedure are listed as follows:

- Cleaning of the machine
- Checking and maintenance of the welding tools
- Checking of connectors, switches and potentiometers
- Checking of electric connections
- Checking of mains cable and plug
- Damaged parts or parts in bad condition are replaced by new ones
- Maintenance testing.
- Operation and performance values of the machine are checked, and when necessary adjusted by means of software and test equipment.

Software loading

Kemppi Service Workshops can also test and load firmware and welding software.

7. DISPOSAL

Do not dispose of electrical equipment with normal waste!

In observance of European Directive 2002/96/EC on waste electrical and electronic equipment, and its implementation in accordance with national law, electrical equipment that has reached the end of its life must be collected separately and taken to an appropriate environmentally responsible recycling facility.

The owner of the equipment is obliged to deliver a decommissioned unit to a regional collection centre, as per the instructions of local authorities or a Kemppi representative. By applying this European Directive you will improve the environment and human health.

And you know.

KEMPPI