PIPA
PLASTICS INDUSTRY
PIPE ASSOCIATION
OF AUSTRALIA LIMITED

INDUSTRY GUIDELINES
POP001 A
Guide to Electrofusion Assembly and Welding

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POP001A GUIDE TO ELECTROFUSION ASSEMBLY AND WELDING

The purpose of this guide is to provide step by step instructions on industry best practice techniques for the safe and reliable joining of PE pipe using electrofusion jointing. This guide should be read in conjunction with POP001 Electrofusion Jointing of PE pipes and fittings for pressure applications.

Good fusion results in high strength and ductility at the interface between the pipe and the fitting. To achieve this, every step of the electrofusion process must be completed in full.

- Trained and competent welders (refer to POP001 Section 4.0 Welder Certification and Training)
- Correct and well-maintained tools and equipment (refer to POP001 Section 5.0 Tools and Equipment)
- Quality plans & recording keeping (refer to POP001 Section 8.0 Quality Control Records)

Each section of this guide provides assembly and installation of different types of EF assemblies:

SECTION 1 – EF SOCKET ASSEMBLY AND WELDING

PREPARE THE SITE AND CLEAN THE PIPE

Refer to section 6.2 Setting up the site to manage environmental conditions of POP001 Electrofusion Jointing of PE Pipes and Fittings for Pressure Applications

1. Plan and set up the site conditions

Prepare necessary machines, tools and components for the installation. Ensure sufficient clearance and cleanliness around the pipe in the working areas. Use appropriate cover to protect the weld assembly, particularly if high levels of sunlight or rain are forecast.

Keep EF fittings in their packaging at this stage.

Electrofusion fittings should only be removed from their packaging directly before the jointing process.

2. Pre-clean the pipe surface

Remove dirt, mud and other debris from the pipe end to prevent contamination and reduce wear on the mechanical peelers and cutting tools. Clean water and a 100% cotton rag can be used, but the pipe components must be dry before starting the installation process.

INSPECTION AND MEASUREMENT OF THE PIPE

Refer to section 6.3 Inspection and measurement of the pipe of POP001Electrofusion Jointing of PE Pipes and Fittings for Pressure Applications

3. Check the pipe surface for damage

Gouges in the weld zone can undermine the EF joint. The weld surface should be as smooth as possible, without excessive gouges or abrasion marks.

Some gouges can be removed during peeling (see step 10). If deep gouges are present, the damaged pipe ends need to be cut off.

4. Check the pipe outside diameter (OD)

Accurately measure the pipe outside diameter (OD) in the weld zone using a Pi tape or diameter tape.

The pipe OD should be no less than the DN printed on the pipe. For example, a DN125 pipe must have an OD of no less than 125mm.

5. Check the pipe end reversion

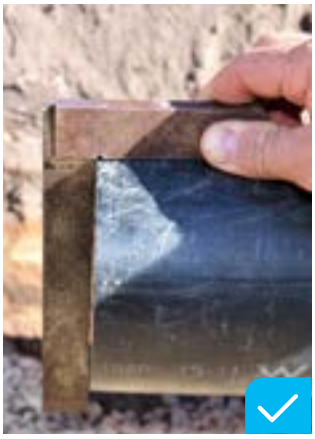
Place a straight edge (either a steel ruler or spirit level) on the pipe end. An excessive gap between the straight edge and the pipe surface that extends into the weld zone can compromise weld integrity.

Pipe ends with an excessive gap (reversion) should be cut off.

Use the following calculation to determine if the reverted pipe end can be welded:

Measure the distance equivalent to DN x 5% from the pipe end. At this position, the pipe OD must be no smaller than the DN.

Once the pipe end has been cut, prepare and carry out the weld as soon as possible.



6. Check the pipe end is cut square

An angled pipe end may reduce contact between the pipe and fitting weld zone, reducing weld integrity. Use a builder's square tool to ensure the pipe end is square. If necessary, recut to create a square end.

