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Poly-Flo® PE– Information and Installation Guide

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Poly-Flo® PE Submittal

A. General

The following is a submittal from Asahi/America, Inc. and our manufacturing partner Agru, Bad Hall, Austria on the Poly-Flo Double containment project. The submittal is inclusive all fittings, pipe and joining required for a Poly-Flo system

B. Materials

1. 0 Resin

All PE pipe and fittings supplied meet the requirements for PE material according to ASTM D 3035 with a minimum cell classification of PE445584C.

Advanced PE Physical Properties

	Technical data for the PE100 RC pipe and fitting material			
	Property	Standard	Unit	PE100-RC black
	Specific density at 23°C	ISO 1183	g/cm³	0,96
	Melt flow index MFR 190/5 MFR 190/2,16 MFR 230/5 MFI range	ISO 1133 ISO1872/1873	g/10min	 0,30 <0,10 T003
Mechanical Properties	Tensile stress at yield	ISO 527	MPa	25
	Elongation at yield	ISO 527	%	9
	Elongation at break	ISO 527	%	>600
	Impact strength unnotched at +23°C Impact strength unnotched at -30°C	ISO 179	kJ/m²	no break no break
	Impact strength notched at +23°C Impact strength notched at 0°C Impact strength notched at -30°C	ISO 179	kJ/m²	16 6
	Ball indentation hardness acc. Rockwell	ISO 2039-1	MPa	46
	Flexural strength (3,5% flexural stress)	ISO 178	MPa	24
	Modulus of elasticity	ISO 527	MPa	1100
Thermal Properties	Vicat-Softening point VST/B/50	ISO 306	°C	77
	Heat deflection temperature HDT/B	ISO 75	°C	75
	Linear coefficient of thermal expansion	DIN 53752	$K^{-1} \times 10^{-4}$	1,8
	Thermal conductivity at 20 °C	DIN 52612	W/(mxK)	0,4
	Flammability	UL94 DIN 4102	--	94-HB B2
Electrical Properties	Specific volume resistance	VDE 0303	OHM cm	$>10^{16}$
	Specific surface resistance	VDE 0303	OHM	$>10^{13}$
	relative dielectric constant at 1 MHz	DIN 53483	--	2,3
	Dielectric strength	VDE 0303	kV/mm	70
	Physiologically non-toxic	EEC 90/128	--	Yes
	FDA	--	--	Yes
	UV stabilized	--	--	carbon black
	Colour	--	--	black

2.0 Product Configuration

All pipe shall be one-piece double-wall extruded simultaneously. The primary pipe shall be integral with the secondary pipe via connecting ribs, which are continuous down the entire length of each section of pipe. No centralizing clips, spiders, disks or supports shall be allowed.

Molded double containment fittings shall be of unitary construction. Permanent alignment of the inner and outer fittings shall be maintained via molded-in ribs. The ends of both the inner and outer fittings shall be flush (in one plane). Molded-in supports shall be set back from the ends of molded fittings to allow mixing of any fluids in the annular space. Not all fittings are required to be molded.

Fabricated fittings shall be allowed where molded fittings are not available. All Fabricated fittings are required to be assembled utilizing butt fusion only. The manufacturer shall provide pressure ratings on fabricated fittings. Consult manufacturer drawings for availability and construction method of each part.

Termination of the double containment shall be conducted utilizing an end termination dogbone or flanged end termination.

3.0 Pressure Rating

Pipe and fittings shall be rated for 150x90 psi in all sizes and materials at 73^{o}F. Fabricated fittings shall be pressure de-rated based on angle of miter cut/weld, contact Asahi America for pressure ratings of mitered fittings

C. Execution

1.0 Joining Methods

All field welding shall be butt welded per the parameters in this document and general guidelines of ASTM D2657 for polyolefin piping, and in general accordance with the manufacturer's printed guidelines shown later in this document.
Due to the nature of butt fusion in general, the interior weld of any pipe is difficult to inspect, therefore the outer weld bead is indication of correct weld to verify proper parameters have been followed, heat temperature, time and fusion pressure.

