

APPENDIX E.

Polyethylene Gas Pipe Fusion Training Procedures and Certification

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CITY OF PALO ALTO: Polyethylene Gas Pipe Training Procedures

A) HEAT FUSION TOOLS

1) BUTT FUSION

NOTE: The manufacturer's operating instructions must be adhered to insure acceptable fusions.

I) Heating Iron

The heating irons are NOT EXPLOSION PROOF and shall not be used in any area with gas present while still connected to a power source.

An electrically resistive coil in the heating iron maintains the temperature at a level sufficient for fusion. The irons operate on 110 volts A.C. with power requirements ranging from 1200 watts McElroy No. 14 to 1750 watts McElroy No. 28 Auto Mac. Teflon coated faces are utilized on both sides of the iron. Extreme care must be exercised to avoid scratching the faces; only cotton cloths should be used for cleaning. The faces are either an integral part of the iron or are detachable and must be recoated when scratched. A dial type thermometer is placed next to the handle. The iron temperature can be adjusted by changing the calibration set screw. The heating iron for the Auto Mac must be connected to the proper outlet on the butt fusion machine, DO NOT attach the iron to any other source as it does not self regulate and it will be burned out.

II) Butt Fusion Machine

The butt fusion machine consists of mobile and stationary alignment clamps that hold the pipe ends during the fusion process. These clamps transfer the force and associated pressure required to fuse the pipe.

III) Alignment Clamp Inserts

Two sizes of inserts are supplied for the 4" machines (2" and 3" IPS). The No. 28 machine also has two inserts (4" and 6" IPS).

IV) Facer

Either manual or electrical facers are provided for the butt fusion machines. The electrical facers are NOT EXPLOSION PROOF and shall not be used in any area with gas present.

2) ELECTRO FUSION

NOTE: The manufacturer's operating instructions must be adhered to insure acceptable fusions.

I) Universal Control Box

This unit controls the fusion process. It processes information received from the optical wand that is used to determine the fitting manufacturer and appropriate fusion times. It also stores fusion related information, which can be downloaded for record information.

II) Optical Wand

This device reads the uniform product code UPC sticker on the fitting.

III) Couplings

A resistant wire embedded in the coupling provides the energy required for fusion.

a) Alignment Clamps

Only required for 2" and larger sizes. These devices align and immobilize the pipe ends and coupling during the fusion and cool down periods.

b) Pipe Scrapers

Three types of scrapers are used to remove oxidation and contaminants from the outside pipe wall prior to electro fusion coupling installation. A paint scraper may be used on 1/2" and 1" CTS sizes only. Virax type or interior anchored pipe scraper can be used on 1/2" CTS - 6" IPS sizes. Additionally, full encirclement Scrapers can be used on 2" - 8" pipe sizes.

IV) Tapping Tees

The tees also have a resistant wire coil that provides the energy for fusion. They require either a back up under saddle or a ratchet operated clamp to fix the tee to the main during fusion. A threaded cutter is included for tapping the main.

a) Service Line Alignment Clamp

When applying the service line to the outlet of a tapping tee an alignment clamp shall be used to insure that the outlet and the service line are straight. This unit also immobilizes the coupling during the fusion and cool down periods.

b) Ratchet Clamp

All pipe sizes require the use of a hold down clamp or backing plate to secure the tapping tee onto the main during fusion.

3) MISCELLANEOUS TOOLS

I) Pipe Cutters

a) "Plier" type cutters for use on 1/2" CTS - 2" IPS sizes.

b) A guillotine type cutter shall be used on 3" and larger sizes.

II) Pipe Squeeze Off Tools

a) Manual squeeze off tools are provided for 1/2" CTS - 2" IPS sizes. These tools are equipped with stops for each pipe size that prevent over squeezing of the pipe.

b) Hydraulic squeeze off tools are necessary for the larger pipe sizes, 3" - 8". These tools are also equipped with stops for each pipe size.

III) Pyrometer

The pyrometer is used to check the surface temperature of the heating irons. It consists of a hand held display unit and an attached surface probe.

B) **MANUAL BUTT FUSION PROCEDURES**

- 1) Energize the heating iron. Once the heater has reached maximum temperature, generator cycles off, check the thermometer for $500^{\circ} \pm 25^{\circ}\text{F}$.

At the start of each day, the reading of the dial thermometer shall be checked against the surface temperature by use of the pyrometer and the heating iron calibration set screw adjusted accordingly (manual machines only).

Note: DO NOT adjust the heating iron for the AutoMac unit as it is regulated (controlled) by the microprocessor.