7. Check pipe ovality

Pipe can become oval during manufacture or while in storage. Ovality can create an uneven annular gap between the pipe and fitting. Excessive gaps can comprise the weld integrity.

Using a ruler or measuring tape find the minimum OD, which will usually be at right angles to the maximum OD. Mark these positions on the pipe.

The difference between the minimum and maximum OD should be no more than the limits in Table 1: Ovality and Flat Spots in POP001. If the limits in Table 1 are exceeded, re-rounding tools will be required to re-round the pipe.

8. Check pipe surface for flat spots

Pipe surfaces may have flat spots that are difficult to identify with the naked eye. Use a pipe ovality gauge to check the pipe circumference.

Flat spots can cause large gaps between the pipe and fitting and difficulty with peeling with mechanical peeling tools. The maximum allowable flat spot depth is 3mm. Refer to Table 1: Ovality and Flat Spots in POP001

JOINT PREPARATION

Refer to section 6.4 Joint Preparation of POP001Electrofusion Jointing of PE Pipes and Fittings for Pressure Applications

9. Mark the peel length on the pipe

Measure the length of the fitting and divide by 2 then add 20mm. Mark this length from the end of the pipe.

The additional 20mm enables a visual check that peeling has been performed with a mechanical peeling tool.

10. Peel the pipe surface

A minimum layer of 0.2mm thickness must be removed from the pipe surface for successful electrofusion jointing. Mechanical peeling tools are designed to remove the correct peel thickness evenly around the pipe circumference. Hand scrapers must not be used for peeling; however these can be used to debur the ends of pipes prior to welding.

Measure the peel strip thickness with a micrometer or calliper, ensuring the minimum required peel depth has been uniformly removed from the pipe surface.

For larger diameter pipes, it may be necessary to remove additional material with more than one rotation of the peeling tool. Ensure that the minimum pipe OD after peeling is not less than that in Table 3: Minimum pipe OD after Peeling in POP001.

Visually inspect the peeled surface. If any scores or gouges are still present, peel again to remove.

Peeled pipe should be welded immediately after preparation to prevent the surface from oxidising again.

11. Clean the weld zone with alcohol wipes

Use fitting manufacturer approved Isopropanol or ethanol-soaked wipes to clean the weld zone.

Wipe away from the pipe end (in the direction shown by the arrow in the picture on the left) to prevent contamination of the weld zone. Make sure any parts of the wipe handled by the installer do not touch the weld zone.

Do not remove the peel length witness mark.

12. Mark the 'Insertion Depth' on the pipe

Measure 20 mm back from the peel length witness mark toward the pipe end, avoiding touching the peeled pipe surface.

Make a mark at this point. This is the insertion depth witness mark of the fitting.

If re-rounding tools are needed as shown in the image on the left (see Table 1) install the re-rounding tool at the witness mark.

13. Slide the fitting onto the pipe

Cut open one end of the plastic bag the fitting is supplied in.

Wipe the inner surface of the fitting with an alcohol wipe if necessary.

Allow the alcohol to evaporate off the pipe and fittings surfaces and slide the fitting onto the pipe end to the insertion depth mark.

14. Repeat steps 2 to 12 on the other pipe end

15. Fit the second pipe

Slide the second pipe end into the opposite end of the fitting, ensuring the pipe ends are inserted the full depth into the fitting socket, aligning with the witness mark.

16. Alignment

Alignment clamps restrain the joint assembly, ensuring it is free of stress, preventing pipe misalignment and movement during welding and cooling phases.

Alignment clamps prevent angles between the pipe and fitting surfaces. Angles create gaps and excessive gaps and compromise weld strength.

THE ELECTROFUSION PROCESS

Refer to section 6.5 The electrofusion process of POP001 Electrofusion Jointing of PE Pipes and Fittings for Pressure Applications.

17. Begin electrofusion welding

- Ensure the generator has sufficient fuel to complete the weld.
- Start the generator. When the generator RPM has stabilised, connect the generator to the EF welding machine. Connect the leads from the EF welding machine to the fitting.
- Using the barcode scanner supplied with the EF welding machine, scan the fitting fusion barcode. Check that the welding time and voltage marked on the fitting label/barcode match the weld time and voltage displayed on the EF welding machine display.
- Start the fusion process.