It is very important to minimize the bead size during the initial melt under pressure; the pressure should be reduced to almost zero for the heat soak, **as soon as a bead begins to develop around the circumference of the pipe or fitting end.** This is important to prevent excessive bead height which could close off the annular space.

Additionally the ribs can be modified at the weld area by cutting a notch into each rib to a depth of 1/8”-1/4” using snips, wire cutters, etc. Also it is important to stagger the ribs at each weld connection to prevent channel zones within the annular space.

The outside weld bead on the containment pipe should be used as your comparison to the sample welds.
Since ambient air temperature and other environmental condition effect weld bead formation, there is no standard or formal specification for the size of the bead. As long as the beads meet the weld inspection criteria
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2.0 Installation and Support

Installation procedures shall be as per the manufacturer’s written specifications. Pipe support spacing must be adequate to prevent any appearance of sagging. Standard design practice for single wall thermoplastic piping with regard to expansion and contraction shall be followed. Valves and other auxiliary items shall be independently supported.

Support Spacing

PE						
Diameter		68 F	86 F	104 F	122 F	140 F
da mm	Nom in	in	in	in	in	in
32mm X 50mm	1" x 1-1/2"	46	42	39	36	33
63mm X 90mm	2" X 3"	65	60	59	52	48
110mm X 160mm	4" x 6"	70	65	62	60	60

Support spacing is based on S.G 0f 1.0 at 68 °F.

Correction factors must be used for denser fluids as follows: 0.90 for S.G = 1.25, 0.85 for S.G = 1.50, 0.75 for S.G = 1.75 and 0.70 for S.G = 2.0

3.0 System Testing

Pressure Systems

To fully test both the inner and outer containment for full pressure rating a hydrostatic test of both the inner and outer pipes shall be performed as outlined in the Uniform Plumbing Code Section 318 as directed by the local Administrative Authority. Specifically, a water pressure test at 1.5 times (150%) the normal working pressure of the inner pipe should be applied to both the inner and outer walls in separate tests.

To avoid a possible leak in the carrier from contaminating the containment space with water, a 5 to 10 psi air test can be first conducted a quick check of the system. See requirements for safety below.

To avoid moisture in the containment an air test can be conducted on the containment pipe. Pressure test is recommended at 5 psi and shall not exceed 10 psi. The inner carrier pipe shall be full of water and under pressure to avoid any possible collapse.

When testing with air on both the carrier and containment piping the ambient temperature should be above 32 °F and extra safety precautions for personnel shall be put in place during the test.

Drainage Systems

For systems in drainage applications a hydrostatic test of 1.5x the working pressure is recommended for the carrier pipe. To avoid moisture in the containment an air test can be conducted on the containment pipe. Pressure test is recommended at 5 psi and shall not exceed 10 psi. The inner carrier pipe shall be full of water and under pressure to avoid any possible collapse. When testing with air the ambient temperature should be above 32 °F and extra safety precautions for personnel shall be put in place during the test.

4.0 Leak Detection

Leak detection shall be provided to monitor the integrity of the secondary containment in compliance with the local administrative authority

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Heating element butt welding procedure using Miniplast or Maxiplast welding machine

