



Plastic Pipe Joining for first timers

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* Always refer to your companies O-M
This presentation is not meant to endorse any Manufacturer



Plastic Vs Steel

Advantages

- Cost
- Flexibility
- Handling
- Corrosion Free
- Various ways to assemble

Disadvantages

- Weaker
- Less rigid
- **More sensitive to Temperature**
- Not as forgiving as other materials

Types of Plastic

- PVC - Poly Vinyl Chloride: it is used for electrical conduits
- ABS - Acrylonitrile-Butadiene-Styrene: it is used for above ground compressed air applications
- PB -Polybutylene: it is used for Hot effluent lines
- PP -Polypropylene: it is used for chemical waste movement
- PE – ***Polyethylene***
- PA -Polyamide

Code Requirements

- The US Department of Transportation Pipeline Safety Regulations, CFR Title 49 Part 192, “Transportation of Natural and Other Gases by Pipeline: Minimum Federal Safety Standards governs the design, manufacture, joining and installation of plastic pipe as well as qualifying persons to make joints.

Code Requirements (cont.)

- Plastic pipe and fittings must be manufactured to a listed specification.
 - One of those specifications is ASTM D2513 – This specification covers requirements and test methods for material dimensions and tolerances, hydrostatic burst strength, chemical resistance, and rapid crack resistance of polyethylene pipe, tubing, and fittings for use in fuel gas mains and services for direct burial and reliner applications. The pipe and fittings covered by this specification are intended for use in the distribution of natural gas

Subject to the limitations of §192.121, the design pressure for plastic pipe is determined by

either of the following formulas:

$$P = 2S \frac{t}{(D - t)} (DF)$$

$$P = \frac{2S}{(SDR - 1)} (DF)$$

- P = design pressure
- D = outside diameter
- t = minimum wall thickness (in)
- SDR = standard dimension ratio (in)
(SDR is the diameter divided by wall thickness)
- DF = design factor = 0.32 ** Refer to the code changes made for PE pipe produced after January 22, 2019 192.121 (C) (2)
- S = hydrostatic design basis (psi)

Design Formula of Plastic Pipe per DOT 192.121

- What does “Hydrostatic Design Basis mean”?
- ***The term hydrostatic design basis (HDB) category refers to the estimated long-term strength in the circumferential, or hoop, direction of a pipe or tube***
- **The test is simply a means to evaluate the long-term material characteristics**
- The hydrostatic design basis for
2406/2708 :@ 73° is 1250 psi
3408/4710 PE100:@ 73° is 1600 psi*

* Taken from PPI's-TR-4 HDB/HDS/PDB/MRS Listed Materials 6/24/2019

Hydrostatic Design Basis: The value of S for design pressure calculation

	73°	140 °
□ PE 2306		
□ PE 2406	1250	800*
□ PE 3406		
□ PE 3408	1600	800*

* these values can vary, check
with Manufacturers

Allowable Pressures (psig)

<i>Pipe Grade</i>	<i>9.3</i>	<i>11.0</i>	<i>13.5</i>	<i>21</i>
<input type="checkbox"/> <i>PE2306</i>				
<input type="checkbox"/> <i>PE2406</i>	<i>96</i>	<i>80</i>	<i>64</i>	<i>40</i>
<input type="checkbox"/> <i>PE3406</i>				
<input type="checkbox"/> <i>PE3408</i>	<i>123*</i>	<i>102*</i>	<i>81</i>	<i>51</i>

** subject to restricting of 100 psig
or Manufacturers suggested pressure
rating which ever is less*

Comparison of Allowable Pressure Vs Operating Temperature

	73°	140 °
PE 3408	102 psig	51 psig*
SDR 11		

* check with Manufacturers for actual HDB values

- So what does all this mean?
- As the temp goes up the pressure allowed in the pipe goes down because plastic pipe is very **sensitive to temperature.**

Something to think about

- when designing systems in an area where you expect elevated temperatures such as near underground steam lines or in encased above ground risers, make sure your operating pressures do not exceed values or increase the wall thickness of the pipe to compensate for its reduced strength

□ §192.285 Plastic pipe: Qualifying persons to make joints.

- (a) No person may make a plastic pipe joint unless that person has been qualified under the applicable joining procedure by:
 - (1) Appropriate training or experience in the use of the procedure; and
 - (2) Making a specimen joint from pipe sections joined according to the procedure that passes the inspection and test set forth in paragraph (b) of this section.
- (b) The specimen joint must be:
 - (1) Visually examined during and after assembly or joining and found to have the same appearance as a joint or photographs of a joint that is acceptable under the procedure; and
 - (2) In the case of a heat fusion, solvent cement, or adhesive joint:
 - (i) Tested under any one of the test methods listed under §192.283(a), or for PE heat fusion joints (except for electrofusion joints) visually inspected and tested in accordance with ASTM F2620-12 (incorporated by reference, see §192.7) applicable to the type of joint and material being tested;
 - (ii) Examined by ultrasonic inspection and found not to contain flaws that would cause failure; or
 - (iii) Cut into at least 3 longitudinal straps, each of which is:
 - (A) Visually examined and found not to contain voids or discontinuities on the cut surfaces of the joint area; and
 - (B) Deformed by bending, torque, or impact, and if failure occurs, it must not initiate in the joint area.
- **(c) A person must be re-qualified under an applicable procedure once each calendar year at intervals not exceeding 15 months, or after any production joint is found unacceptable by testing under §192.513.--this references- Test requirements for plastic pipelines.)**
- (d) Each operator shall establish a method to determine that each person making joints in plastic pipelines in the operator's system is qualified in accordance with this section.