If the generator cuts out during the weld cycle, some manufacturers advise rewelding of the fitting once it has cooled down to ambient temperature.

Other manufacturers may require the fitting to be cut out and replaced. If in doubt, consult the fitting manufacturer.

Never reweld the fitting before it has cooled to ambient temperature. Rewelding while the fitting is hot can overheat the fitting, which will cause damage to the PE material and may also cause a fire.

Note: the time for the complete assembly to cool below 45 deg C could be up to 24 hours depending on fitting size and environmental conditions.

18. Make timing marks

Mark the relevant fusion parameters on the pipe surface – date, start and end times of the weld, cooling time and welder name. Update the site documentation.

19. Wait for cooling time to elapse

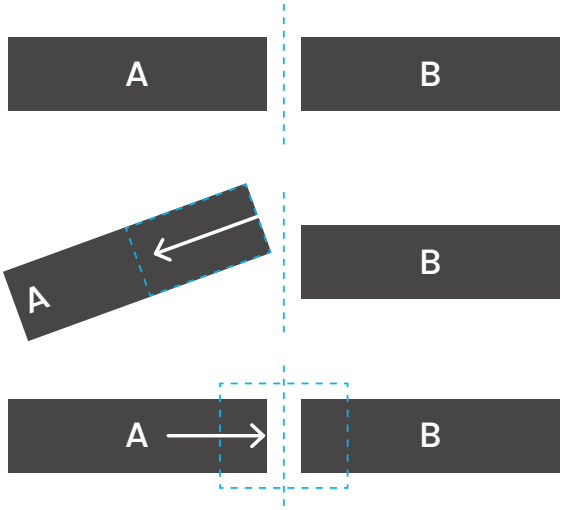
At the end of the weld time, wait for the full cooling down time stated on the fitting label to elapse before removing the welding terminals, re-rounding tools and/or alignment clamps.

20. Remove pipe re-rounding tools and alignment clamps and complete checks.

- Remove pipe re-rounding tools and alignment clamps from the joint.
- Check the welding machine has completed the weld cycle and no error messages are displayed.
- Inspect the fitting socket to ensure that molten polyethylene has not escaped from the socket. In addition, heating wires should not be visible or displaced between the socket annular gap.
- Check that the melt indicator pins have risen. These small plastic pins should rise during the weld cycle.
- Check the pipe has not moved during welding by ensuring the insertion depth mark is in the same position during joint assembly.
- If any faults are observed, consult the fitting manufacturer.

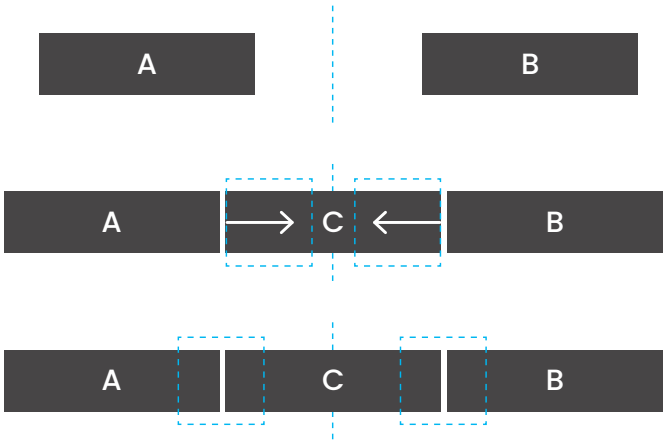
SECTION 2 – ELECTROFUSION SLIP COUPLINGS

Pipe ends are sometimes butted against one another and require jointing using a slip coupling installation method. When using slip couplings in addition to the steps in Section 1 the following steps must also be taken into consideration.



