Butt Fusion Installation Manual
For Polypropylene & Polyethylene

CPV
Engineering Pipework Solutions

The Chemical Pipe & Vessel Company

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Butt Fusion Welding

Jointing Procedure for Thermoplastic Pipe
and Butt Weld Spigot Fittings

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Section 1

Introduction

This guide provides basic information to perform a butt fusion joint of thermoplastic material

Refer to DVS 2207 for detailed standards

The methods outlined in this procedure are to butt weld pipe to pipe or butt weld spigot fittings. If butt weld spigot fittings are being welded, slim-line clamps will be required to accommodate the fitting

These procedures are a generic overview of the techniques involved in performing satisfactory butt welds and not specific to individual manufacturers butt welding equipment

Note:
The machine manufacturer's operating instructions must be followed at all times

Safety Notice
To ensure operator safety and comply with Health and Safety regulations all butt fusion machines must be operated from an effectively earthed power supply in accordance with manufacturer's operating instructions

Equipment Required

A generator of suitable size to power the butt fusion machine with un-interrupted 110v supply

Alternatively a site 110v power supply can be used with adequate extension leads capable of maintaining the required supply

Always refer to machine manufacturer's literature for power requirements

Butt fusion machine c/w pipe clamp liners for pipe and fitting sizes to be joined

Pipe roller supports

Welding tent or shelter and ground sheet to protect joint and equipment from rain and other adverse weather conditions

Bead gauge

External and internal de-beading tools (if required)

Pipe end covers to protect against wind chill

Tape measure

Indelible marker pen

Pipe cutter or hand saw

Note: Butt welding Hiline pre-insulated pipes and fittings

When butt welding the service pipe on Hiline pre-insulated pipes and fittings, it is important to only clamp on the service pipe and not the casing pipe. This is because the pipes may not be exactly concentric and may result in mis-alignment of the weld

Because of the limited working area to perform the butt weld, the correct size butt welding machine must be selected to enable the front pair of jaws on the pipe clamps to be fitted with liners to suit the service pipe, while the back pair of jaws are not fitted with any liners and the ID of the clamps should clear the casing pipe

Note:

The minimum working areas for service pipe OD's are:

Up to 160mm [150mm stick out each end] = 300mm (min)
200mm – 250mm [200mm stick out each end] = 400mm (min)

Due to manufacturing tolerances, the length of stick out may vary and the service pipe will require cutting back in some instances

IMPORTANT:
THE MAXIMUM ACCEPTABLE UN-INSULATED GAP ON ALL CASING JOINTS IS 450mm

IMPORTANT NOTICE

Before commencing the service pipe welding the alarm wires must be tested in every pipe and fitting

Service pipe – PPR
Jointing method - Butt Weld or Electrofusion

Using a portable test meter, check the following:

- Circuit continuity (alarm loop resistance)
- Insulation resistance (moisture detection)
- Wires are not in contact with each other (short circuit)
- These checks should also be carried out again before the casing oversleeve is fitted
- Always follow procedures in the equipment manufacturer's instruction manual

If there is any moisture detected in the insulation, it will probably be at either end of the casing

Carefully pick out the insulation to a depth of 10mm being careful not to damage the alarm wires

Check again for moisture

If there is still moisture detected in the insulation the pipe section must be rejected (see pipe installation manual)

Make sure the orientation of the wires is correct

Always connect the corresponding wires in both pipe or fitting sections being joined

If there is a need to change the orientation, care must be taken when crossing over wires and these sections MUST be insulated

It is important to mark any wiring circuit changes or cross-overs on the site installation drawing

Section 2

Principles of Butt Welding

The pipes to be joined are held in the welding machine clamps which grip and re-round the pipe. Butt weld machines are either hydraulically operated by hand pumps or motorised pumps. In the case of manual and semi-automatic machines, clamp movement is controlled by the operator. In automatic machines the computer controls clamp movement during the automatic welding cycle

Pipe ends to be welded must be clean and dry. They are prepared by planing with an electrically driven trimmer and then heated using an electrically powered temperature controlled non-stick heater plate. When a sufficient melt bead has formed on the pipe ends, the heater plate is removed and the pipe ends are brought together and held under pressure until cooled

