



footage, operating pressure, installation date, years of UV exposure) of the pipe are shown on the map “2009 PE Pipe Outdoor Exposure Assessment Map”. All PE pipe used at MLGW is PE 3408, high density. All PE pipe identified with more than two years of outdoor exposure is manufactured by Performance Pipe. All PE pipe in inventory at MLGW is now protected from UV exposure and is covered with tarps temporarily until a storage building can be constructed.

| <b>Table 1</b><br><b>Summary</b><br><b>Installed PE Pipe with Outdoor Storage Period in Excess of 2 years Footage</b> |           |               |           |           |           |           |            |
|-----------------------------------------------------------------------------------------------------------------------|-----------|---------------|-----------|-----------|-----------|-----------|------------|
| <b>5/8"</b>                                                                                                           | <b>1"</b> | <b>1-1/4"</b> | <b>2"</b> | <b>4"</b> | <b>6"</b> | <b>8"</b> | <b>12"</b> |
| 4,630'                                                                                                                | 545'      | 786'          | 3,625'    | 8,539'    | 5,204'    | 5,483'    | 282'       |

A leak survey of the 108 locations of the identified PE pipe with more than two years of outdoor exposure was completed February 17, 2009 with no leaks found.

Leak survey data was researched from 1998 – 2008. To better identify if there were leaks on the identified PE pipe the identified locations and the surrounding areas actual leak data was evaluated.

- 1) All MSS leak data was gathered from 2003-2008, which included all origins of leak reports (i.e. leak survey, customer reports, third party damage reports, etc.). The time frame encompassed the installation of all identified pipe.
- 2) The leak data was filtered to exclude any above ground leak reports that were resolved by gas fitters or customer service.
- 3) The leaks were exported to Microsoft Excel. The below ground leak data resulted in 14,437 leaks.
- 4) Leaks in the vicinity of the identified pipe were identified by manual search of the excel spread sheet. MLGW CableCAD, Document Image WebExtender, and MSS were used to determine what the leak was and if the leak occurred before or after installation of the subject pipe.
- 5) The final list identified 34 leaks of interest. No identified PE pipe leaks were found. The following table lists the 34 leaks of interest and the leak cause