Plastic Pipe Materials

Two different types of plastic material are used:

- Medium Density Polyethylene - MDPE (PE 2406)
 - Yellow wall
 - MAOP of 60 psig with the exception of .50 CTS *
 - * MAOP of .50 CTS is 100 psig
 - SDR - various, dependent on pipe size ex: 7, 10, 11.5, 12.5, 13.5
 - 1.25" CTS SDR 15.3 has a 56# MAX Press Rating
 - OUTDOOR STORAGE up to 3 YEARS

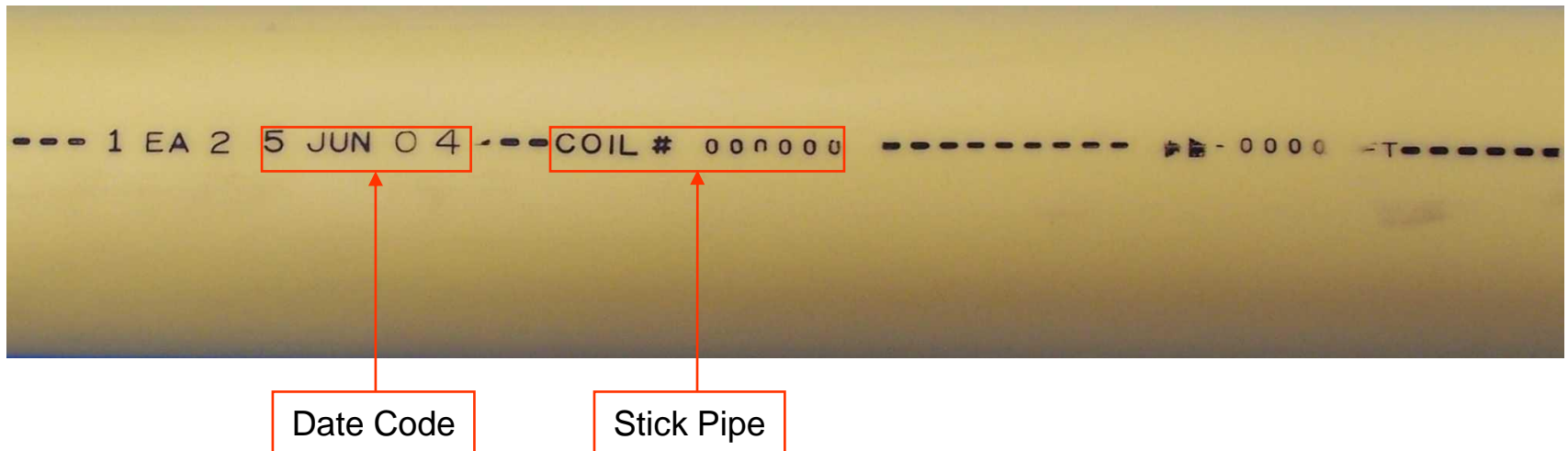
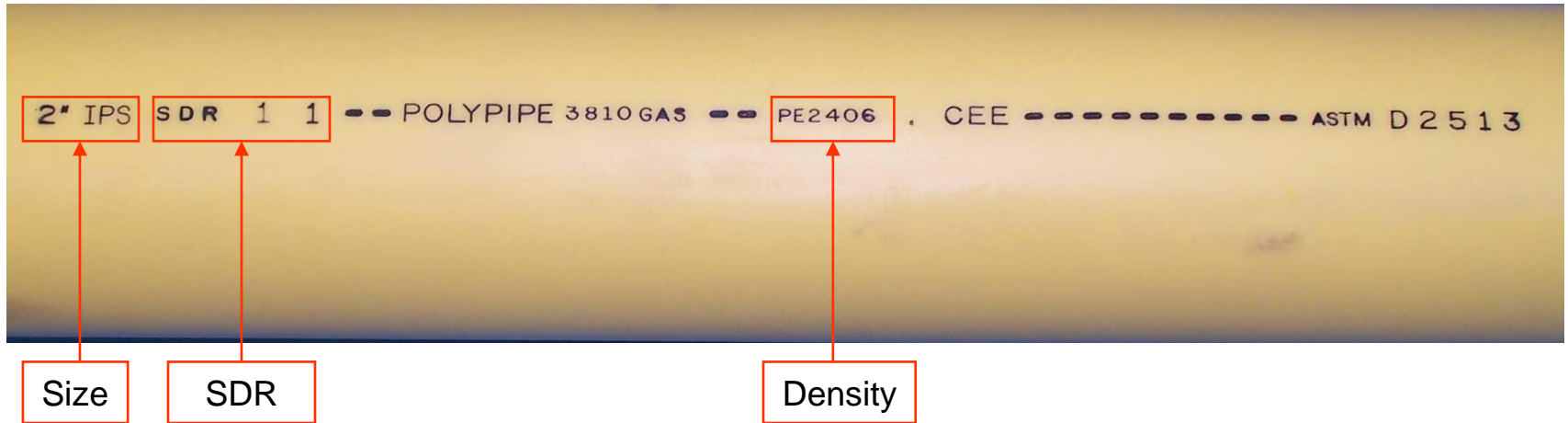
- High Density Polyethylene - HDPE (PE 3408)
 - Black wall with yellow stripe
 - MAOP of 100 psig
 - SDR - 11 for all sizes
 - OUTDOOR STORAGE up to 10 YEARS

Pipe Identification

- Information such as Density and SDR* can be found in the Print Line marking on the pipe.
- *SDR is now printed as DR with some pipe manufacturers
- The SDR is a ratio of the pipe's wall thickness to the pipe's outside diameter.

- Remember:
The higher the SDR number, the thinner the pipe wall.

Print Line



Compatibility

- Different types and thickness' of plastic melt and cool at different rates
- **Check SDR of pipe and of fittings before fusing**
- Different SDR's have different wall thickness'

Plastic Fusion Fittings

- Plastic fittings are available in:
 - MDPE (yellow)
 - HDPE (black)

- Yellow fittings marked 2406 can be used up to 100 PSIG-***The base is rated for 125# but only SDR 7 outlets are rated for 100#***

Mechanical Fittings

4 fitting categories

Good idea when qualifying field installers:

Qualify to the category the fitting is in not the specific fitting

192.281 Plastic pipe.

(e) *Mechanical joints*. Each compression type mechanical joint on plastic pipe must comply with the following:

- (1) The gasket material in the coupling must be compatible with the plastic.
- (2) A rigid internal tubular stiffener, other than a split tubular stiffener, must be used in conjunction with the coupling.
- (3) All mechanical fittings must meet a listed specification based upon the applicable material.
- (4) **All mechanical joints or fittings installed after January 22, 2019, (April 22, 2019 3" and below) must be Category 1** as defined by a listed specification for the applicable material, providing a seal plus resistance to a force on the pipe joint equal to or greater than that which will cause no less than 25% elongation of pipe, or the pipe fails outside the joint area if tested in accordance with the applicable standard.

