

Waters & Farr Technical Guide

Jointing of Polyethylene Pipes Using Electrofusion Fittings

With electrofusion fitting jointing, an integral electrical resistance element is incorporated in the socket or base of the saddle of the fitting which, when connected to an appropriate power supply, melts and fuses the materials of the fitting and inserted pipe together.

Refer to PIPA, Plastics Industry Pipe Association of Australia, guidelines POP001 for more detailed information (<http://www.pipa.com.au/documents/electrofusion-jointing-pe-pipe-and-fittings-pressure-applications>).

Necessary equipment for welding includes:

- dedicated, properly maintained, electrofusion unit capable of barcode input of welding parameters;
- power source, a nominal 240 V generator of minimum 5 kVA capacity (or more - dependent of pipe size);
- diameter tape and ruler to measure pipe outside diameter, ovality and insertion depth in the weld zone;
- pipe cutter or guided circular saw, and deburring tool;
- pipe clamps or other approved tools for restraining, aligning and re-rounding the pipes;
- pipe surface preparation tool to remove oxidized surface of the pipe (peeler);
- Isopropanol impregnated pipewipes;
- disposable lint-free material, cloth, or paper towel.

Generic guide

Use a shelter against adverse weather conditions and cover the pipe ends remote from the joint, as possible, to prevent contamination of the fusion interface or excessive cooling of the weld. Ensure that no water or other fluid can access the fusion area neither from inside nor from outside the pipe. There shall be a sufficient space to permit access to the jointing area. Electrofusion shall be performed by qualified and experienced operators.

Wipe any traces of dirt, mud, etc. from the pipe weld zone with a clean, disposable, lint-free material. Ensure that hands and tools are free from any contaminants.

1. For socket type fittings, cut the pipe ends squarely

Cut the pipe ends to be jointed square, that is, at right angles to the axis of the pipe. For larger pipe sizes, cut off "curled" factory pipe ends at a distance of one half to one pipe diameter from the end. Remove burrs and shavings.

When cutting an existing pipe, make sure that the line pressure is blocked off or vented.

Prepare pipe clamps or other means for restraining, aligning pipes and fittings, and re-rounding the pipes.

2. Measure and mark the edges of weld zone

Measure and mark on the pipe the depth of pipe penetration into the socket (place bagged fitting alongside the pipe end). Mark also the whole length of the fitting on the pipe end if the fitting has to be slid fully on the pipe for installation.

For saddle type fittings, outline the saddle base area.

Do not remove the fitting from its packaging (if any) at this stage.

3. Prepare the outer surface

Immediately prior to jointing, use a peeler to remove the outer surface of the pipe weld zone(s) (insertion piece/fitting spigots). Any traces of oxidised material remaining on the surface of the pipe will reduce the quality of the weld and may cause a leak in the pipe connection.

Remove the entire surface of the pipes slightly past the marked weld zone to a depth of 0.2-0.4 mm uniformly, avoiding gouging or removing excessive material from the pipe surface. Check lines may be made in the middle of the surface to be scraped – removing the check line while peeling ensures good cleaning. Use mirror to inspect completeness of peeling under any fixed pipe end.

Remove burrs and shavings.

Do not touch the prepared pipe areas.



4. Clean the pipe(s) and the fitting

Clean the prepared weld zone(s) wiping them with fresh Isopropanol impregnated pipewipes (ensure that they are still moist). For larger pipes, use multiple wipes. Allow the surface to dry naturally and completely.

Remove the fitting from its packaging (if any) and check that the bore of the socket or saddle base is clean. Otherwise (or if the packaging has been punctured or torn) wipe the fitting bore/base with Isopropanol impregnated pipewipes and allow it to dry naturally and completely.

When a coupler has to be slipped fully onto a pipe, clean and dry the pipe end for at least twice the length of the marked zone of fitting penetration to prevent contamination of the inner surface of the fitting during installation.

Ensure, without touching, that the prepared surfaces are completely dry before proceeding. The insertion depth or saddle base marking may be restored, if removed while cleaning.

Care should be taken not to contaminate the fusion zone again.

5. Position the fitting on the pipe(s)

Use re-rounding clamps, as necessary.

For socket type fittings, centre the fitting on the pipe ends or on the inserted pipe section, valve or tee using previously made marks. Insert the pipe ends into the socket till they are in contact with pipe stops (or till edges of the fitting reach the marked depth of pipe penetration into the fitting). When inserting a tee, a valve or a pipe section, slide couplers on the pipes completely, but not out of the previously cleaned area. The pipe penetration stops within the coupler may be removed before cleaning the bore, or sometimes may simply be sheared off by pressing on the fitting and sliding it over the pipe. Once the couplers are in place, position the pipe section, valve or tee.



Using pipe clamps, secure the fitting and pipes in place to prevent movement of the joint during the fusion and cooling cycle. Ensure that the pipes and fitting are properly aligned (with no angle between pipe axes), are not subjected to a bending stress, and are not left to support their own weight in the fitting or weight of the fitting.

For a fitting with separate fusion zones, each side of the fitting shall be fused successively.