| Cause | Type | WR Number | Street Address        | Date       | Leak Cause                                 |
|-------|------|-----------|-----------------------|------------|--------------------------------------------|
| 300   | 231  | W8Y08299  | 904 PHILADELPHIA ST   | 6/16/2004  | riser replaced                             |
| 301   | 227  | W8G50956  | 908 PHILADELPHIA ST   | 6/21/2004  | service tap leak                           |
| 300   | 231  | W8Y08325  | 2184 NELSON AV        | 6/23/2004  | riser replaced                             |
| 300   | 231  | W8Y08761  | 1196 WHITTEN RD       | 9/22/2004  | replace trap coupling                      |
| 300   | 231  | W8Y08772  | 1196 WHITTEN RD       | 9/23/2004  | cut service 3rd party damage               |
| 300   | 231  | W8Y23295  | ELLENDAL RD           | 5/4/2005   | 3rd party damage                           |
| 300   | 231  | W8Y30439  | APPLING RD            | 7/13/2005  | repair leak on valve                       |
| 300   | 231  | W8Y31023  | 6327 BRAM BL          | 10/17/2005 | repair cut main 3rd party damage           |
| 300   | 231  | W8Y31193  | NUNN CV               | 11/7/2005  | replace 2" valve                           |
| 300   | 231  | W8Y32043  | 165 GREENBRIAR DR     | 3/7/2006   | replaced crimped PE                        |
| 300   | 231  | W8Y32258  | 2011 ELZEY AV         | 4/10/2006  | replace PE pipe 3rd party damage           |
| 300   | 231  | W8Y26504  | 5074 BRIAN RIDGE RD   | 5/31/2006  | cut line 3rd party damage                  |
| 300   | 231  | W8Y32601  | 5098 BRIAN RIDGE RD   | 5/31/2006  | repair cut service 3rd party damage        |
| 300   | 231  | W8Y30067  | 7981 PARKMONT AV      | 7/28/2006  | repair cut service 3rd party damage        |
| 300   | 231  | W8Y33078  | GERLAND CREEK PW      | 8/16/2006  | replace cut PE 3rd party damage            |
| 300   | 231  | W8Y29296  | 7459 CASH CV          | 9/26/2006  | replace wing cock                          |
| 300   | 231  | W8Y33218  | BILLY MAHER RD        | 11/9/2006  | replaced tee                               |
| 300   | 231  | W8Y26898  | 1362 E ISLAND PL      | 12/6/2006  | replaced PE 3rd party damage               |
| 300   | 231  | W8Y26937  | 1354 E ISLAND PL      | 12/8/2006  | bar holed no leak found                    |
| 300   | 231  | W8Y34229  | ELLENDAL RD           | 1/10/2007  | valve leak                                 |
| 300   | 231  | W8Y27407  | 7504 DELMONICO CV     | 1/23/2007  | replace PE pipe 3rd party damage           |
| 300   | 231  | W8Y34361  | WALNUT GROVE RD       | 1/24/2007  | repair cut service tap 3rd party damage    |
| 300   | 231  | W8Y35208  | 194 GREENLAW AV       | 4/4/2007   | cut service 3rd party damage               |
| 300   | 231  | W8Y35266  | LATTING RD            | 4/11/2007  | wing cock leak                             |
| 300   | 231  | W8Y28643  | 1775 SHOAL CREEK LN   | 6/6/2007   | no leak found                              |
| 300   | 231  | W8Y36008  | 11949 WALNUT GROVE    | 7/9/2007   | repair cut service at tap 3rd party damage |
| 300   | 231  | W8Y36141  | APPLING RD            | 7/31/2007  | repair damaged 6" 3rd party damage         |
| 300   | 231  | W8Y36724  | 5239 CEDRICK CV       | 10/19/2007 | Cut by electric 3rd party damage           |
| 302   | 227  | W8J41293  | BILLY MAHER RD        | 10/29/2007 | tighten 2" tee cap                         |
| 300   | 231  | W8Y37823  | 7600 NESHOB RD        | 2/27/2008  | Cut gas line 3rd party damage              |
| 300   | 231  | W8Y37903  | 2898 OVERTON CROSSING | 3/6/2008   | Repair 2" crimped main 3rd party damage    |
| 300   | 231  | W8Y41170  | WALNUT GROVE RD       | 4/16/2008  | Cut line 3rd party damage                  |
| 302   | 227  | W8J78003  | OVERTON CROSSING      | 4/24/2008  | Leak on main valve                         |
| 300   | 231  | W8Y47769  | 305 AUCTION AV        | 10/30/2008 | Service valve leak                         |

**2. It is our understanding that material tests have been performed on some of the subject pipe. Please provide a list of the tests performed; history of the pipe samples (installed or from stock, installation date, operating pressure, UV exposure time, etc.); pipe classification, diameter and wall thickness; and test results.**

MLGW submitted three pipe samples to Performance pipe for testing to confirm conformance to ASTM D 2513.

4" SDR 11 stored outside for nine years and not installed

1-1/4" SDR 11 stored outside for five years and installed for three years

6" SDR 11 stored outside for eight years and installed for four years.