Pipe and Fitting Selection

Check that pipes or fitting spigots to be joined are of the same size, SDR (standard dimension ratio) and material. Only pipes/spigots of the same size (OD) and material should be joined together. Pipe information is marked on the pipe at approximately one metre intervals and fittings are labelled accordingly

Note:
Dissimilar materials cannot be joined together by butt fusion welding

Positioning the Equipment

The butt fusion machine should be located as close as possible to the working area and placed on a suitable clean dry level base. It should be protected from rain at all times

Working Area Preparation

It is strongly recommended that all Butt Welding is performed inside a tent or shelter

This is to minimise contamination and wind chill and provide shelter for the operators. In wet or adverse weather conditions a ground sheet should also be used to protect the working area and equipment against mud contamination

Section 3

Pre-jointing Checks

Only equipment that has been regularly serviced and is in good condition should be used. Ensure the correct welding parameters for the machine and pipe or fitting being joined are known and understood

If using a generator, make sure it has sufficient fuel to complete the welding cycle

The heater plate must be clean and free of any dirt or contamination such as melt residue from previous welds. Melt residue can be carefully removed from the heater plate using cotton rags or paper towels, while it is still hot

Caution:

- **Do not attempt to scrape the residue from the heater plate when cold as it may cause damage to the non-stick coating**

- **Do not use wipes made of man-made fibres to clean the heater plate while hot**

Dirt or mud must be carefully washed off when the plate is cold using clean water and then thoroughly dried with clean lint-free wipes

Make sure the trimmer is clean and the blades are not damaged or clogged with swarf, and are in good condition

Ensure liners of the correct size and type to suit the pipe and/or spigot are correctly fitted to the machine clamps. The liners must be clean and sit fully in the clamps thus ensuring correct alignment

Check that the heater plate is at the correct temperature for the material being welded

Butt Welding Parameters

Select the correct welding parameters for the pipe and/or spigot being joined:

Heating plate temperatures

PP + PE80 – 200-220˚C
PE100 - 220˚C

Welding pressure

	Bead-up N/mm²	Heat Soak N/mm²	Welding Pressure N/mm²	Cooling N/mm²
PP	0.1	≤ 0.01	0.1	0.1
PE100	0.15	≤ 0.015	0.15	0.15

Weld cycle times

Material	Wall Thickness (mm)	Heat Soak Time (sec)	Dwell Time (sec)	Pressure Build up Time (sec)	Cooling Time (min)
PP	2.0 - 4.5	135	5	6	6
	4.5 - 7.0	135 - 175	5 - 6	6 - 7	6 - 12
Standard	7.0 - 12.0	175 - 245	6 - 7	7 - 11	12 - 20
DVS	12.0 - 19.0	245 - 330	7 - 9	11 - 17	20 - 30
2207-11	19.0 - 26.0	330 - 400	9 - 11	17 - 22	30 - 40
	26.0 – 37.0	400 - 485	11 - 14	22 - 32	40 - 55
	37.0 – 50.0	485 - 560	14 - 17	32 - 43	55 – 70
PE	2.0 – 4.5	45	5	5	6
	4.5 – 7.0	45 - 70	5 - 6	5 - 6	6 - 10
Standard	7.0 – 12.0	70 - 120	6 - 8	6 - 8	10 - 16
DVS	12.0 – 19.0	120 - 190	8 - 10	8 - 11	16 - 24
2207-1	19.0 – 26.0	190 - 260	10 - 12	11 - 14	24 - 32
	26.0 – 37.0	260 - 370	12 - 16	14 - 19	32 - 45
	37.0 – 50.0	370 - 500	16 - 20	19 - 25	45 - 60
	50.0 – 70.0	500 - 700	20 - 25	25 - 35	60 - 80

Trial Weld

To make a trial *dummy* weld follow the jointing procedures below and abort the cycle after the full soak time has elapsed then open the machine and remove the heater plate. If automatic welding machine is used the machine should show an Error Message such as *'Aborted during Fusion'*

Alternatively allow the welding cycle to complete and cut out the joint once cooled

Making a Butt Welded Fusion Joint

Preparation

Connect the machine to the power supply and allow the heater plate to reach the correct temperature