Safety Precautions

1. Keep working area clean and tidy.
2. Keep electrical tools away from moisture. Never use in a wet environment or humid conditions. Working area should be well illuminated. Keep tools away from chemicals and other corrosive materials.
3. Keep visitors at a safe distance.
4. Electrical tools not in use should be stored away safely.
5. Do not wear loose clothing or jewelry. They can inadvertently get stuck in the moving parts of the machine, causing injury.
6. Never carry tools by the electric cable. Never unplug by pulling the cable. Keep cables away from oil, heat and sharp edges.
7. Always check that the pipe and fittings are clamped down tightly.
8. The heating element can reach temperatures in excess of 300°C (570°F). Do not touch the surface, and keep non-operating personnel at a safe distance.
9. Keep tools clean and sharpened. They produce better and safer results. Missing and worn-out parts should be replaced immediately. Always assure that the accessories are properly mounted on the machine. Only use factory parts.
10. Always use correct extension cable with properly grounded ends, recommended wire size is 14 gauge/ 3 conductor to minimize voltage drop.
11. Do not use tools and machines when housing or handles, specifically plastic ones, are bent or cracked. Dirt and humidity in any fracture can lead to electrical shock should the insulation in the machine be damaged.

Welding Conditions

1. The welding environment needs to be protected against unfavorable conditions, e.g. rain, wind, dust, excessive humidity or temperature below 5°C (41°F). Wind greater than 10 mph should be considered potentially problematic. Welds can be made on a dirt surface provided the dirt is not in a dry state where dust particulates can be visible on welding surfaces. The welding area can be shielded to reduce wind and dirt particles from entering the welding zone.

2. It needs to be assured that the pipe wall temperature is adequate for welding. If necessary, the pipe has to be warmed up or an environmentally controlled welding tent needs to be erected. The pipe should be acclimated to the environment where it will be welded for 24-48 hours prior to welding. Acclimation will alleviate any temperature differences between the two parts that could affect the quality of the weld. If these conditions are met, the welding can be performed at virtually any environmental temperature. Prior to welding the surfaces need to be welded, the ends of pipe 2+" and/or fittings need to be above 41 degrees F. Welding with material temperatures below 41 degrees F needs to be avoided. It is advisable to verify the weld quality by making some test welds at the given conditions.

3. Should the pipe be irregularly heated by intense sunshine, it may be necessary to cover the pipe ends to be welded so that a balanced temperature is obtained.

4. The pipe ends to be welded must be checked for damage and be free from oil, grease, dirt and other contaminates. Cleaning the pipe ends must be done just prior to welding. This should be done with a lint free paper or cloth towel. Isopropyl Alcohol with a concentration of 70% or higher can be used to remove oil, grease, or tape residues. (Hereinafter is referred to as "cleaning agent" or any reference to cleaning).

5. The weld must be kept free from external stresses during the weld process until the material has sufficiently cooled. Weld parameters are provided in the parameters section of this document. The cooling period can be reduced by 50% if weld joint will not see excessive stress from pipe bending and handling.

6. The weld process has to be observed continuously. It is recommended to keep a record of each weld. A Weld Log is provided at the end of this document.

7. A regular stop watch, egg timer, or wrist watch with a second hand is to be available in order to register the actual times for heating up and cooling down.

8. A regular heat stick or regular pyrometer is to be available in order to verify the correct heating element temperature.

9. A table is to be available from which you can read the parameters that are prescribed by the welding regulation for the pipe dimension to be welded. Weld parameters are provided in the parameters section of this document.

10. The heating element surfaces are to be clean and, above all, free from grease using above described cleaning agent.

11. The pipe and fitting condition should be checked upon arrival to site and prior to beginning the welding process. Check for gouging, cracking, nicks, inconsistencies in shape, etc.

*After the above conditions are met, start preparing to weld.

Machine Set Up and Operation

Materials: PP, HDPE, PVDF
Joint Type: Contact Butt Fusion (including: pipe to pipe, pipe to fitting & fitting to fitting)

1. General Tool Information

A. The MiniPlast Shop 4 is made for butt fusion with a diameter range of ½”-4” (20mm-110mm). Maxiplast Shop 6 is made for butt welding of pipes and fittings with a diameter range of 1 ½” – 6” (50mm –160mm).

