UNDERGROUND CONSTRUCTION TECHNOLOGY
THE UNDERGROUND UTILITIES EVENT | JANUARY 25-27, 2022 | FORT WORTH, TEXAS

Pipeline Construction Inspection Guidelines

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Presentation Goals

Re-inforce importance of:

- Collecting records before assets are buried
- Verifying all materials meet specifications
- Verifying that installers are qualified for work specified
- Verifying that fabrication equipment/tooling is capable/functional
- Capturing images for future maintenance activity
- Knowing underground location (GPS) of all fittings, pipe alignment, etc.
- Uploading all of the above information into a Geographical Information System (GIS)

16” HDPE Water Main Fabrication

Municipal Advisory Board (MAB)

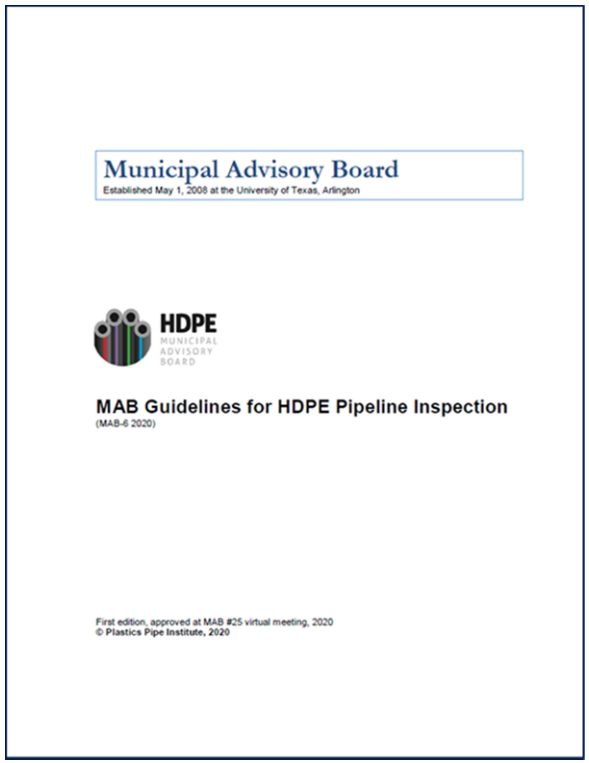
https://plasticpipe.org/MunicipalAdvisoryBoard?hkey=0332405c-e02d-4c01-969e-2a3d42c2a58b

- Group of water distribution companies/Cities nationwide
- User Members have realized the benefits of HDPE water systems
- User Members concerns addressed by prioritizing document development
- Task Group teams formed of User Members, manufacturers and consultants for each document produced

MAB Accomplishments

https://plasticpipe.org/MunicipalAdvisoryBoard?hkey=0332405c-e02d-4c01-969e-2a3d42c2a58b

- MAB -1: Generic Electrofusion Procedure for Field Joining of 12 inch & Smaller Polyethylene Pipe (≤305mm)
- MAB-2: Generic Electrofusion Procedure for Field Joining of 14 inch to 30 inch Pipe (355mm-762mm)
- MAB-3: Model Specification for PE 4710 Buried Potable Water Service, Distribution and Transmission Pipe & Fittings
- MAB-4: Basic HDPE Repair Options
- MAB-5:Guidelines for PE 4710 Pipe Bursting of Potable Water Mains
- MAB-6: Guidelines for HDPE Pipeline Inspection
- MAB-7: Guidelines for Use of Mini-Horizontal Directional Drilling for Placement of HDPE (PE4710) Pipe in Municipal Applications



MAB – 6 Guidelines for HDPE Pipeline Inspection

MAB-6 Document

https://plasticpipe.org/Shared_Content/Publications/MAB-Publications/MAB-6-Main.aspx
(intended for field use by providing forms for documentation)

- Introduction
- Appendix A – HDPE Material Inspection Forms
- Appendix B – HDPE Equipment Qualification Forms
- Appendix C – HDPE Connection Inspection Forms
- Appendix D – HDPE Pressure Testing Form
- Appendix E – Other Sources of Information

14” Butt Fusion/MJ Joint Adapter Fitting

Appendix A -HDPE Material Inspection Forms

- Pipe
- Molded and Fabricated Fittings
- Electrofusion Fittings
- Mechanical Fittings

Project HDPE Pipe Storage - 8”, 12”, 14”, 16”

MAB-6 APPENDIX A: HDPE INCOMING MATERIAL INSPECTION/QC FORM

Project Name: _____ Project Number: _____
Inspector Name: _____ Employee Number: _____
Date: _____