- 2) Install the proper size alignment clamp inserts if required.
- 3) Inspect the pipe and/or fitting ends and cut off any damaged or flattened portions.
- 4) Clean each pipe/fitting end with a clean cotton cloth and place them in the alignment clamps. Pipe ends should overlap the alignment clamps by approximately 1/2".
- 5) Place the manual or the motorized facer on the guide rods and bring the pipe ends in contact with it. Turn the manual facer in the direction of the arrow or turn the motorized facing unit on and apply light force on the carriage lever to advance the pipe ends. The motorized facer speed will increase when the pipe has bottomed out.
- 6) Retract the carriage lever and remove the facer. Discard the strips of material from the pipe ends taking care not to touch the clean surfaces. Check the discarded strips to insure that a continuous length from the entire diameter has been removed.
- 7) Check alignment of the pipe ends and adjust for high-low if necessary. If an adjustment is made or a visible gap exists between the pipe ends, repeat the procedures from Step 4.
- 8) Wipe heater with a non-synthetic clean dry cloth and place it on the guide rod(s) and bring the pipe ends into contact with it. Maintain a light force on the carriage until a small melt bead forms around the entire circumference of both pipe ends. Relax the force on the carriage but keep both pipe ends in contact with the heater and start the melt time cycle. Refer to Table 1 for proper melt times.
- 9) After the melt time has been observed snap the carriage back (open) and quickly remove the heater being careful not to hit the melt.
- 10) Inspect the pipe ends for complete melt. Bring the pipe ends together quickly, DO NOT SLAM, applying only enough pressure to form a double roll back bead. The proper bead thicknesses are shown in Table 1. Over-pressuring the melt will cause the bead to overlap itself resulting in a subquality fusion due to displacement of the melt to the OD and ID of the joint leaving a cold ring in the center. Under pressuring can result in inadequate fusion due to insufficient contact pressure in the melt area.
- 11) Maintain the pressure exerted on the fusion area for one minute for 1/2"-4" sizes and for three minutes for 6". Relaxing the pressure prior to expiration of the cooling time can result in

porous fusion joints.

- 12) Allow the joint to cool for additional three to four minutes (see Table 1) prior to removal from the alignment clamps. The pipe can now be handled with care. Complete cooling requires approximately twenty minutes.
- 13) Check the melt bead for uniformity and size. If the joint exhibits poor characteristics, determine the cause, make the necessary corrections, cut out the suspect joint, and repeat the procedure from Step 4.
- 14) Clean the heater faces with a clean cotton cloth. DO NOT use synthetic cloths or metal implements.

TABLE 1: Manual Butt Fusion Parameters

Pipe Size	Melt Bead Size	Heating Time (seconds)	Hold Time (seconds)	Cooling Time (minutes)
1/2" CTS	1/16"	3-6	60	3
1" CTS	1/16"	5-9	60	3
2" IPS	1/16"-1/8"	15	60	4
3" IPS	1/8"	20	60	4
4" IPS	1/8"	20	60	4
6" IPS	3/16"	30	180	4

C) AUTOMATED BUTT FUSION PROCEDURES

Follow the appropriate manufacturer's procedures when producing butt fusion with automatic equipment.

D) ELECTRO FUSION PROCEDURES

NOTES: See the Universal Control Box Manufacturer's literature for fusion information. The manufacturer's literature must be adhered to insure acceptable fusions.

In the event that the supply voltage varies outside of the stated limits the fusion cycle will be interrupted. A new cycle can be started after a ten-minute cool down period has been observed. The fusion system will automatically adjust the duration of the cycle to compensate for the previously aborted attempt. A maximum of three attempts may be tried. If the tapping tee has already been tapped, **NO** retries are allowed.

E) MAIN INSTALLATION PROCEDURES

1) DIRECT BURIAL

- l) Excavate 34" plus pipe diameter deep trench.

- II) Make sure trench bottom is level and free of sharp objects, rocks or other materials that may damage pipe.
 - III) Shade trench with 4" min. sand bed and level sand as needed.
 - IV) Install a #10 copper tracer wire adjacent to pipe.
 - V) Install pipe in trench and snake it. Observe pipe during installation for scratches, gouges or others defects. Avoid dragging pipe over rough surfaces and scratching it.
 - VI) Pressure test pipe with 100 PSIG air for 24 hours.
 - VII) Backfill to top of pipe and haunch the sides.
 - VIII) Backfill trench with 12" lifts of sand and compact to 95% compaction.
 - IX) Purge pipe.
- 2) INSERTION
- I) Two methods may be used to identify possible obstructions in the pipe to be inserted:
 - Video inspection of the existing pipe
 - Pulling of a proof piece of similar diameter pipe through the section to be inserted and inspection of it for damage.