Stab Type	
Manufacturer	Fitting
Continental Industries	I.D. SEAL CON-STAB
Elster Perfection	PERMASERTS
Elster Perfection	SERVISERTS
Nut-Follower Type	
Manufacturer	Fitting
Chicago Fitting Corp	85 Series
Chicago Fitting Corp	87 Series
Chicago Fitting Corp	750 Series
Chicago Fitting Corp	X-Riser
Continental	Continental Self Tapping Tee 1315
Dresser	Style 90
Dresser	Style 401
Lyall	Steel to PE Compression Tee
Bolted Type	
Manufacturer	Fitting
Dresser	STYLE 711
Smith Blair	Maxi-Grip EZ
Smith Blair	Maxi-Grip U
Smith Blair	EZ-Trans
Compression Type	
Manufacturer	Fitting
Dresser	Style 501
Dresser	Style 502
Dresser	Style 700
Elster Perfection	PERMALOCK Mechanical Tapping Tee
JM EAGLE	METFIT
Lyall	LYCOFIT
Lyall	O.D. SEAL TRANSITIONS
Lyall	I.D. SEAL TRANSITIONS

Stab Fitting

Permasert Brand is in the Stab fitting category



There's always some type of Pipe Preparation

- Cut the tubing end square
 - Always use a cutter designed for plastic tubing
- Inspect the tubing surface for scratches or other defects
 - visible defects on tubing shall be cut out
- Wipe tubing with a dry, clean, lint free cloth

Fitting Installation

- Check for correct diameter and wall thickness **(SDR)** on the fitting label and the tubing print line **(SDR)**
- If bag has been ripped or if fitting is otherwise contaminated, get another fitting

Always use the correct tooling for the fitting being utilized

- A Perfection chamfer tool must be used when installing *Permasert* fittings

Fitting Installation

- Always have the correct instructions on hand for the fitting being installed and be sure to have reviewed them prior to installing the fitting
- Always FOLLOW the instructions

Bolted Coupling

Dresser 711 is in the Bolted fitting category

- Bolted coupling that seals and restrains
 - no straps are required
- These couplings will be the transition from steel to plastic



Stiffeners are code required for joining plastic pipe mechanically

- 192.281.(e)(2) says: A rigid internal tubular stiffener, other than a split tubular stiffener, must be used in conjunction with the coupling.
- Select proper stiffener based on pipe size and SDR



There's always some type of pipe preparation

- Cut pipe ends square
- Clean pipe ends
 - metallic pipe must be cleaned to bare metal
 - plastic pipe must be clean and free of scratches and gouges
 - Wipe pipe with a dry, clean, lint free cloth
- Install proper stiffener in plastic end(s)

Fitting Installation

- Always have the correct instructions on hand for the fitting being installed and be sure to have reviewed them prior to installing the fitting
- Always FOLLOW the instructions

Nut Follower

Style 90 Insulated Restraining Coupling is in the Nut Follower fitting Category

- Available in sizes up to 2" in regular and reducing
- 192.281.(e)(2) says: A rigid internal tubular stiffener, other than a split tubular stiffener, must be used in conjunction with the coupling.
- Select proper stiffener based on pipe size and SDR



There's always some type of pipe prep

- Cut pipe ends square
- Clean pipe ends
 - metallic pipe must be cleaned to bare metal
 - plastic pipe must be clean and free of scratches and gouges
 - Wipe pipe with a dry, clean, lint free cloth
- Install proper stiffener in plastic end(s)

Make sure to use the proper size pipe wrench

Nominal Pipe Size (ID)	Wrench Size (in)
3/4"	14
1"	18
1-1/4"	18
1-1/2"	24
2"	24

Fitting Installation

- Always have the correct instructions on hand for the fitting being installed and be sure to have reviewed them prior to installing the fitting
- Always FOLLOW the instructions

Compression

Met Fit is in the compression fitting Category



There's always some type of pipe prep

- Cut pipe ends square
- Clean pipe ends
 - plastic pipe must be clean and free of scratches and gouges
 - Wipe pipe with a dry, clean, lint free cloth

Fitting Installation

- Always have the correct instructions on hand for the fitting being installed and be sure to have reviewed them prior to installing the fitting
- Always FOLLOW the instructions

Fusion Equipment & Gaseous Atmosphere



- Many pieces of fusion equipment use electricity.

Use caution in areas with a gas in air mixture.

- Electrofusion processor*
- Heating irons*
- Power facers*
- Hydraulic pump on 28 machine*

***These are not explosion proof.**

Electrofusion

§ 192.281 Plastic pipe.

(a) *General.* A plastic pipe joint that is joined by solvent cement, adhesive, or heat fusion may not be disturbed until it has properly set. Plastic pipe may not be joined by a threaded joint or miter joint.

- (3) An electrofusion joint must be made using the equipment and techniques prescribed by the fitting manufacturer, or using equipment and techniques shown, by testing joints to the requirements of §192.283(a)(1)(iii), to be equivalent to or better than the requirements of the fitting manufacturer.