PIPE

All of the following data is available in the print line of the pipe. (One form should be completed for each pipe OD delivered)

Pipe Supplier/Vendor Name: _____

Manufacturer Name: _____ Manufacturer Date: _____

Manufacturing Standard: □ C906 (AWWA) □ C901 (AWWA) □ Other (ex. ASTM F714)

Material Certification: □ NSF 61 □ Other _____

Type of HDPE Material: □ PE4710 □ Other _____

Diameter Sizing: □ CTS □ DIPS □ IPS □ Other _____

Pipe OD: ____inches

Pipe Pressure Class (PSI)/SDR: □ 250/9.0 □200/11.0 □160/13.5 □125/17 □Other ____

See Appendix F for pipe dimension standards.

Pipe Packaging: □ Coil Length of coil _____

□ Straight Lengths- Individual Length: □ 40ft □50 ft □Other ____

Total Length Delivered: _____ ft

Damage:

Manufacturing Defect: □Out of tolerance OD
□Out of tolerance ID
□Charred material in pipe
□Voids/ Inclusions/ Non-uniformity/ inconsistent pigmentation
□Mismarking
□Other: _____

Handling/Shipping: □Scratching/ Gouging/ Other defects
□Strapping (band damage)
□Lifting equipment damage
□Missing end caps

Amount of Pipe Rejected: _____ ft

Amount of Pipe Accepted: _____ ft

A 1

Appendix B – HDPE Equipment Qualification

- Conventional Heat Fusion
  - Socket Fusion
  - Sidewall Fusion
  - Butt Fusion (hydraulic & manual)
- Electrofusion
  - Couplings
  - Sidewall
- Generator
- Ancillary Tooling (peelers, alignment clamps, etc.)

Typical Tooling Required
For EF Saddle Installation

MAB-6 APPENDIX B: HDPE EQUIPMENT QUALIFICATION

Project Name: _____ Project Number: _____
Inspector Name: _____ Employee Number: _____
Contractor Name: _____ Contractor Contact/ #: _____
Date: _____

GENERATOR

Make/ Manufacturer: _____ Model: _____ Serial Number: _____

Output Capacity: _____ Last Recorded Maintenance Date: _____

Verification Method of Output: _____ Date: _____

Caution: Welding generators are not recommended as power supply for fusion.

Does the generator meet the minimum requirements of the equipment to be powered?

□ Yes □ No

The following Tag should be attached to all generators used to power HDPE fusion equipment for field employees/inspectors to verify qualification for the specific generator in use. Consideration should be used for the Tag material which will last for the duration of the project (plastic coated, plastic, water proof).

Sample Tag

Qualified Generator
(Company/Owner Name Here)
Make: _____ Model: _____
Serial Number: _____
Qualification Number: _____
Qualification Date: _____
Employee Issuing Qualification: _____
Employee Number: _____

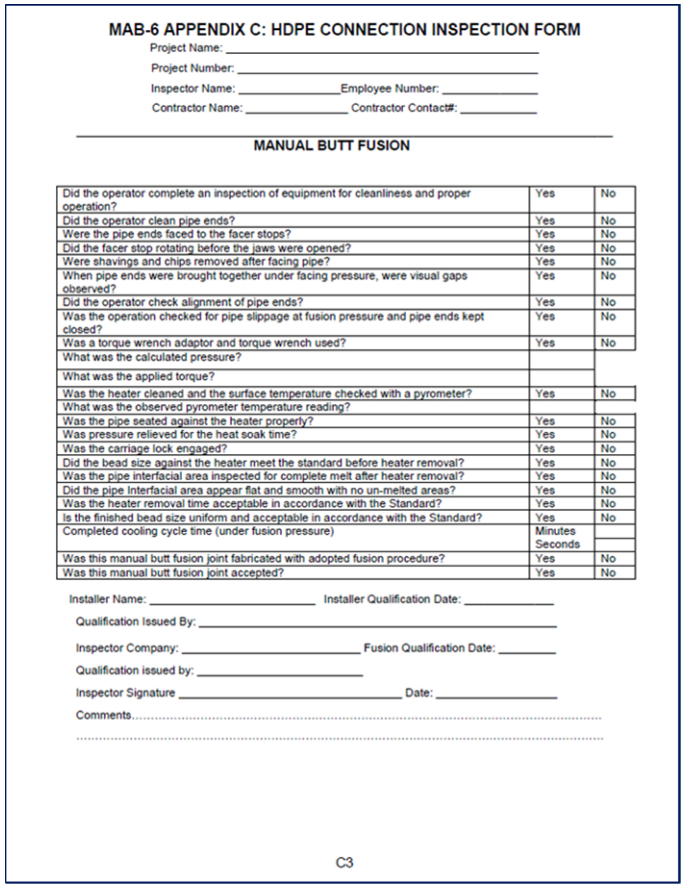
○ (hole for zip tie attachment)