All obstruction must be removed prior to insertion of a gas main.
 - II) At the location of all service tees a section of main must be removed prior to insertion to allow installation of a tapping tee.
 - III) Deburr casing ends, run mechanical brush, and use compressed air to blow debris out of casing. Install a suitable casing cable protector on the casing end to protect the pipe coating from damage.
 - IV) Attach a #10 copper tracer wire to existing steel pipe casing. If the casing is plastic attach the tracer to the new pipe.
 - V) Seal end of the pretested pipe to be inserted with an end cap. Insert the pretested pipe into existing casing taking care not to scrape it at the entrance. Pipe shall be extended at least two feet past the casing end and inspected for gouges and scratches. If damaged, replace the pipe and go back to Step I.
 - VI) Leak test pipe with 100 PSIG air applying water soap mixture to all joints and verify no leakage is present.
 - VII) Purge pipe.
- 3) DIRECTIONAL BORING
- I) Prospect/expose all existing underground utility services/facilities prior to boring. Additionally, all private sewer laterals must be potholed to determine exact vertical and horizontal position before boring.
 - II) After establishing the pilot hole, a back reamer/compactor must be used. The back

reamer/compactor must be a minimum 2 times larger than the nominal diameter of the pipe that will be pulled in.

- III) A commercially available weak link must be used on the pull head to avoid damaging the pipe during pull in.
- IV) Attached an end cap and tracer wire to the pipe prior to pull in.
- V) Care must be taken to avoid scraping or gouging the pipe during pull in. Rollers shall be used at all bend points in the launching pit and every 15' along the pipe. **Pipe shall not be dragged on street surface.**
- VI) After pull in, check continuity of tracer wire.
- VII) Install service tees and bore in service lines.
- VIII) Care must be exercised, when filling service and sewer pits, to insure proper backfill and support of installed pipe. Fill pits up to the top of pipe and hand tamp backfill around pipe haunch.

F) SERVICE INSTALLATION PROCEDURES

1) DIRECT BURIAL

- I) Excavate 24" plus pipe diameter deep trench.
- II) Make sure trench bottom is level and free of sharp objects, rocks or others materials that may damage pipe.
- III) Install a #10 copper tracer wire adjacent to pipe.
- IV) Install pipe in trench. Always "snake" the pipe in the trench bottom during installation (This insures that when the pipe contracts at lower temperatures it won't pull out from connections). Observe the pipe during installation for scratches, gouges or others defects.
- V) Attach ASR or insert existing riser.
- VI) Install tapping tee and connect service line to it, including installation of an excess flow valve.
- VII) Pressure test pipe with 100 PSIG air for 15 minutes and check all connections for leaks.
- VIII) Tap main and purge pipe.
- IX) Backfill pipe and replace the landscape in kind.

2) INSERTION

- I) Deburr casing ends and use compressed air to blow debris out of casing. Install a suitable casing cable protector on the casing end to protect the pipe coating from damage.
- II) Attach a #10 copper tracer wire to existing steel pipe casing. If the casing is plastic

attach the tracer to the new pipe.

- III) Seal end of pipe to be inserted with an end cap. Insert pipe into existing casing taking care not to scrape it at the entrance. Pipe shall be extended at least two feet past the casing end and inspected for gouges and scratches. If damaged, replace the pipe and go back to Step I.
- IV) Install tapping tee and connect service line to it.
- V) Pressure test pipe with 100 PSIG air for 15 minutes and check tapping tee for leaks.
- VI) Tap main and purge pipe.

3) BORE

- I) Establish a service bore hole with a pneumatic or similar gopher type boring device.
- II) Verify depth at meter end of bore hole. If bore hole is less than 24" deep, restart procedure from Step I.
- III) Install an end cap and attach a #10 tracer wire to service line.
- IV) Insert service line into bore hole.
- V) Attach an ASR to the meter end of service line.
- VI) Install a service tee and connect the service line to it.
- VII) Pressure test pipe with 100 psig air for 15 minutes and check tapping tee for leaks.
- VIII) Tap main and purge pipe.

G) **ADDITIONAL TOPICS**

1) SQUEEZE OFF

- I) Set the pipe stops to the appropriate diameter.
- II) Ground the squeeze machine and the pipe end.
- III) Take your time while squeezing the pipe, advance the squeeze a little bit each time and then allow the pipe to conform to the new set before continuing the process. Complete shut off may not be achieved in the larger sizes.
- IV) Perform the repair.
- V) Remove the squeezer, allowing for the pipe to expand in steps during the removal.

2) MAIN REPAIRS

Control the gas flow by closing valves or by installing pipe squeezers. Depending on the cause, either install a clamp or cut out the damaged portion and install a short section of PE. If working on PE use two electro fusion couplings to make connections. With materials other than PE use two Maxi Grip Couplings and required stiffeners.

3) **SERVICE REPAIRS**

If the service piping material is other than PE, replace the entire pipe with PE, including retapping the main with a new service tee. Abandon the old tee at the main.