Electrofusion

4 Steps to perform Electrofusion

- Preperation
- Assemble
- Fusion
- Cool Time

Electrofusion

- A minimum of a 3500 watt generator is recommended for this application up to 8”
- **CAUTION:** The rated capacity of a generator is typically less than the peak generator capacity; use the lower of the two stated capacities to determine suitability for use
- Always let the generator run in the **manual mode** for at least 30 seconds before turning the processor on
- Ensure generator is **DOWNWIND** of the processor so exhaust is not affecting the processor as it accurately measures the ambient temperature

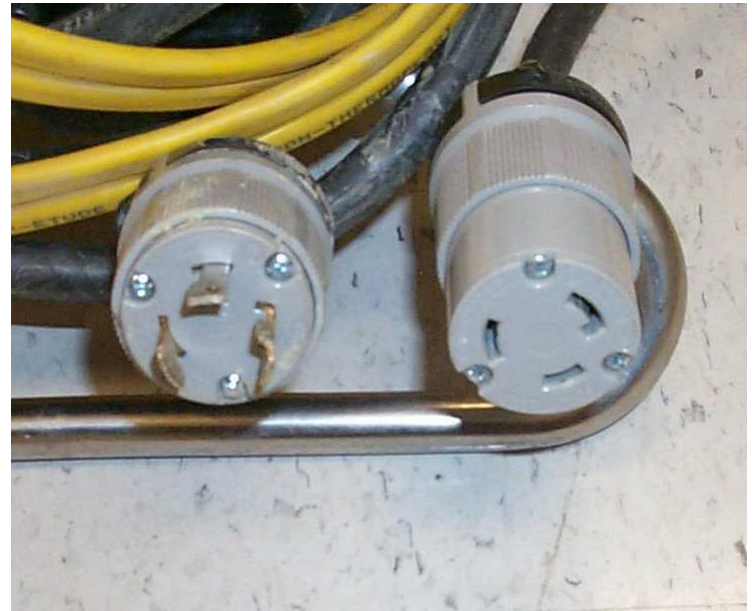


- The voltage switch must be set to 120 volts
 - GFI protected and equipped with the proper size amp circuit



Extension Cords

- Be sure to verify if extension cords can be used, keeping in mind they should be of sufficient gauge and not more than specified for the maximum length if allowed
- **For Ex: Cord Length Wire Gage**
- 25 ft. # 10/3 (6 mm²)
- 50 ft. # 8/3 (10 mm²)
- **NO #2 GAUGE WIRE IS ALLOWED IE: 12-2, 14-2**





Preparation

Cleaning the Pipe

- Leak test soap **SHALL NOT** be used to clean pipe for any fusion
 - During the initial pipe inspection and prior to scraping, the pipe can be cleaned of mud and debris with clean water. Use no detergents as wetting agents and other substances contained in detergents can be difficult to remove from the pipe and will interfere with the fusion process later. If oils are suspected to be on the pipe surface at this point, additional cleaning with 90% or greater isopropyl alcohol may be necessary.

Preparation

Lining up the Pipe



- Leave plenty of over lap when installing new pipe this will help when tying it in
- When cutting pipe, you should minimize the maximum gap between pipe ends.
- For example:
 - for 1/2" - 4" pipe = 1/8" - 5/16"
 - for 6" and 8" pipe = 1/2" and 3/4"

Preparation

Scraping the pipe

Scraping/Peeling Scraping/peeling is perhaps the most important and least understood aspect of making a sound electrofusion joint. Improper pipe preparation is overwhelmingly the leading cause of unsuccessful electrofusion joint attempts because the installer may not completely understand the goal of pipe scraping, which is to remove a thin layer of the outer pipe surface to expose clean virgin material beneath.

- **THIS STEP IS VITALLY IMPORTANT TO SUCCESSFUL FUSION JOINTS!!!!**
- **CAREFUL ATTENTION MUST BE GIVEN TO PIPE PREPARATION AND SCRAPING!!!!**

Preparation

Scraping the Pipe

- Pipe surfaces can undergo surface oxidation from the extrusion process, transportation, handling, and outdoor UV exposure. Surface oxidation is a normal chemical reaction that results in a physical change to the molecular structure of the polymer chains on the pipe surface. Oxidation acts as a physical barrier, and therefore those surfaces cannot be heat fused. Oxidation cannot be wiped away with any cleaner. Simply roughing or scratching the pipe surface is not sufficient. In order to achieve fusion this oxidized layer must be removed. Even new pipe can have surface contamination and must be properly scraped/peeled before a fusion will be successful.

Preparation

Scraping the pipe

- Always use witness marks to help identify un-scraped pipe surface areas. Allow marks to dry completely before scraping. You should use a permanent marker of a color that is visible on the pipe to mark the location of the fitting on the pipe. This mark indicates the pipe surface that will be scraped/peeled to remove contamination and oxidation. As a visual indicator, it is recommended to mark the entire fitting location or the circumference of the pipe with lines in a horizontal and vertical crisscross pattern. These “witness” marks serve as visual indicators while scraping because any marks that are still visible on the pipe after scraping are evidence that little or no pipe surface material was removed by scraping

Assembly

□ Clamping of Couplings:

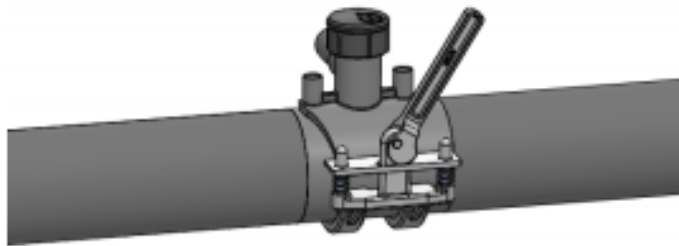
Clamps for couplings and reducers are designed to align and restrain the pipe ends on either side of the coupling. The coupling itself is not clamped and is free between the clamps:



Assembly

□ Clamping of Saddles:

Clamps are always required when fusing saddles. The clamps provide the necessary attachment to the pipe and resist melt expansion forces to achieve the intended melt pressure on the pipe. Saddle clamps may be an external mechanical clamp that is re-usable or an integrated and permanent bolt-on clamp or strap. An underclamp (or strap) is a clamp that “pulls” the fitting base onto the pipe. A top loading clamp “pushes” the fitting downward onto the pipe. Each saddle fitting has a specific clamp(s) that has been designed and qualified for use. **Substitutions are not acceptable and may result in failed fusion attempts.**



Mechanical re-usable clamp



Permanent bolt-on underpart or understrap

Fusion

- Connect leads to the fitting
- Scan the bar code
- “Shoot” the coupling

Note: Let the control box acclimate to the jobsite weather conditions for a minimum period of 15 minutes to ensure that it accurately measures the ambient temperature before beginning the fusion process.