Slip Coupling Installation – Type A

- Pipes A and B are fixed in place and butted together but unwelded.
- Pipe end A is moved aside, and a coupler (dashed) is slid onto pipe end A. The Peel Length and insertion depth on pipe A is equal to the entire length of the coupler. The peel length on pipe B is ½ the coupler length + 20mm.
- Pipe end A is moved back into alignment and the coupler is repositioned with 50% of its length on pipe A and 50% on pipe B.



Slip Coupling Installation – Type B

- Pipes A and B are fixed in place, but a gap exists between them.
- A length of 'cut in' pipe C spanning pipe between pipe ends A and B has 2 couplers slid onto both ends. The peel length and insertion depth on the cut in pipe (C) is equal to the entire length of the coupler. The peel length on pipes A & B is ½ the coupler length + 20mm.
- The two couplers are re-positioned with 50% of their length on pipe C and 50% on pipe ends A and B.

When using slip couplers, peel as close to the DN as possible (without peeling below the minimum pipe OD after peeling limit in Table 3). This allows the coupler to be slid its full length onto the pipe end without using excessive force.

Alignment clamps should be used when installing slip couplings to ensure the joint assembly is well aligned.

SECTION 3 – ELECTROFUSION SADDLES

TOP LOAD TOOL MOUNTED BRANCH SADDLES

Top load electrofusion branch saddles are typically used for large-diameter branch connections ≥ 90 mm. Applications include new installations, repair and live pressure branch connections on existing PE mains for sizes up to DN2000.

1. Prepare the joint for electrofusion jointing in accordance with section 1.

   Mount the fitting to the pipe, following the manufacturer's instructions and using the manufacturer's top load tool. Ensure positive contact is made between the pipe and saddle. The gap between the saddle and pipe surfaces should not exceed 3mm.

   Only use clamps provided by the fitting manufacturer. These are not interchangeable with other EF fitting manufacturer clamps.

2. Connect the assembled saddle fitting to the control box and commence the weld cycle, following the instructions in step 17 section 1.
3. Mark the fusion start, end and cooling times on the pipe, following the instructions in step 18 of section 1.
4. The assembled joint must remain in the top load tool clamps during electrofusion and the manufacturer's specified cooling period.

   Do not tap the saddle fittings until the manufacturer's recommended cooling time is complete.

5. Following completion of the allocated cooling time, remove the top load tool clamps and hydrostatic pressure test the saddle joint assembly in accordance with the manufacturer's instructions.

UNDERCLAMP SADDLES

1. Follow steps 1-11 in section 1 remembering to always use an ovality gauge to check pipe ovality and flat spots.
2. Without removing the fitting from its packaging, place the saddle over the required position on the pipe. Mark the pipe surface outlining the saddle base area plus 20 mm with a marker pen. This marking indicates the approximate area to be peeled.
3. Peel the electrofusion jointing fusion area, following the instructions section 1, steps 9 & 10.
4. Clean the peeled area with an alcohol wipe in accordance with section 1, step 11.
5. Remove the saddle fitting from its packaging and check that the jointing surface of the saddle fitting is clean. Wipe the fitting fusion area with an alcohol wipe if necessary. Allow the alcohol to completely evaporate before continuing joint assembly.
6. Position the saddle fitting base onto the prepared pipe surface. Bring the lower saddle into position. Gradually and equally tighten the bolts and nuts, following the manufacturer's instructions until the upper saddle makes firm contact with the prepared surface of the pipe. Carefully inspect the fitting to ensure positive contact with the pipe over the entire upper saddle contact area.
7. Connect the assembled fitting to the control box and commence the weld cycle in accordance with step 17 of section 1.
8. Mark the fusion start, end and cooling times on the pipe in accordance with step 18 section 1.
9. Allow the fused saddle assembly to remain undisturbed for the manufacturer's recommended cooling time.

   Do not tap the saddle fittings until the manufacturer recommended cooling time is complete.
10. Following completion of the allocated cooling time, hydrostatic pressure test the saddle's joint assembly in accordance with the manufacturer's instructions.

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