B. Voltage: 110 AC (Two required)
Amperage: 15 Amps

2. Heating Element Temperature Setting

A. Connect the plug of the heating element to a 110-volt outlet. Portable Generators are acceptable provided they will handle the Amp load of the heater and planer shown below. The heater is thermostat controlled and indicated by lighted switch, therefore temperature is monitored to avoid welding with heating element too cool. The Amp load of the Heat Plate (mirror) and Planer is 7 Amp (each).

Technical Data

Heating Element		**Planer**	
Power:	-1500 Watts	Motor:	-Single Phase Alternating Current Motor
Voltage:	-110V (+/- 10%)	Power:	-950 Watts
Current:	-7 A (+/- 10%)	Voltage:	-110V (+/- 10%)
Frequency:	-50-60 Hz	Current:	-7 A (+/- 10%)
Element:	-Electric Temperature Control -Power Indicator Light On/Off Switch -Connecting Cable with Plug and Earth Ground	Frequency:	-50-60 Hz

B. The thermostat is located in the heating element and can be adjusted by turning the dial located above the handle. The thermostat will be factory set if using a rental unit.
1. HDPE 215°C-230°C/ 420°F-446°F as shown in welding parameters.

3. Welding Machine Setup

A. The machine can be mounted on a bench by bolting the base to the bench with the enclosed screws or it can be placed in a vice.

4. Clamping Setup

A.1. For pipe to pipe joints with pipes smaller than tools maximum diameter, appropriate pipe clamp inserts must be placed into the master pipe clamps and fixed with the appropriate screws. For 160mm pipe to pipe joints, the master pipe clamps should be used. The pipe should be placed in the clamps with ½ -1½ inches extended out of the clamps.

A.2. For pipe to fitting joints, the master pipe clamp, which is fixed to the movable part of the machine, must be replaced with the master fitting clamp. For fittings smaller than tools maximum size, use the appropriate fitting inserts and fix them with the appropriate screws

A.3. For fitting to fitting joints, the second master pipe clamp should be replaced with the other master fitting clamp with the appropriately sized inserts.

A.4. To weld a flange to pipe or fitting, the flange adapter should be placed in the pipe master clamp and the flange centered on the flange adapter.

B. It is possible to manufacture segmented elbow pieces. The master pipe clamps can be swiveled from 0-15 degrees on either side. The upper part of the planer is radially adjustable in order to adjust the cutters axial to the end of the pipe. It is possible to produce equally segmented elbow pieces provided the limit stops are set exactly.

5. Facing

A. The planer has to be placed onto the two shafts and locked using the rotary button.

B. Use the hand wheel to gently press the ends of the pipe against the rotating cutters of the planer. The planing step is complete when the shavings on both pipes are producing a continuous ribbon. Release the pressure using the hand wheel while the cutters of the planer are rotating. Facing pressures are based on the size/wall thickness of piping and such that the planer motor is not overloaded. The purpose of the facing process is to get a clean, flat face on the ends of the pipe and/or fitting surfaces to be joined. The pressure required to achieve this may vary during the planning process from beginning to end. Do not to apply too much pressure that would put too great of load on the planer motor or stop rotation entirely.

We do want to apply enough pressure to achieve a continuous strip or “ribbon” of material around the entire perimeter. A continuous strip indicates the welding area is flat and both sides are parallel.

C. After the planer has completed rotation, loosen the rotary button, remove the planer and store in an appropriate place.

6. Alignment

A. Using the hand wheel, bring the two ends of the pipe together to check alignment both parallel and axial.

B. Adjustments can be made using the horizontal adjustment. Loosening or tightening the clamps will adjust the vertical alignment. The misalignment of the pipe should not exceed 10% of the wall thickness of the pipe. Wall Thickness provided in table below. No visible light is to be seen between the pieces being welded when checking alignment.

C. Loosening or tightening the clamps can eliminate egg-shaped pipe, as can be seen when too much clamping pressure is applied.