Re-Fusion of Electrofusion Fittings

Re-Fusion

□ In the event that a fusion cycle does not complete, and is not due to incorrect assembly or a fitting fault, it may be necessary to re-fuse (restart) a fusion cycle.

⚠ **Consult your company's (or the pipeline owner's) O&M guidance to determine if re-starting a fusion is allowed. If prohibited, follow the O&M guidance.**

Only under circumstances of an input power interruption can a fitting can be re-fused. These events are typically associated with generator power loss to the control box or fusion cables being inadvertently disconnected from the fitting during the fusion cycle. Fittings that fault for any other termination causes should be removed or abandoned and replaced with a new fitting.

Cooling

- Proper observation of cooling time is important. During the heating phase of the fusion process the PE material of the pipe and fitting is heated to melting in order to allow co-mingling of the molecular structures. As the materials cool and co-crystallize into a solid state again the structures cannot be disturbed. PE is a thermoplastic that softens when heated and does not regain its full strength until cooled.

Cooling

- **Clamped cooling time:** The minimum time the fitting must remain clamped after the fusion cycle is complete. This is the time displayed by the control box.
- **Time before rough handling:** The minimum time before the joint can be subjected to forces such as pulling, lifting, or back filling.

Misaligned Electrofusion Coupling



Butt Fusion

Butt Fusion

§ 192.281 Plastic pipe.

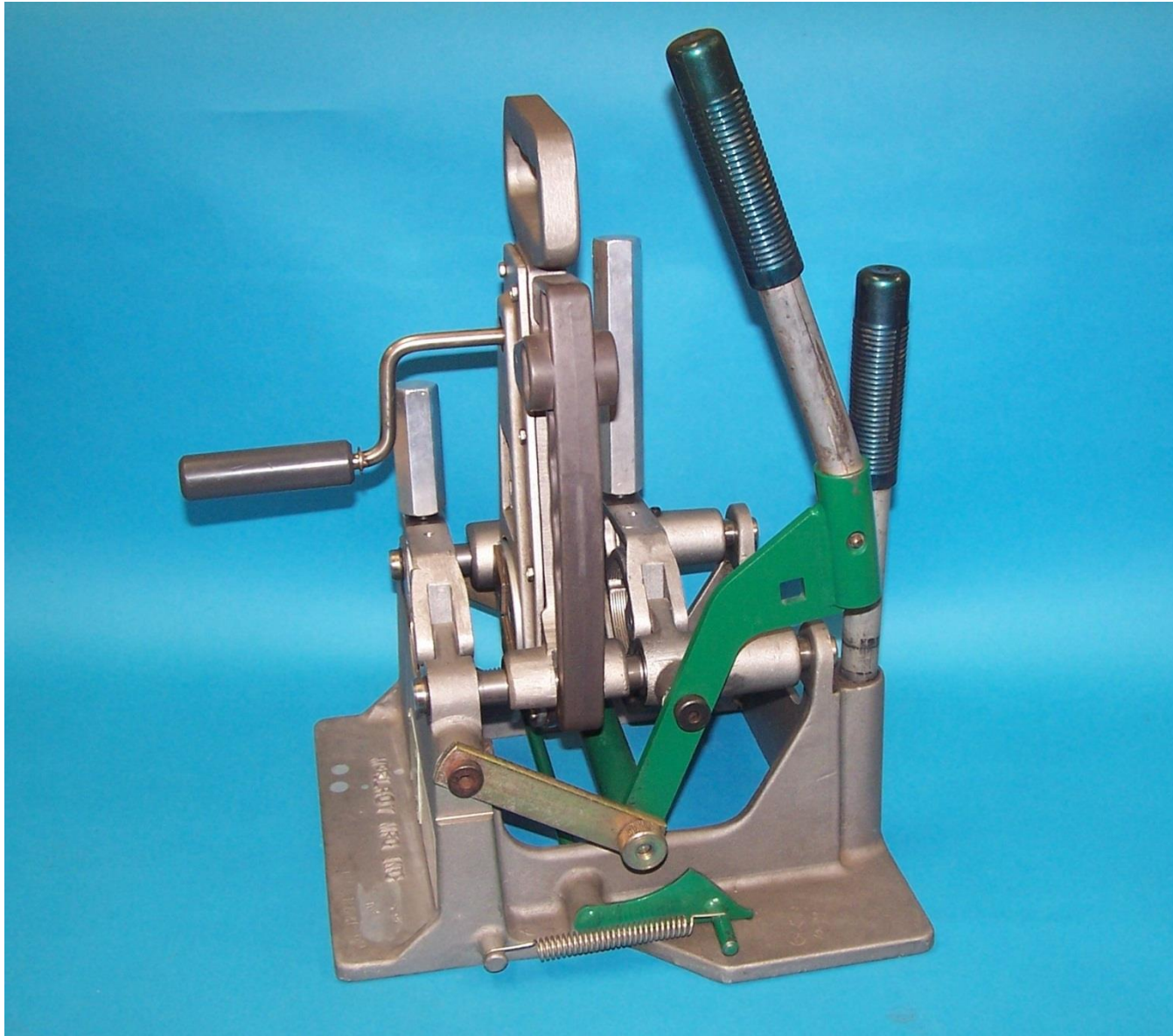
(a) *General.* A plastic pipe joint that is joined by solvent cement, adhesive, or heat fusion may not be disturbed until it has properly set. Plastic pipe may not be joined by a threaded joint or miter joint.