Load the trimmer into the machine

Place rollers underneath the pipes to be joined to reduce drag

Cover pipe ends to prevent draughts

Clean pipe/spigot ends inside and out and place in position in the clamps and touching the trimmer faces

Securely tighten the clamps onto the pipe/fitting

The following sequences are performed either manually or automatically depending of the type of welding machine being used:

Trim the surfaces to be welded until completely flat and smooth and until a continuous strip of swarf is produced of full pipe wall thickness

Remover the trimmer from the weld area and secure. **Do not touch the welding surface**

Bring the trimmed ends together and visually check for completeness of trimming and alignment of pipe and/or fitting. Adjust if required and re-trim if necessary

Do not remove swarf by pulling through trimmed pipe surfaces as this may contaminate the weld faces

Load the heater plate into the weld area between the surfaces to be welded

Once the heater plate has reached the correct temperature, set the welding cycle into start mode

The butt-fusion welding cycle consists of heating and cooling phases as detailed below: (see diagram)

Bead-up – the surfaces are pressed against the heater plate until a continuous melt bead around the circumference has formed

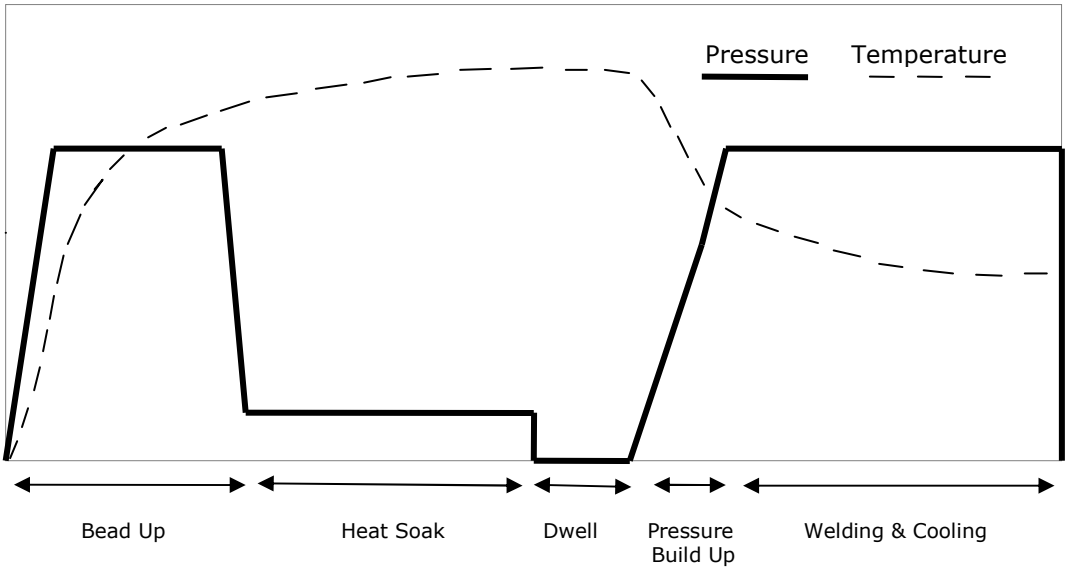
Heat soak – pressure reduced allowing the heat to penetrate into the material

Dwell time – time allowed to remove heater plate and start pressure build up

Pressure build up – pressure applied and butt welding commences

Welding and cooling – pressure maintained until butt welding completed and allowed to cool

Butt Fusion Welding – Process Cycle



Weld Completion

Once completely cooled, the assembly can be un-clamped and removed from the machine

The Butt Weld is now complete and a print out of the welding parameters can be produced if required (see Quality Control)

Note: Do not use artificial cooling (i.e. air or water) as this will result in a brittle joint

Bead removal

The internal and external weld beads can be removed using specialist de-beading equipment, if specified

Testing

The pipe assembly can now be pressure tested in accordance with the requirements of the installation specification. If the operator is confident that the welding was satisfactory, testing can be deferred until several joints have been completed and then tested at the same time

Section 4

Quality Control - Continuous checks

Check bead width with bead gauge

Visually inspect formation of bead for excessive irregularities which may indicate poor alignment

If required, remove the external weld bead and inspect the underside for signs of contamination.