7. Initial Heating

A. Check whether the heating plate has reached the working temperature (see Welding Parameter Charts at the end of this manual). The working temperature is reached when the lamp blinks in short intervals. A heat stick or pyrometer should be used to verify temperature.

B. Place the heating element on the shaft of the welding machine with the brackets on either side of the shaft. Using the hand wheel, bring the pipe ends against the heater, applying the proper initial melt pressure (see charts at the end of this manual for proper welding pressures). Also see note regarding drag pressure at welding chart near the end of this document.

C. Watch for a continuous bead to form 360 degrees around both pipe or fitting ends, the size of the bead is not important as long as melt is observed around the pipe and/ or fitting face. **Minimize the size of the bead to prevent excessive weld bead into the annular space.** Continue once a uniform continuous bead forms around the circumference on both sides.

D. Lower pressure using the hand wheel until the pressure is reduced to almost zero, just enough pressure to keep welding zone on the heating plate.
Be sure the mirror (or heating plate) does not break contact with the pipe or fitting.

Note: If the hand wheel is moved too far in this direction, the pipe may move away from the heater causing a bad weld.

8. Heat Soak

A. With the pressure almost at zero, begin to time the heat soak time (see welding parameters). It is important to assure that the pipe ends remain in full contact with the heating element.

9. Change Over Time

A. With the hand wheel, move the pipe ends apart. Remove the heating element and then bring the pipe end back together.

B. Bring the pressure back to the original weld pressure. Do not over pressurize, as this will cause a bad weld. These steps must be performed within the allowable change over time (see parameters at the end of the manual for proper time).

10. Cooling Time

A. Keep the machine under pressure until the cooling time has expired. The cooling time can be reduced by 50% as long as the welded area does not see excessive force from movement or bending.

Weld Bead Inspection

A. To ensure a safe and proper installation it is recommended that a standard inspection process be developed by the local quality assurance team following these guidelines. These guidelines were established using DVS 2202-1 Imperfections in Thermoplastic Welded Joints and DVS 2207-1 Heated Tool Welding of Pipes, Piping parts, and panels made of PE.
B. To inspect butt fusion joints, the inspector should look for the following characteristics on each weld;
    1. Welds should have two beads that are 360* around the pipe or fitting
    2. Beads should be of consistent height and width, there will be a slight (~1/16”) elevation of bead height at each of the ribbed areas.
    3. Beads should have a rounded shape
    4. Beads shall be free of burrs or foreign material
    5. The bead on either side should not reduce greatly in width or disappear
    6. The components welded together should be properly aligned and cannot be misaligned by more than 10%

As previously explained, the outside weld bead is the only indication of a successful simultaneous weld of the carrier (inner) and containment (outer) zones. It is recommended that each welder create one or several welds at proper parameters and evaluate all further welds to compare bead height and shape.

HDPE PolyFlo Weld Examples

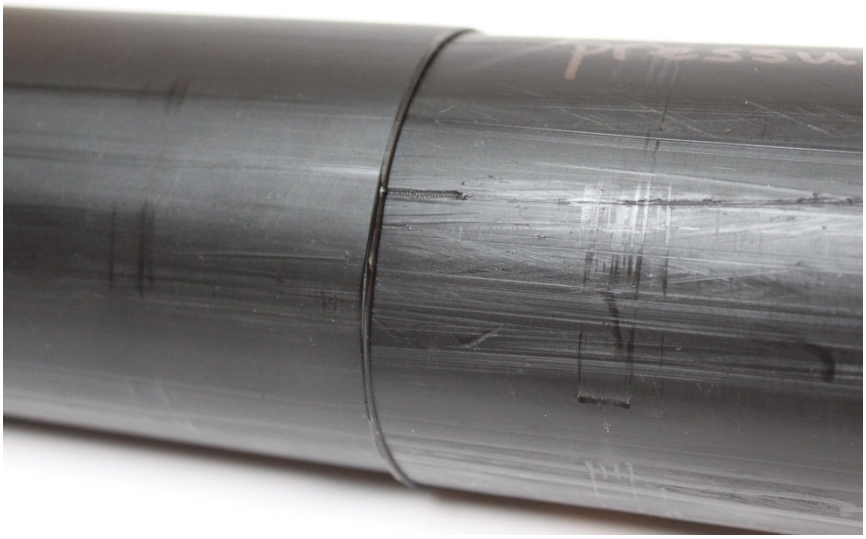
Picture showing PolyFlo PE, PP weld beads are very similar.