(C) (1) A butt heat-fusion joint must be joined by a device that holds the heater element square to the ends of the pipe or component, compresses the heated ends together, and holds the pipe in proper alignment in accordance with the appropriate procedure qualified under § 192.283

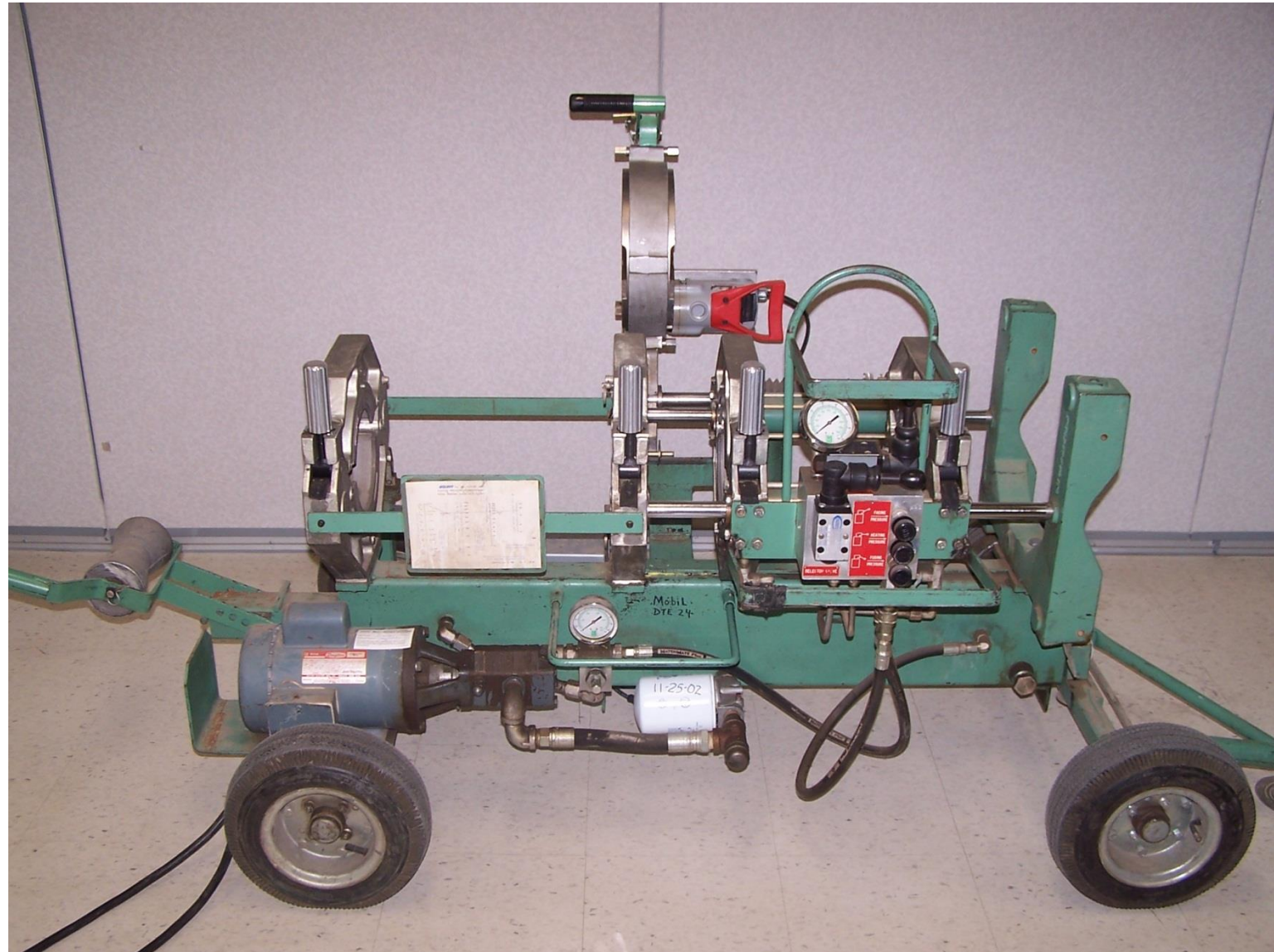
Butt Fusion

- Be sure you know what procedure you were qualified to and what your proper temperatures are.
- The gauge on a heating iron gives you the internal temperature of the iron which varies from the surface temperature
 - check heater plates with a pyrometer, before every fusion

Manual Butt Fusion Machine



Hydraulic Butt Fusion Machine



Compatibility

- Different types and thickness' of plastic melt and cool at different rates
- Check SDR of pipe and of fittings before fusing
 - Different SDR's have different wall thickness'
- Check the density of the pipe or fittings
 - 2406 or 3408
- The preferred method for joining incompatible plastic is electrofusion or a mechanical fitting.

Plastic Fusion Fittings

- Butt fusions can be used to join pipe to pipe or pipe to molded fittings.
- Plastic butt fittings are available in:
 - MDPE (yellow)
 - HDPE (black)



Surface Contact Thermometer

- These thermometers are used to check the surface temperature of heating irons



Inspect plastic

- Check pipe ends for cuts, gouges, deep scratches or other damage
(Remember the 10% rule)
- Remove surface damage at pipe ends that could affect pipe joining
 - this includes pipe that is being butt fused after being scraped in preparation for electrofusion
- Cut “necked down/toe-in” area from ends of pipe
 - too much to just face off

Inspect Heating Iron

- Wipe face of iron with clean rag
- Inspect surface of iron for scratches
 - if scratch runs through area of pipe contact do not use; replace both heating plates
 - Ensure the Iron has the teflon coating on it



Heating Cycle

- Insert heating iron closest to stationary jaw
- Close pipe ends against iron strongly enough to insure full contact
- Relax to contact pressure only
 - if pressure against the iron is maintained, melt will be squeezed away from the pipe ends
 - pipe ends will be concave
 - could result in weak fusion

Visually determine proper melt

APPROXIMATE MELT BEAD SIZE	
Pipe Size	Approximate Melt Bead Size (single bead prior to joining pipe)
1 ¼" and smaller (40mm and smaller)	1/32" – 1/16" (1-2mm)
Above 1 ¼" through 3" (40mm-90mm)	1/16" (2mm)
Above 3" through 8" (90mm-225mm)	1/8"- 3/16" (3-5mm)
Above 8" through 12" (225mm-315mm)	3/16"-1/4" (5-6mm)
Above 12" through 24" (315mm-630mm)	1/4"- 7/16" (6-11mm)

Fusion Procedure

- Open pipe ends
- Remove iron being careful not to displace melt
 - manual machines may require a quick snapping action to open ends and remove heater
- Bring pipe together quickly
- Do not slam together
 - may cause excessive displacement of melt

Fusion Procedure (cont.)

