

# Polyethylene Gas Pipe Hydraulic Butt Fusion Procedure

## Introduction

This document has been developed to assist workers responsible for the butt fusion joining of Teel Plastics piping products used in gas and energy applications. This procedure is in alignment with ASTM F2620 Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings. Refer to ASTM F2620 for more specific butt fusion information, guidance, and safety information when using #28, #412, and #618 fusion machines.

## Equipment

The equipment needed for hydraulic butt fusion includes the proper hydraulically operated butt fusion machine for the pipes being fused, a facing unit, a heating unit for heating the ends of the pipe and the proper inserts for the pipe sizes to be butt fused. Pipe support rollers and stands are also needed to bring the pipes to be fused in alignment with the fusion machine centerline. With the McElroy #28 Fusion Machine, a 120VAC power supply is needed so a generator is usually required. Consult the fusion machine manufacturer's information on the generator size required. Some hydraulic butt fusion machines are self-contained and have their own generator.

## Set-Up Guidelines

1. Make sure that the butt fusion equipment used meets the manufacturer's specifications and is in good working order before using.
2. Make sure the fusion machine operator has been trained properly on the hydraulic butt fusion machines being used, typically in accordance with ASTM F3190.
3. Set-up the fusion machine in a level area if possible. If the hydraulic carriage is removed from the rolling or track carriage and operated at ground level, pipe rollers are available for better alignment to the fusion machine centerline and to protect the pipe as it is pulled down the pipeline.
4. If the hydraulically operated fusion machine is being operated on the carriage, install a pipe support stand or McElroy PolyPorter®, about half the length of the pipe segment to be installed, on both ends of the fusion machine to help with alignment.
5. Check the print-line on the pipe to be butt fused to make sure it meets the pipe specified for the job.
6. Make sure the proper pipe size inserts are installed in the fusion



machine clamps to match the pipe OD to be butt fused.

## **Procedure**

Note: See ASTM F2620 Section 8 for the complete butt fusion procedure.

After setting up the pipe supports and starting the fusion machine, plug in the heating unit to the appropriate voltage outlet on the fusion machine carriage. Set the heater temperature to approximately 440° F and allow time to heat up before proceeding with the fusion process. The heater's surface temperature should be 425° F  $\pm$  25° F. This should be confirmed before each fusion with an infrared or surface pyrometer in center area of the heater surface.

## **Setting Hydraulic Pressures for Steps in Fusion Process**

If using a McElroy #28, #412 or #618 fusion machine, shift the front selector valve, on the front of the hydraulic manifold, to the up position (FACE). Then shift the top lever valve to the left until the movable carriage bottoms out. Adjust the top pressure reducing valve until the gauge reads less than 100 psi. Then move the front selector valve to the middle position (HEAT) and adjust the middle pressure reducing valve as low as possible. Then move the selector valve to the bottom position (FUSE) and set the pressure to about 150psi until actual fusion pressure is calculated.

## **Clean, Install, and Clamp**

Clean the pipe ends, before placing in the fusion machine, with a clean, dry, lint-free cloth like cotton. Set the pipe ends into the fusion machine with the ends protruding inside the inner jaws about 1" – 1 ¼" and clamp the pipes until firm resistance is felt. Tighten the outer jaws slightly more to prevent slippage.

## **Face**

Install the facing unit into the fusion machine between the two pipe ends. Shift the front selector valve to the up position (FACE), turn on the facing unit and shift the top carriage control valve to the left to bring the pipe ends in contact with the facing unit. Adjust the Facing pressure reducing valve up or down as needed to keep the pipes in contact with the facing unit but not causing it to stall. Continue the facing until the facer body meets mechanical stops. Turn the facer off and wait for it to stop, shift the top carriage control valve to the right and open the carriage. Stop the carriage and remove the facing unit and the pipe shavings from the machine. Brush any loose shavings away from the pipe ends with a clean,



dry, lint-free cloth. **Do not touch the pipe ends with your hand or anything that could contaminate the pipe ends.**

## Align

Bring the pipe ends together at the facing pressure and check for any “hi-lo” OD misalignment or gaps. If there is a little misalignment, always tighten the high side down. Then snug both clamp knobs down a little to prevent slippage. There should be no gaps between the pipe ends before heating.