The following three tables are the actual test data.

| <b>Test Results Confirmation From MLGW Stock Pipe (Not Installed)<br/>Conformance to ASTM D2513 Specifications</b> |                                   |                                                     |                              |                                  |
|--------------------------------------------------------------------------------------------------------------------|-----------------------------------|-----------------------------------------------------|------------------------------|----------------------------------|
| Pipe Size and Type                                                                                                 | 4" SDR 11, 3408, High Density PE  |                                                     |                              |                                  |
| Manufacturer                                                                                                       | Performance Pipe Yellowstripe®    |                                                     |                              |                                  |
| Date of Manufacturing                                                                                              | January 9, 1999                   |                                                     |                              |                                  |
| Years Outside Exposure                                                                                             | 9                                 |                                                     |                              |                                  |
| Date of Testing                                                                                                    | June 18, 2008                     |                                                     |                              |                                  |
| <b>Test</b>                                                                                                        | <b>Test Method</b>                | <b>Test Value</b>                                   | <b>Requirement</b>           | <b>Result</b>                    |
| Melt Flow                                                                                                          | ASTM D3350 and ASTM D1238 190/5.0 | 0.3663 g/10min                                      | 0.34 g/10min nominal         | Pass (Within expected variation) |
| Carbon Black %                                                                                                     | Microwave Furnace                 | 2.11%                                               | >2.0 %                       | Pass                             |
| Density                                                                                                            | ASTM D3350 and ASTM D1505         | 0.954 g/cc black<br>0.945 g/cc (natural calculated) | 0.946 g/cc (nominal natural) | Pass (Within expected variation) |
| Thermal Stability                                                                                                  | ASTM D2513 and ASTM D3350         | 245 deg C                                           | >220 deg C                   | Pass                             |
| ID Ductility                                                                                                       | ASTM D2513 A.1.5.11.1             | Pass                                                | Pass                         | Pass                             |
| Ring Tensile Strength                                                                                              | ASTM D2513 and ASTM D2290         | 3794 psi                                            | >2920 psi                    | Pass                             |

**Test Results Confirmation Installed Pipe  
Conformance to ASTM D2513 Specifications**

|                        |                                      |
|------------------------|--------------------------------------|
| Pipe Size and Type     | 1-1/4" SDR 11, 3408, High Density PE |
| Date of Manufacturing  | February 21, 2000                    |
| Manufacturer           | Performance Pipe Yellowstripe®       |
| Date of Installation   | August 17, 2005                      |
| Years Outside Exposure | 5                                    |
| Years Installed        | 3                                    |
| Date of Testing        | October 13, 2008                     |

| Test              | Test Method                       | Test Value                                          | Requirement                  | Result                           |
|-------------------|-----------------------------------|-----------------------------------------------------|------------------------------|----------------------------------|
| Melt Flow         | ASTM D3350 and ASTM D1238 190/5.0 | 3.3 g/10min                                         | 3.4 g/10min nominal          | Pass (Within expected variation) |
| Carbon Black %    | Microwave Furnace                 | 2.09%                                               | >2.0 %                       | Pass                             |
| Density           | ASTM D3350 and ASTM D1505         | 0.955 g/cc black<br>0.946 g/cc (natural calculated) | 0.946 g/cc (nominal natural) | Pass (Within expected variation) |
| Thermal Stability | ASTM D2513 and ASTM D3350         | 247 deg C                                           | >220 deg C                   | Pass                             |
| ID Ductility      | ASTM D2513 A.1.5.11.1             | Pass                                                | Pass                         | Pass                             |
| Quick Burst       | ASTM D2513 and ASTM D1599         | Ductile                                             | Ductile                      | Pass                             |