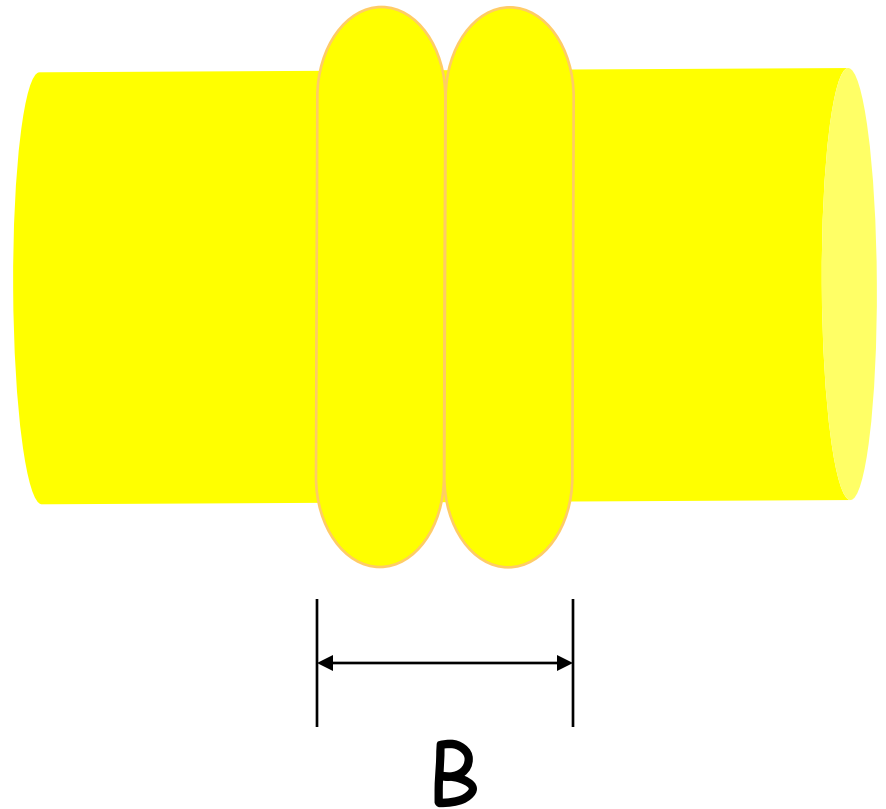
- Bring pipe ends together with enough pressure to roll the melt beads back over to the pipe surface
(Hydraulic Machines have a prescribed pressure requirement)
- Cool (**under pressure**) for about 30 – 90 seconds per inch of pipe diameter. Do not try to decrease the cooling time by applying water, wet cloths or the like.
- Avoid pulling, installation, pressure testing and rough handling for at least an additional 30 minutes.

Pipe handling considerations when removing a newly made joint from a butt fusion machine

- Under no circumstances are the pipe clamps to be loosened while the joint is cooling (30-90 seconds per inch of pipe diameter or until the surface of the melt bead is cool to the touch). This is also known as the cooling time (clamped).
- After the cooling time (**clamped**) has elapsed follow the equipment manufacturer's instructions for releasing pressure on the joint and opening the clamps/jaws.
- * If the pipe must be moved prior to the required cooling time
- After the required clamped time has elapsed the pipe may be lifted by human force only and by the minimum amount necessary. It must be accomplished by supporting both sides of the fused joint as parallel to the adjacent ground as reasonably possible to facilitate careful removal of the fusion equipment. The pipe can then be gently returned to the same plane where the fusion took place
- The pipe movement should not exert excessive force on the joint. Excessive force such as pressure testing, backfilling, bending, dragging and pulling can lead to fusion joint damage.
- If conditions make it difficult to keep the pipe and joint supported, the pipe should not be moved until the additional rough handling time has elapsed.

Bead Width

- Bead width, “B”, is the overall width of the double bead rollback



Proper Rollback

<u>Pipe</u>	<u><i>Approximate FINAL Bead width</i></u>
1¼"	1/32" – 1/16"
Above 1¼"- 3"	1/16"
Above 3" – 8"	1/8" - 3/16"
Above 8"- 12"	3/16" - 1/4"

- The double bead width should be 2-2½ times its height
- bead shall be uniform in size and shape all the way around
- joint shall not be mitered
- “ S “ Configuration when fusing coiled pipe

Compatibility

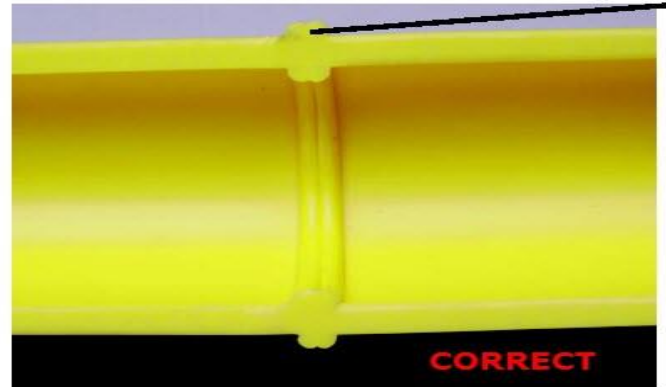
- A properly made butt fusion will have:
 - an evenly sized double rollback bead around the circumference of the pipe,
 - no gaps or voids, and
 - no misalignment of the pipe
 - Check SDR of pipe and of fittings before fusing
 - Different SDR's have different wall thickness'
 - Use electrofusion or a mechanical fitting to join incompatible plastic.