At this point, you need to read the Drag Pressure of the carriage on the gauge. To do this, you need to move the top carriage control valve to the left until the pipe ends are about 2” apart and move the carriage control valve to the center position to stop the carriage. Move the selector valve to the middle position (HEAT) and then shift the top carriage control valve to the left and read the pressure on the gauge. If the carriage does not move, adjust the middle pressure reducing valve slowly until the carriage starts moving and read the pressure. On most high force machines, this is between 30-50psi with one stick of pipe in the movable jaws. Let the pipe ends meet. The next step is to calculate the fusion joining pressure for the pipe that is being joined. For this, you will need the pipe size and DR (i.e. 4” IPS DR11) and have the McElroy McCalc app installed and open on your phone, iPad or computer. Input the information requested on the fusion machine being used, select the ASTM F2620 procedure, input the pipe size and DR or wall thickness, input 75psi for the interfacial pressure and input the Drag Pressure. The App will calculate the fusion pressure to set on the machine. Shift the selector valve to the bottom position (FUSE) and adjust the pressure with the bottom pressure reducing valve to the pressure indicated on the McCalc app.

## Formula

The formula for calculating the fusion pressure set on the fusion machine is:

$$\text{Pressure (gauge) (psi)} = \frac{\text{Pipe Area (in}^2\text{) x Interfacial Pressure (75 psi)}}{\text{TEPA (in}^2\text{) of Fusion Machine}} + \text{Drag Pressure (psi)}$$

## Heat

Verify the heater surface temperature is 425 degrees F  $\pm$  25° F with a pyrometer. Clean the heater faces with

a clean, dry, lint-free, non-synthetic cloth like cotton and install the heater on the guide rods of the fusion machine between the two faced pipe ends. Shift the Selector valve to the (FUSE) position and shift the carriage control valve to the left to bring the pipe ends against the heater. Once in complete contact and an indication of melt is observed around the pipe circumference, shift the front selector valve to the center position (HEAT) and then shift the top carriage control valve to the center position to lock the carriage position. This is the start of the heat soak cycle and you should not apply hydraulic pressure during this time. Heat the pipe ends until the proper melt bead size is formed between each heater surface and pipe ends. For

| Material Options                      | Mat. | Heater Surface Temp. (°F) | Melt Bead Size (IN) | Max. Heater Plate Removal Time (SECS) | Min. Cooling Time (MINS) |
|---------------------------------------|------|---------------------------|---------------------|---------------------------------------|--------------------------|
| 2" IPS - SDR 11 Yellow                | MDPE | 425 ± 25                  | 1/16                | 8                                     | 2.38                     |
| 2" IPS - SDR 11 Black/Yellow Stripe   | HDPE | 425 ± 25                  | 1/16                | 8                                     | 2.38                     |
| 4" IPS - SDR 11.5 Yellow              | MDPE | 425 ± 25                  | 3/16                | 10                                    | 4.3                      |
| 4" IPS - SDR 11.5 Black/Yellow Stripe | HDPE | 425 ± 25                  | 3/16                | 10                                    | 4.3                      |
| 6" IPS - SDR 11.5 Yellow              | MDPE | 425 ± 25                  | 3/16                | 15                                    | 6.34                     |
| 6" IPS - SDR 11.5 Black/Yellow Stripe | HDPE | 425 ± 25                  | 3/16                | 15                                    | 6.34                     |

14" pipe and larger, there is a minimum heat soak time of 4.5 minutes per inch of pipe wall thickness that must be met in addition to the bead size before removing the heater. See Table 3 in Section 8 of ASTM F2620 fusion standard for the minimum melt bead size to reach before removing the heater.

### **Remove the Heater**

After achieving the proper melt bead size, shift the front selector valve to the bottom position (FUSE) and then shift the top carriage control valve to the right to open the movable jaw of the machine until both pipe ends separate from the heater. Stop the carriage by shifting the top carriage control valve to the center position. Remove the heater, inspect the pipe ends for the proper melt pattern (smooth with no marks or contamination). Then bring the pipe ends together by shifting the top carriage control valve to the left. The melt beads will roll back to the pipe surface. Maintain that hydraulic pressure for the entire cool cycle.



In Table 6 in Section 8 of the ASTM F2620 fusion standard, you will find the maximum time allowed to open the carriage, remove the heater and bring the pipe ends together for the fusion cycle. This depends on the pipes wall thickness.

## **Fuse/Cool**

Let the fusion joint cool in the machine for a minimum of 11 minutes per inch of wall thickness (i.e. ½" wall pipe will need 5.5 minutes of cool time minimum).

An additional 30-60 minutes of cooling time is recommended prior to rough handling or backfilling of the pipe depending on pipe wall thickness and ambient temperature.

## **Inspect**

After the cool cycle is completed, move the top carriage control valve to the center position and unclamp the jaws from the pipe. Visually inspect the fusion joint for the proper bead appearance. It must have a complete and uniform double rollback. Inspect the bead for signs of contamination. Refer to ASTM F2620 for visual acceptance pictures and illustrations.

Pictures provided by McElroy Manufacturing, Inc.

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