There are multiple sources of generator testing equipment available; one source is: https://www.sotcher.com/Load_Bank_Generator_Test_Sets/

Appendix C – HDPE Connection Inspection Conventional Heating Forms

- Butt Fusion (manual or hydraulic)
  - Tooling review
  - Fusion Technician Qualification
  - Interfacial pressure
  - Iron temperature verification
  - Heating time
  - Bead size/uniformity

14” Butt Fusion



MAB-6 APPENDIX C: HDPE CONNECTION INSPECTION FORM

Project Name: _____

Project Number: _____

Inspector Name: _____ Employee Number: _____

Contractor Name: _____ Contractor Contact#: _____

MANUAL BUTT FUSION

Did the operator complete an inspection of equipment for cleanliness and proper operation?	Yes	No
Did the operator clean pipe ends?	Yes	No
Were the pipe ends faced to the facer stops?	Yes	No
Did the facer stop rotating before the jaws were opened?	Yes	No
Were shavings and chips removed after facing pipe?	Yes	No
When pipe ends were brought together under facing pressure, were visual gaps observed?	Yes	No
Did the operator check alignment of pipe ends?	Yes	No
Was the operation checked for pipe slippage at fusion pressure and pipe ends kept closed?	Yes	No
Was a torque wrench adaptor and torque wrench used?	Yes	No
What was the calculated pressure?		
What was the applied torque?		
Was the heater cleaned and the surface temperature checked with a pyrometer?	Yes	No
What was the observed pyrometer temperature reading?		
Was the pipe seated against the heater properly?	Yes	No
Was pressure relieved for the heat soak time?	Yes	No
Was the carriage lock engaged?	Yes	No
Did the bead size against the heater meet the standard before heater removal?	Yes	No
Was the pipe interfacial area inspected for complete melt after heater removal?	Yes	No
Did the pipe Interfacial area appear flat and smooth with no un-melted areas?	Yes	No
Was the heater removal time acceptable in accordance with the Standard?	Yes	No
Is the finished bead size uniform and acceptable in accordance with the Standard?	Yes	No
Completed cooling cycle time (under fusion pressure)	Minutes Seconds	
Was this manual butt fusion joint fabricated with adopted fusion procedure?	Yes	No
Was this manual butt fusion joint accepted?	Yes	No

Installer Name: _____ Installer Qualification Date: _____

Qualification Issued By: _____

Inspector Company: _____ Fusion Qualification Date: _____

Qualification issued by: _____

Inspector Signature _____ Date: _____

Comments.....

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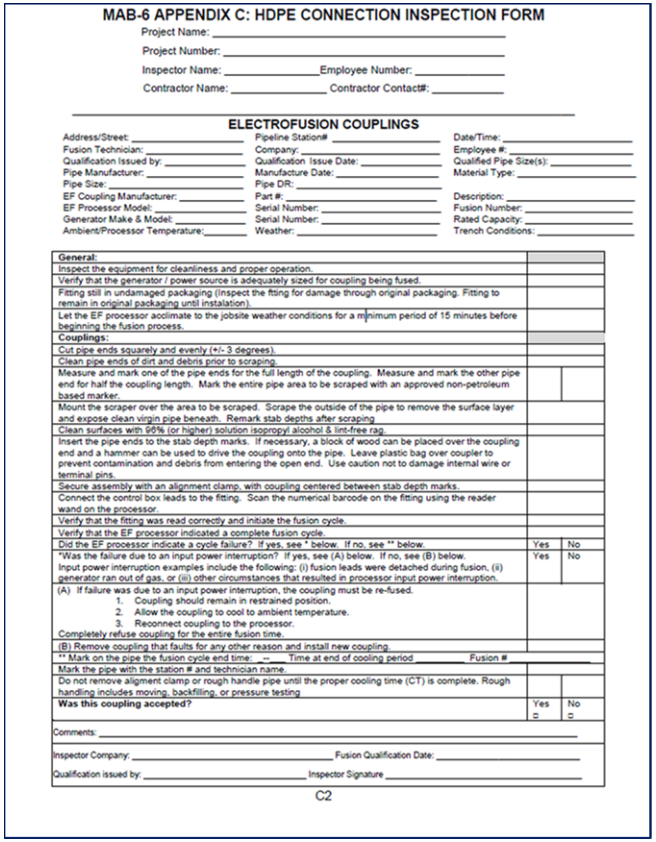
Appendix C – HDPE Connection Inspection Electrofusion Coupling Form