Melt Pressure Comparison

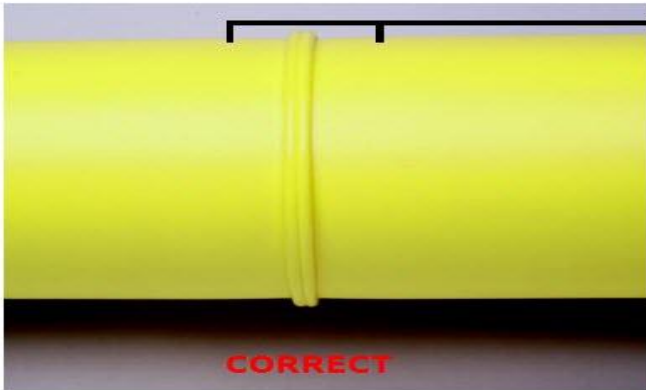
ACCEPTABLE FUSIONS



Proper double roll-back bead
Proper alignment



Proper double roll-back bead



Proper alignment



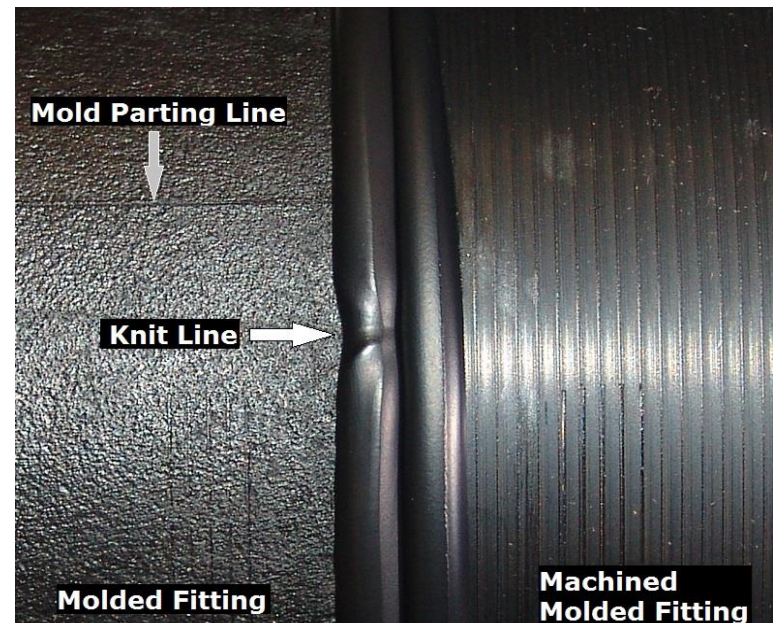
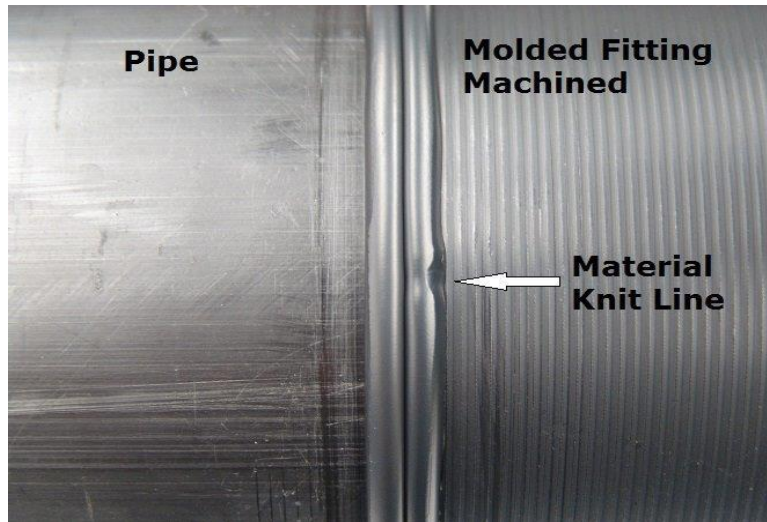
No gaps or voids when bent

Correctly made butt fusion



ACCEPTABLE FUSIONS – MOLDED FITTINGS

When butt fusing to molded fittings, the fitting side bead may display shape irregularities such as minor indentations, deflections, and non-uniform bead rollover from molded part cooling and knit lines. In such cases, visual examination is based mainly on the size and shape of the pipe-side bead. Below are examples of acceptable fusion joints between PE molded fittings and pipe.



UNACCEPTABLE FUSIONS



Insufficient heat time; melt bead too small



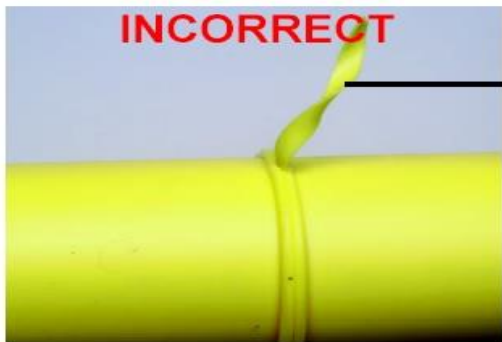
Excessive heat time or pressure applied during heating; melt bead too large



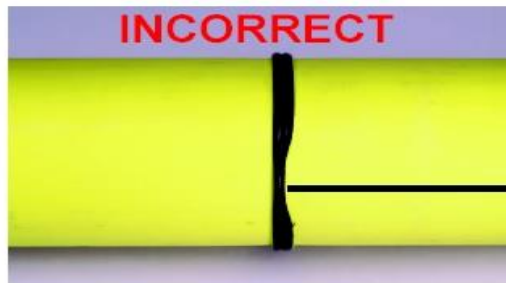
Pipe angled into fusion unit



Improper "High-Low" alignment



Incomplete face off or failure to remove faced off ribbons



Incomplete face off

Mitered Fusions

- The joint appears angled
- Mitered fusions are not acceptable regardless of the appearance of the fusion bead and rollback



Contaminated Fusions

- Fusions are unacceptable if:
 - there is any object protruding from the melt bead area
 - this includes any sized pieces of shavings
 - the bead has a lump or bump in it
 - there are bubbles in the melt area

THANK YOU

- Program review
- Questions and answers
- Always refer to your companies specific O-M