If the service pipe is PE and the failure is pull out related (either by a third party or temperature contraction) replace the entire line. With dig in situations, control the flow and use either of the approved fusion methods to repair the line.

H) **METFIT**

1" X 1/2" and 1" MetFit couplings shall be installed with the MetFit V-Tool. MetFit V Tool shall be used in accordance with the manufacturer's literature.

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Name: _____

Date: _____

Title: _____

Individual should be tested on all procedures he/she is to be certified under. (Unmarked boxes constitute failure in that type procedure)

BUTT FUSION MANUAL

- 1. Pipe ends were faced properly.
- 2. Removed cuttings from interior of pipe.
- 3. Aligned pipe ends and adjusted for "high-low".
- 4. Verified heating iron temperature.
- 5. Observed recommended melt bead prior to timing.
- 6. Observed recommended melt time.
- 7. Maintained pressure on fusion during recommended cool down period.
- 8. Allowed joint to cool in machine for recommended period.

BUTT FUSION AUTOMATIC

- 1. Observed fusion machine manufacturer's recommended procedures.

ELECTRO FUSION

COUPLINGS

- 1. Pipe ends were cut square and even.
- 2. Cleaned pipe inside and out.
- 3. Measured and marked pipe ends.
- 4. Scraped pipe ends.
- 5. Took proper precautions to avoid contamination of pipe ends.
- 6. Cleaned fitting and pipe ends with alcohol.
- 7. Properly installed pipe in alignment tool.
- 8. Centered fitting between marks.
- 9. Connected control box to proper 110 volt A.C. power source in correct sequence.
- 10. Verified the operation of sensor switches. (If Innogaz System)
- 11. Had thorough understanding of operation sequence and warning light functions.
- 12. Swiped fitting UPC with optical wand.
- 13. Noted time that FUSION START BUTTON was depressed.
- 14. Marked time of day on pipe at end of fusion.
- 15. Removed leads from fitting 30 seconds or longer after fusion was over.
- 16. Verified presence of plastic flow into both wells. (If Innogaz System)
- 17. Allowed fitting to cool in secured position for recommended time.

TAPPING TEES

- 1. Cleaned pipe around fusion zone.
- 2. Scraped entire pipe surface that will fall under tee.
- 3. Took proper precautions to avoid contamination of scraped pipe.
- 4. Cleaned fitting and scraped area with alcohol.
- 5. Placed tee on scraped area.
- 6. Properly installed under-saddle/hold-down clamp.
- 7. Connected control box to proper 110 volt A.C. power source in correct sequence.
- 8. Verified the operation of sensor switches.
- 9. Had thorough understanding of operation sequence and warning light functions.
- 10. Swiped fitting UPC with optical wand.
- 11. Noted time that FUSION START BUTTON was depressed.
- 12. Marked time of day on pipe at end of fusion.
- 13. Removed leads from fitting 30 seconds or longer after fusion was over.
- 14. Verified presence of plastic flow into both wells.
- 15. Allowed fitting to cool in secured position for recommended time.
- 16. Outlet Connection:
 - a. Pipe end had square cut.
 - b. Cleaned pipe end and outlet.
 - c. Measured and marked pipe end.
 - d. Scraped pipe and outlet end.
 - e. Cleaned fitting and scraped areas with alcohol.
 - f. Installed fitting properly.
 - g. Followed proper fusion procedure.
 - h. Immobilized pipe during fusion and cool down periods.

JOINT EVALUATION

Visual Examination (During and after assembly. Compare to Photograph or sample of acceptable joint.)

Procedure/Joint Appearance

PROCEDURE		JOINT APPEARANCE		ADDITIONAL INSTRUCTION REQUIRED IN
		PASS	FAIL	
BUTT FUSION				
ELECTRO FUSION	COUPLING			
	TAPPING TEE			

DEFORMATION TEST

- Specimen cut into longitudinal straps. (Joint should be free of voids or unbonded areas on surface.)

Joint Evaluation (Visual)

PROCEDURE		JOINT APPEARANCE		APPARENT CAUSE OF FAILURE
		PASS	FAIL	
BUTT FUSION				
ELECTRO FUSION	COUPLING			
	TAPPING			

Joint Evaluation (Deform joint by bending or compression.)

PROCEDURE		JOINT APPEARANCE		APPARENT CAUSE OF FAILURE
		PASS	FAIL	
BUTT FUSION				
ELECTRO FUSION	COUPLING			
	TAPPING			

Inspector _____

Individual demonstrated the ability to follow the recommended procedures and produce acceptable fusion joints.

Yes No

RECOMMENDATION:

- Retest Required.
- Certification Card Issued/Date _____
- Re-Certification Card Issued/Date _____

Certified in the following application(s):

- Butt Fusion
- Couplings
- Tapping Tees

Authorized Observer/Tester

Date