- Tooling review
- Fusion Technician Qualification
- Fitting used
- Alignment clamps used
- Followed fusion procedures
- Observed recommended cooling time

8” EF Coupling



MAB-6 APPENDIX C: HDPE CONNECTION INSPECTION FORM

Project Name: _____
Project Number: _____
Inspector Name: _____ Employee Number: _____
Contractor Name: _____ Contractor Contact#: _____

ELECTROFUSION COUPLINGS

Address/Street: _____ Pipeline Station# _____ Date/Time: _____
Fusion Technician: _____ Company: _____ Employee #: _____
Qualification Issued by: _____ Qualification Issue Date: _____ Qualified Pipe Size(s): _____
Pipe Manufacturer: _____ Manufacture Date: _____ Material Type: _____
Pipe Size: _____ Pipe DR: _____
EF Coupling Manufacturer: _____ Part #: _____ Description: _____
EF Processor Model: _____ Serial Number: _____ Fusion Number: _____
Generator Make & Model: _____ Serial Number: _____ Rated Capacity: _____
Ambient/Processor Temperature: _____ Weather: _____ Trench Conditions: _____

General:		
Inspect the equipment for cleanliness and proper operation.		
Verify that the generator / power source is adequately sized for coupling being fused.		
Fitting still in undamaged packaging (Inspect the fitting for damage through original packaging. Fitting to remain in original packaging until installation).		
Let the EF processor acclimate to the jobsite weather conditions for a minimum period of 15 minutes before beginning the fusion process.		
Couplings:		
Cut pipe ends squarely and evenly (+/- 3 degrees).		
Clean pipe ends of dirt and debris prior to scraping.		
Measure and mark one of the pipe ends for the full length of the coupling. Measure and mark the other pipe end for half the coupling length. Mark the entire pipe area to be scraped with an approved non-petroleum based marker.		
Mount the scraper over the area to be scraped. Scrape the outside of the pipe to remove the surface layer and expose clean virgin pipe beneath. Remark stab depths after scraping.		
Clean surfaces with 96% (or higher) solution isopropyl alcohol & lint-free rag.		
Insert the pipe ends to the stab depth marks. If necessary, a block of wood can be placed over the coupling end and a hammer can be used to drive the coupling onto the pipe. Leave plastic bag over coupler to prevent contamination and debris from entering the open end. Use caution not to damage internal wire or terminal pins.		
Secure assembly with an alignment clamp, with coupling centered between stab depth marks.		
Connect the control box leads to the fitting. Scan the numerical barcode on the fitting using the reader wand on the processor.		
Verify that the fitting was read correctly and initiate the fusion cycle.		
Verify that the EF processor indicated a complete fusion cycle.		
Did the EF processor indicate a cycle failure? If yes, see * below. If no, see ** below.	Yes	No
*Was the failure due to an input power interruption? If yes, see (A) below. If no, see (B) below. Input power interruption examples include the following: (i) fusion leads were detached during fusion, (ii) generator ran out of gas, or (iii) other circumstances that resulted in processor input power interruption.	Yes	No
(A) If failure was due to an input power interruption, the coupling must be re-fused. 1. Coupling should remain in restrained position. 2. Allow the coupling to cool to ambient temperature. 3. Reconnect coupling to the processor. Completely refuse coupling for the entire fusion time.		
(B) Remove coupling that faults for any other reason and install new coupling.		
** Mark on the pipe the fusion cycle end time: _:_ Time at end of cooling period. Fusion #		
Mark the pipe with the station # and technician name.		
Do not remove aligment clamp or rough handle pipe until the proper cooling time (CT) is complete. Rough handling includes moving, backfilling, or pressure testing		
Was this coupling accepted?	Yes ☐	No ☐

Comments: _____

Inspector Company: _____ Fusion Qualification Date: _____
Qualification issued by: _____ Inspector Signature _____