For saddle type fittings, secure the pipe (in clamps or otherwise). Position the fitting onto the prepared area and secure (clamp) it as per fitting manufacturer's instructions. There should be no gap between the fitting and pipe.

6. Attach leads from electrofusion unit to the fitting terminals

Refer also to the operating instructions for the corresponding electrofusion units. All equipment should be well-maintained and kept in clean condition at all times.

Generator used should be of appropriate capacity, properly serviced and calibrated according to the manufacturer's recommendations. Check that there is sufficient fuel for the generator to complete the joint. Check that it is functioning correctly before connecting electrofusion unit to the generator.

Connect electrofusion unit to the power source. Start the generator and switch on the unit.

Attach the output leads from the unit to the fitting - press them all the way home. **The leads' terminals must not be loose on the fitting terminal pins.**

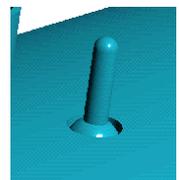
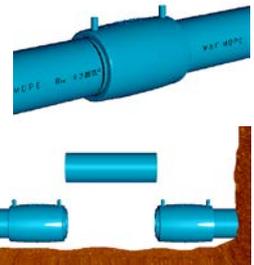
7. Fuse the pipes and the fitting.

Input welding parameters into the control unit's program by reading barcode information with the scanner or manually (nominal fusion time and voltage are printed on the fitting label). The nominal fusion time is typically suitable for welding at the ambient temperature 15°C to 25°C. Information in the barcode allows electrofusion units to adjust the fusion time automatically. For manual input, typically reduce the fusion time up to 0.3% of the nominal fusion time per 1°C of the excessive temperature, or increase the fusion time up to 0.7% of the nominal fusion time per 1°C beneath 15°C.

Activate the fusion cycle from the electrofusion unit control panel according to the unit operating instructions. Watch for faults. On completion of the heating cycle, the correct time (equal to the required fusion time shown prior to the welding) should be indicated on the control unit display.

Most fittings are equipped with fusion (melt) indicators. At the completion of the fusion cycle, indicator(s) should have risen. Differing movement of a fusion indicator may be noted dependent on welding conditions – if there is no movement, the joint may be suspicious.

If the fusion cycle terminates before completion of the fusion time, check for faults as indicated by the control unit. If the fault is equipment related, some fitting may be re-fused (check whether



fitting manufacturer permits second fusion cycle). **Do not attempt a second fusion cycle within one hour of the first attempt.** Make sure that the fusion interface is not contaminated in any way in that time.

Precaution: Observe closely the rise of the fusion indicators - if very fluid melt emerges around the pins or around the edges of the fitting, the fusion cycle should be stopped. Observe normal precautions when using electrical equipment, particularly in wet conditions, wear personal protection including face shield. We recommend to remain at least 1 m away from the fusion area to avoid burns by molten polyethylene material that may be ejected should a malfunction occur or due to high ambient temperature.

8. Disconnect leads from the fitting

Leave the joint in the clamps for the duration of the cooling time (indicated on the electrofusion unit display or shown on the fitting label; if no data is available, typical cooling time for smaller size joints is shown in the table below may be used).

Take all necessary means to prevent any movement of the joint and to avoid any stresses being applied to the joint during the cooling time duration. Restraining clamp, re-rounding or alignment tools must not be removed until completion of the cooling period. We recommend extending these restrictions to the whole duration of the waiting time, if possible.

Pipe sizes, mm		Minimum cooling time*, min.	Waiting time before applying operating pressure or full test*, min.
Nominal bore	Nominal OD		
Up to 25 (1")	Up to 32	5	10
32-40 (1¼-1½")	40-50	10	20
50 (2")	63	15	30
80 (3")	90-110	20	45
100 (4")	125	25	60

* This time should be increased for extremely hot weather conditions.

On completion of the cooling time, carefully disconnect the welding leads from the fitting. If both the pipe(s) and the fitting are securely fixed (that is, neither can be moved nor disturbed), the leads can be removed from the fitting terminals at the end of the fusion process, though we do not recommend such practice.

Remove the joint from clamps (do not remove an underclamp from saddle type fitting if it comprises a part of the fitting).

9. To accept the joint before testing, tapping the pipe, or applying operating pressure, assure the fusion cycle has been completed without interruption within the time specified for the fitting type and size used (adjusted to the actual welding conditions).

When removed from clamps, visually check the joint for misalignment, incomplete pipe insertion, excessive melt exudate outside the fitting edges – these signs may indicate a fault in the joint.

We recommend marking the completed joint (for example, writing weld number, actual fusion time, welder's ID, and so on).

10. A pipeline (or its section), whether new or repaired, shall not be operated until it has passed the required field testing. We recommend to keep all connection points exposed and accessible for the test.

The pipe should not be tapped, the joint should not be subjected to a full test and to operating pressure before the completion of waiting period after the cooling cycle – refer to fitting manufacturer's instructions. Typical waiting time is specified in the table above for smaller size joints.

We recommend destructive testing an electrofusion fitting joint made from the pipe and fitting type to be used and under the intended welding conditions prior to installation as well as random testing during construction.