Bend the bead back at several positions and examine for slits or defects

The removed bead can be numbered and kept with the joint record print out if required

Always check and monitor cleanliness around weld area during working

If using a welding machine fitted with a data logging device, a print out of the results and welding parameters can be produced

Butt Welding Do's

Adhere to equipment manufacturer's instructions at all times

Inspect jointing equipment for signs of damage before use

Report any defects to the supervisor

All welding operatives must be fully trained and familiar with the equipment

Always weld inside a shelter on a prepared level base

Use a base board and ground sheets to protect against mud

Check pipe sizes and material are compatible

Make sure pipes and fittings are correctly aligned

Support pipes on rollers to minimise drag

Cover pipe ends to eliminate wind chill of the heater plate and joint interface

Always clean around surfaces to be welded inside and out (approx 300 mm)

Clean pipe ends and clamps before inserting pipe in machine

Always use equipment that has been regularly maintained and calibrated

Position pipes into the clamps with the pipe marking uppermost and aligned

Wash the heater plate when cold before every welding session

Perform trial *dummy* welds when at correct temperature to remove fine particles from hotplate

Carry out one *dummy* weld on pipe size 180mm or below, and two *dummy* welds on larger pipe sizes

Perform a *dummy* weld after changing from one pipe size to another

Trimmer plate to be cleaned before use with lint free wipes (see safety notes)

Trim the ends until a continuous ribbon of swarf equivalent to the wall thickness is produced from each end and before commencing the final alignment operation

Replace the trimmer in the stand provided or locate away from the work area during welding

Always remove swarf from underneath pipe ends and machine chassis

Visually inspect that both ends are completely trimmed

Check pipes for alignment and any gaps around the entire circumference of the abutted pipes

Once satisfactory alignment checks have been completed, proceed with the welding cycle as soon as possible

Identify each joint and weld bead with a unique number code using an indelible marker

This number should also be recorded on the site layout drawing

Butt Welding Don'ts

Attempt to use equipment unless trained to do so

Attempt to weld pipes of incompatible materials or SDR

Leave swarf inside pipe or on machine chassis

Allow dirt to contaminate trimmed pipe ends whilst removing swarf

Touch trimmed pipe or fitting ends

Remove pipes from machine before the cooling time has elapsed

Cut corners in any part of the welding cycle

Attempt to install pipe until fully cooled

Section 5

Safety Notice

Although butt welding machine manufacturers make every effort to design equipment that ensures operator safety, it is worth bearing in mind the following precautions:

Do not touch heater the plate except for cleaning

Never allow molten or semi-molten plastic material to come into contact with the skin. In the event of such an occurrence it is recommended that clean cold water should be used to flush the affected area

Always seek expert medical advice immediately after the incident and report all accidents to the supervisor

DO NOT UNDER ANY CIRCUMSTANCES ATTEMPT TO PULL THE MATERIAL FROM THE SKIN AS THIS WILL INVARIABLY REMOVE THE SKIN AS WELL

When cleaning the trimmer take care to avoid direct contact with the blades

Never attempt to touch the trimmer while in operation. These blades are very sharp and can cause serious cuts to fingers etc

Under no circumstances should the trimming device be operated while out of the machine chassis. Never attempt to by-pass the safety switch

Always keep fingers and hands away from the pipe ends, chassis, trimmers and heaters while operating the machine

Avoid wearing loose clothing that could become entangled in the equipment during operation

Do not attempt to lift heavy equipment or long lengths of pipe without assistance or mechanical aid

Some manufacturers provide an audible alarm on automatic butt fusion machines to warn of any movement during operation

Always remove all traces of plastic from the heater plate surfaces after welding to prevent the production of fumes from degraded residues. At normal jointing temperatures the production of fumes will be minimal, however, these will be more pronounced at higher temperatures and prolonged exposure to the heat source

Health & Safety advice regarding the pipe and fitting material can be obtained from the pipe supplier

The manufacturer's safety precautions should be observed when handling electrical equipment and, for safety reasons, all 110v portable generator sets should be "CentreTapped" for site use +55/0/-55 volts

Suitable protective workwear (PPE) must be provided for all welding operatives to protect against unforeseen circumstances occurring during jointing. It is advisable to wear protective workwear such as overalls, gloves, safety glasses and safety boots.

Always refer to individual site safety requirements and the current HSE Legislation

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