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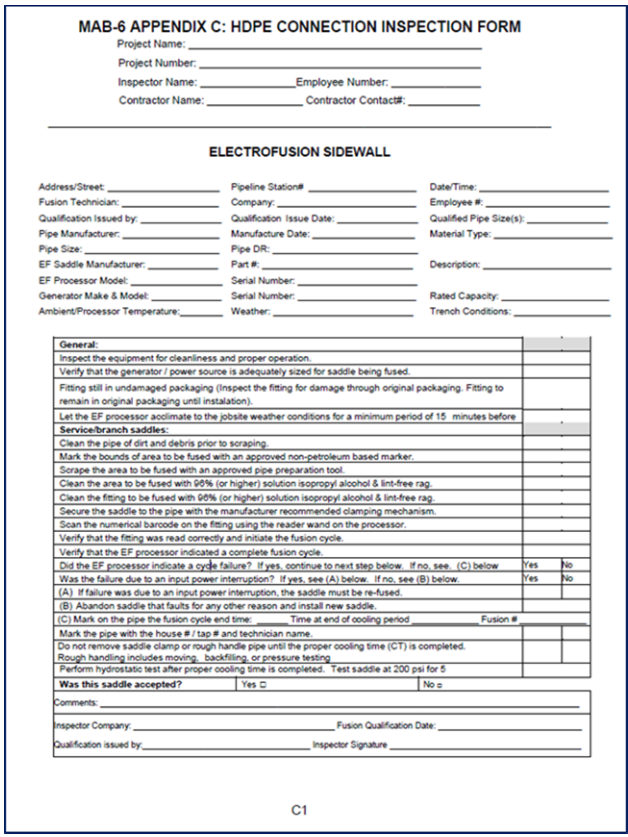
Appendix C – HDPE Connection Inspection Electrofusion Sidewall Form

- Tooling review
- Fusion Technician Qualification
- Fitting used
- Manufacturer specified clamp used
- Followed fusion procedures
- Observed recommended cooling time
- Observed pressure testing of fitting

8” X 1” EF Saddle
Pressure Tested Before Tapping



MAB-6 APPENDIX C: HDPE CONNECTION INSPECTION FORM

Project Name: _____
Project Number: _____
Inspector Name: _____ Employee Number: _____
Contractor Name: _____ Contractor Contact#: _____

ELECTROFUSION SIDEWALL

Address/Street: _____	Pipeline Station# _____	Date/Time: _____
Fusion Technician: _____	Company: _____	Employee #: _____
Qualification Issued by: _____	Qualification Issue Date: _____	Qualified Pipe Size(s): _____
Pipe Manufacturer: _____	Manufacture Date: _____	Material Type: _____
Pipe Size: _____	Pipe DR: _____	
EF Saddle Manufacturer: _____	Part #: _____	Description: _____
EF Processor Model: _____	Serial Number: _____	
Generator Make & Model: _____	Serial Number: _____	Rated Capacity: _____
Ambient/Processor Temperature: _____	Weather: _____	Trench Conditions: _____

General:		
Inspect the equipment for cleanliness and proper operation.		
Verify that the generator / power source is adequately sized for saddle being fused.		
Fitting still in undamaged packaging (Inspect the fitting for damage through original packaging. Fitting to remain in original packaging until installation).		
Let the EF processor acclimate to the jobsite weather conditions for a minimum period of 15 minutes before		
Service/branch saddles:		
Clean the pipe of dirt and debris prior to scraping.		
Mark the bounds of area to be fused with an approved non-petroleum based marker.		
Scrape the area to be fused with an approved pipe preparation tool.		
Clean the area to be fused with 95% (or higher) solution isopropyl alcohol & lint-free rag.		
Clean the fitting to be fused with 95% (or higher) solution isopropyl alcohol & lint-free rag.		
Secure the saddle to the pipe with the manufacturer recommended clamping mechanism.		
Scan the numerical barcode on the fitting using the reader wand on the processor.		
Verify that the fitting was read correctly and initiate the fusion cycle.		
Verify that the EF processor indicated a complete fusion cycle.		
Did the EF processor indicate a cycle failure? If yes, continue to next step below. If no, see (C) below	Yes	No
Was the failure due to an input power interruption? If yes, see (A) below. If no, see (B) below.	Yes	No
(A) If failure was due to an input power interruption, the saddle must be re-fused.		
(B) Abandon saddle that faults for any other reason and install new saddle.		
(C) Mark on the pipe the fusion cycle end time: _____ Time at end of cooling period _____ Fusion # _____		
Mark the pipe with the house # / tap # and technician name.		
Do not remove saddle clamp or rough handle pipe until the proper cooling time (CT) is completed. Rough handling includes moving, backfilling, or pressure testing		
Perform hydrostatic test after proper cooling time is completed. Test saddle at 200 psi for 5		
Was this saddle accepted?	Yes ☐	No ☐