2x3 HDPE PolyFlo pipe and molded 45's

Close up of molded fitting to fitting weld, bead height approx 1/16”-3/32”, with approx 1/32” deep notch between beads. Both beads have nice rounded edge.

Close up of molded fitting to pipe weld, fitting bead remains slightly rounded, pipe bead has slight straight edge, due to processing differences of injection molded fitting versus extruded pipe. Bead height remains the same approx. 3/32”

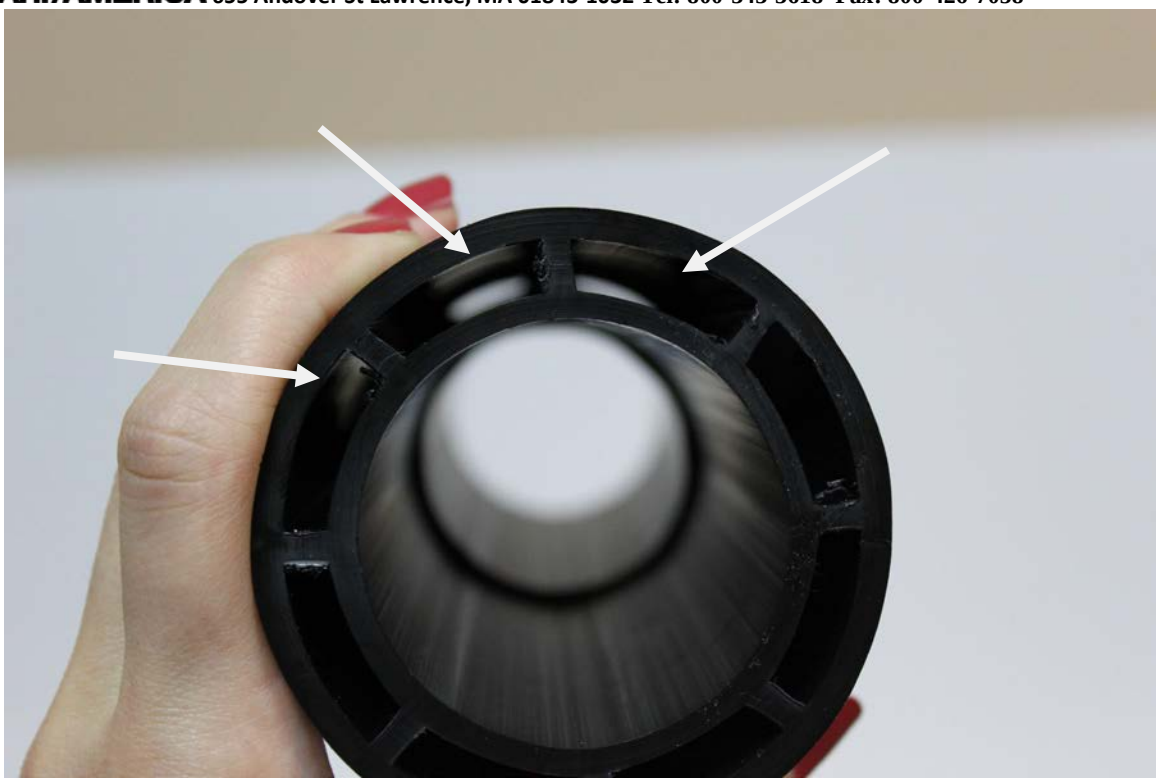
Pipe to pipe weld, with INSUFFICIENT pressure.