Comments: _____

Inspector Company: _____ Fusion Qualification Date: _____

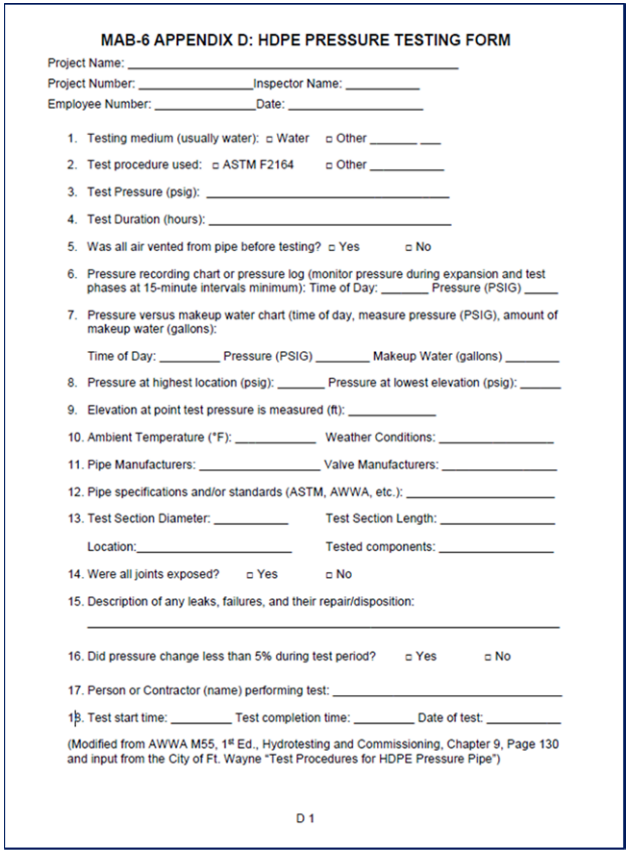
Qualification issued by: _____ Inspector Signature _____

C1

Appendix D – Pressure Testing

- Provided a form for pressure testing documentation
- Based on AWWA M-55 and the City of Fort Wayne, Indiana, USA forms

Hydro Static Pressure Test
Prior to HDD/Bursting Installation



MAB-6 APPENDIX D: HDPE PRESSURE TESTING FORM

Project Name: _____

Project Number: _____ Inspector Name: _____

Employee Number: _____ Date: _____

1. Testing medium (usually water): ◻ Water ◻ Other _____
2. Test procedure used: ◻ ASTM F2164 ◻ Other _____
3. Test Pressure (psig): _____
4. Test Duration (hours): _____
5. Was all air vented from pipe before testing? ◻ Yes ◻ No
6. Pressure recording chart or pressure log (monitor pressure during expansion and test phases at 15-minute intervals minimum): Time of Day: _____ Pressure (PSIG) _____
7. Pressure versus makeup water chart (time of day, measure pressure (PSIG), amount of makeup water (gallons):

   Time of Day: _____ Pressure (PSIG) _____ Makeup Water (gallons) _____
8. Pressure at highest location (psig): _____ Pressure at lowest elevation (psig): _____
9. Elevation at point test pressure is measured (ft): _____
10. Ambient Temperature (°F): _____ Weather Conditions: _____
11. Pipe Manufacturers: _____ Valve Manufacturers: _____
12. Pipe specifications and/or standards (ASTM, AWWA, etc.): _____
13. Test Section Diameter: _____ Test Section Length: _____

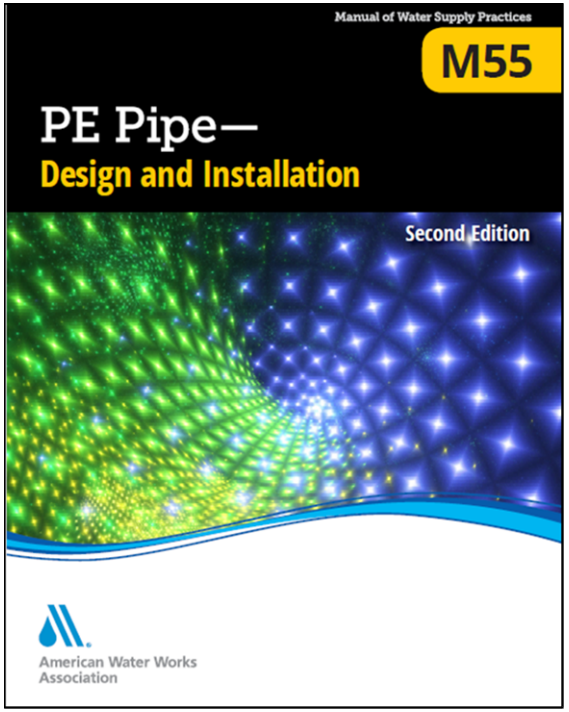
    Location: _____ Tested components: _____
14. Were all joints exposed? ◻ Yes ◻ No
15. Description of any leaks, failures, and their repair/disposition:

    _____
16. Did pressure change less than 5% during test period? ◻ Yes ◻ No
17. Person or Contractor (name) performing test: _____
18. Test start time: _____ Test completion time: _____ Date of test: _____

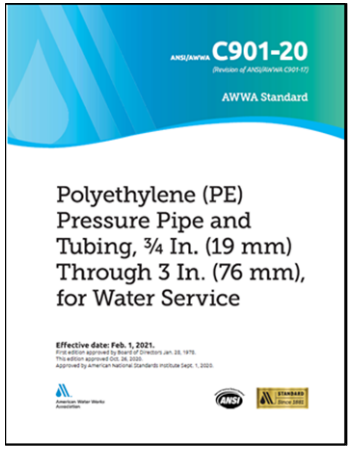
(Modified from AWWA M55, 1st Ed., Hydrotesting and Commissioning, Chapter 9, Page 130 and input from the City of Ft. Wayne "Test Procedures for HDPE Pressure Pipe")

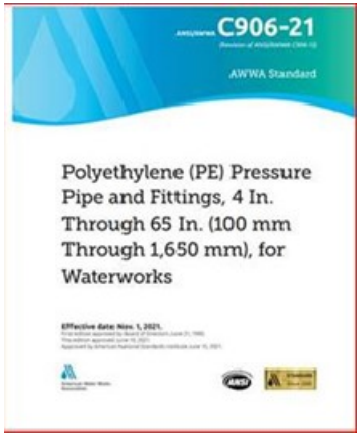
D 1

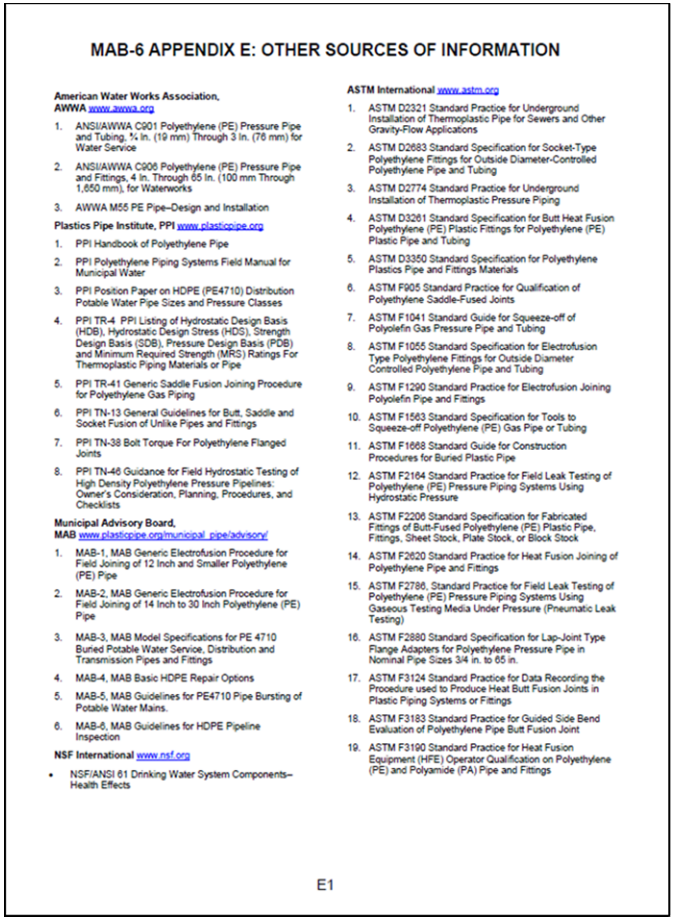
Appendix E – Other Sources of Information



AWWA M55 2nd Edition







MAB-6 APPENDIX E: OTHER SOURCES OF INFORMATION

American Water Works Association, AWWA www.awwa.org

1. ANSI/AWWA C901 Polyethylene (PE) Pressure Pipe and Tubing, ¾ In. (19 mm) Through 3 In. (76 mm) for Water Service
2. ANSI/AWWA C906 Polyethylene (PE) Pressure Pipe and Fittings, 4 In. Through 65 In. (100 mm Through 1,650 mm), for Waterworks
3. AWWA M55 PE Pipe–Design and Installation