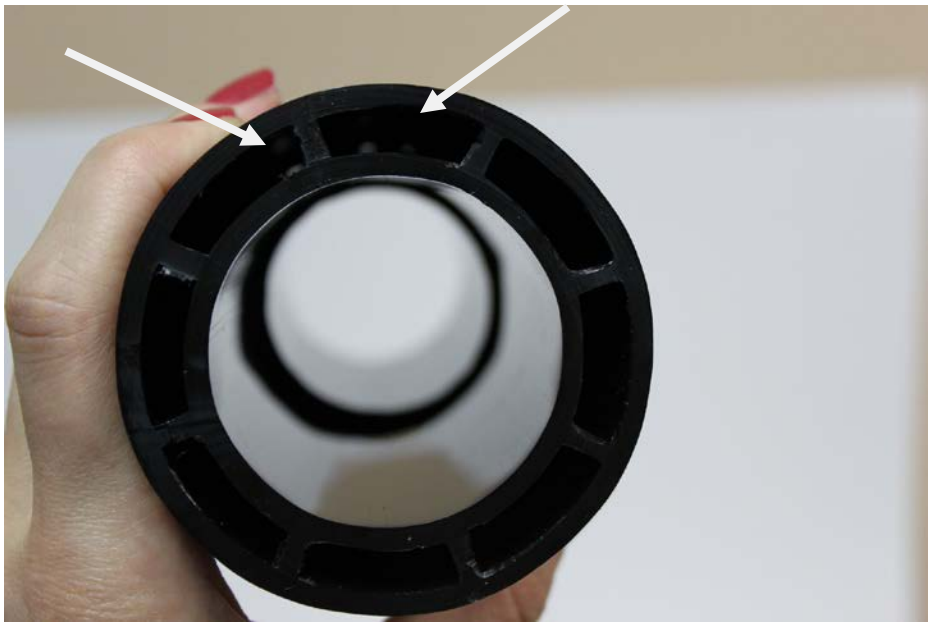
Close up of above weld. Bead height varies from 0”-1/32”.

Pipe to pipe weld, with EXCESSIVE pressure.

Close up of above weld, bead height approx 1/8”-5/32”



Annular space is open with proper weld pressure.
(see light penetration at arrows)



Annular space closed by excessive weld pressure
(pin holes of light at arrows)

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Welding Parameters

Miniplast// Maxiplast
PolyFlo Double Containment Butt Fusion

pipe diameter OD x OD [mm]		SDR	bead-up force [lbs]	circular bead min. [mm]	heat-up time [s]	max. change-over time [s]	time to reach welding pressure [s]	welding force [lbs]	cool-down time [min] ❶
PE PolyFlo									
32x50		11x17	25	0.5	25	4	4	25	4
63x90		11x17	65	1.0	35	5	5	65	8
110x160		11x17	223	1.5	80	7	7	223	14

PE Welding Temperatures 393-410*F 200-210*C

❶ **Remaining under the cool-down time for up to 50% is allowed under the following conditions:**

- prefabrication under workshop conditions
- low additional pressure at unclamping
- no additional pressure during further cooling down

Drag pressure: If the pipe is under friction load or extended line lengths, the force to close the clamps will be significantly higher. This force must be added to the welding pressure during the initial melt and final weld.

Determining drag pressure: Prior to planning, attached pipe in machine as described in step 4 above in machine set up. Rotate the closure hand wheel while watching the spring tension pressure gauge and record pressure shown as pipe is moving. This reading must be added to the Initial Melt Pressure and Welding Pressure shown above.

For example, for 2x3 PolyFlo, if you find 25 lbs of resistance while closing the hand wheel, this 25 lbs must be added to the 45 Lbs of melt pressure which means now both Initial Melt Pressure and Welding Pressure must be 70 lbs during the weld procedure.

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