Plastics Pipe Institute, PPI www.plasticpipe.org

1. PPI Handbook of Polyethylene Pipe
2. PPI Polyethylene Piping Systems Field Manual for Municipal Water
3. PPI Position Paper on HDPE (PE4710) Distribution Potable Water Pipe Sizes and Pressure Classes
4. PPI TR-4 PPI Listing of Hydrostatic Design Basis (HDB), Hydrostatic Design Stress (HDS), Strength Design Basis (SDB), Pressure Design Basis (PDB) and Minimum Required Strength (MRS) Ratings For Thermoplastic Piping Materials or Pipe
5. PPI TR-41 Generic Saddle Fusion Joining Procedure for Polyethylene Gas Piping
6. PPI TN-13 General Guidelines for Butt, Saddle and Socket Fusion of Unlike Pipes and Fittings
7. PPI TN-38 Bolt Torque For Polyethylene Flanged Joints
8. PPI TN-46 Guidance for Field Hydrostatic Testing of High Density Polyethylene Pressure Pipelines: Owner's Consideration, Planning, Procedures, and Checklists

Municipal Advisory Board, MAB www.plasticpipe.org/municipal_pipe/advisory/

1. MAB-1, MAB Generic Electrofusion Procedure for Field Joining of 12 Inch and Smaller Polyethylene (PE) Pipe
2. MAB-2, MAB Generic Electrofusion Procedure for Field Joining of 14 Inch to 30 Inch Polyethylene (PE) Pipe
3. MAB-3, MAB Model Specifications for PE 4710 Buried Potable Water Service, Distribution and Transmission Pipes and Fittings
4. MAB-4, MAB Basic HDPE Repair Options
5. MAB-5, MAB Guidelines for PE4710 Pipe Bursting of Potable Water Mains.
6. MAB-6, MAB Guidelines for HDPE Pipeline Inspection

NSF International www.nsf.org

- NSF/ANSI 61 Drinking Water System Components–Health Effects

ASTM International www.astm.org

1. ASTM D2321 Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
2. ASTM D2683 Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing
3. ASTM D2774 Standard Practice for Underground Installation of Thermoplastic Pressure Piping
4. ASTM D3261 Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
5. ASTM D3350 Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
6. ASTM F905 Standard Practice for Qualification of Polyethylene Saddle-Fused Joints
7. ASTM F1041 Standard Guide for Squeeze-off of Polyolefin Gas Pressure Pipe and Tubing
8. ASTM F1055 Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing
9. ASTM F1290 Standard Practice for Electrofusion Joining Polyolefin Pipe and Fittings
10. ASTM F1563 Standard Specification for Tools to Squeeze-off Polyethylene (PE) Gas Pipe or Tubing
11. ASTM F1668 Standard Guide for Construction Procedures for Buried Plastic Pipe
12. ASTM F2164 Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure
13. ASTM F2206 Standard Specification for Fabricated Fittings of Butt-Fused Polyethylene (PE) Plastic Pipe, Fittings, Sheet Stock, Plate Stock, or Block Stock
14. ASTM F2620 Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings
15. ASTM F2786, Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Gaseous Testing Media Under Pressure (Pneumatic Leak Testing)
16. ASTM F2880 Standard Specification for Lap-Joint Type Flange Adapters for Polyethylene Pressure Pipe in Nominal Pipe Sizes 3/4 in. to 65 in.
17. ASTM F3124 Standard Practice for Data Recording the Procedure used to Produce Heat Butt Fusion Joints in Plastic Piping Systems or Fittings
18. ASTM F3183 Standard Practice for Guided Side Bend Evaluation of Polyethylene Pipe Butt Fusion Joint
19. ASTM F3190 Standard Practice for Heat Fusion Equipment (HFE) Operator Qualification on Polyethylene (PE) and Polyamide (PA) Pipe and Fittings

E1

GIS - EBMUD Electrofusion Third Party Inspection

- Initiated in 2019
- Inspector on-site during fusion activities to document
  - Adequacy of tooling
  - Verify Qualification of Fusion Technician
  - Adherence to fusion procedures
  - Witness pressure testing (sidewall) prior to tapping
- Provide records for each electrofusion based on geopositional location (service address or pipeline station)

Cloud Mapping Product To Track EF Fitting Installations

Capture Critical GIS Information Before and During Installation (Traceability)

- Population of GIS Attributes for all installed Features (components)
  - Feature Class (pipe, fitting, etc.)
  - Diameter
  - Material
  - Pressure Class
  - Manufacturer
  - Date Installed
  - Installation Technician Name/Qualification
  - Fusion Record
  - Location (GPS coordinates)
  - Pressure Test(s) Record(s)
- Allow future generations to make analytical decisions of what to replace/increase maintenance activity based on:
  - Specific material performance
  - Individual component performance
  - Mandated material replacement
  - Manufacturer recalls
  - Failure/repair rates associated with identical/similar GIS Features

Thank You for Attending

Questions

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