| Test Results Confirmation Installed Pipe<br>Conformance to ASTM D2513 Specifications |                                   |                                                     |                                              |                                  |
|--------------------------------------------------------------------------------------|-----------------------------------|-----------------------------------------------------|----------------------------------------------|----------------------------------|
| Pipe Size and Type                                                                   | 6" SDR 11, 3408, High Density PE  |                                                     |                                              |                                  |
| Date of Manufacturing                                                                | August 7, 1996                    |                                                     |                                              |                                  |
| Manufacturer                                                                         | Performance Pipe Yellowstripe®    |                                                     |                                              |                                  |
| Date of Installation                                                                 | November 12, 2004                 |                                                     |                                              |                                  |
| Years Outside Exposure                                                               | 8                                 |                                                     |                                              |                                  |
| Years Installed                                                                      | 4                                 |                                                     |                                              |                                  |
| Date of Testing                                                                      | October 13, 2008                  |                                                     |                                              |                                  |
| Test                                                                                 | Test Method                       | Test Value                                          | Requirement                                  | Result                           |
| Melt Flow                                                                            | ASTM D3350 and ASTM D1238 190/5.0 | 3.3 g/10min                                         | 3.4 g/10min nominal                          | Pass (Within expected variation) |
| Carbon Black %                                                                       | Microwave Furnace                 | 2.17%                                               | >2.0 %                                       | Pass                             |
| Density                                                                              | ASTM D3350 and ASTM D1505         | 0.955 g/cc black<br>0.946 g/cc (natural calculated) | 0.946 g/cc (nominal natural)                 | Pass (Within expected variation) |
| Thermal Stability                                                                    | ASTM D2513 and ASTM D3350         | 247 deg C                                           | >220 deg C                                   | Pass                             |
| ID Ductility                                                                         | ASTM D2513 A.1.5.11.1             | Pass                                                | Pass                                         | Pass                             |
| Ring Tensile Strength                                                                | ASTM D2513 and ASTM D2290         | 3660 psi Ductile                                    | >2920 psi                                    | Pass                             |
| 80 deg C testing                                                                     | ASTM D2513 A.3.2.1                | 670 psi                                             | 5 samples to exceed >170 hrs without failure | >200 hrs Pass                    |

The most important consideration for outdoor stored pipe is if the UV radiation has affected the long term performance of the pipe. The key long term test to assure long-term performance is the elevated temperature sustained pressure test. Good pipe will fail on the ID of the pipe in its normal failure time. UV degraded pipe will fail on the OD of the pipe in a shorter failure time.

### Testing Summary Results

6" SDR 11 pipe was exposed to UV radiation for eight years, the pipe survived over 200 hours at 80<sup>0</sup> C/670 psig. This pipe is used in the MLGW gas distribution system at 99 psig. This 6" pipe meets the ASTM D 2513 requirements for elevated sustained pressure testing.

### Long Term Projection

The MLGW average annual ground temperature is about 60<sup>0</sup> F(15<sup>0</sup> C). Using the

Popelar Shift Factors, the testing results shifts to over twenty-seven years at 1,425 psi hoop stress at 60<sup>0</sup> F(15<sup>0</sup> C). This testing indicates that this 6" pipe (exposed to eight years outdoor storage) will last at least twenty-seven years at a stress three times the operating stress.

**3. *What is the operator's proposed process for selecting pipe from installed and stocked pipe for testing?***

The criteria for selecting pipe from existing stock for testing was pipe that had the most outdoor exposure.

The criteria for selecting installed pipe for testing was that the pipe selected be a small diameter (1-1/4") and a large diameter (6") but not the same size pipe as the 4" that was selected from stock for testing. The pipe testing locations were then randomly selected from the identified locations.

**4. *Based on the test results in your waiver, it does not appear that any long term testing was performed. Please specify how the tests performed fulfill the requirements of ASTM D 2513 — 99.***

Since the original waiver was submitted, 80<sup>0</sup> C sustained pressure was completed on 6" installed pipe that had been stored outdoors for eight years and is currently operating at 99 psig. The elevated temperature sustained pressure test is the most meaningful long-term test that can be conducted to determine the effect of UV exposure on the outside surface of the pipe. The test results were equivalent to over twenty-seven years of service at three times the maximum operating stress at the MLGW operating temperatures.

**5. *Describe the construction details used in the installation of subject pipe relative to pipe bedding and envelope.***

MLGW construction practices include the removal of sharp objects, rocks, bricks, stones boards and other construction materials from trenches, excavations and backfill materials before installing PE or steel gas pipe.

MLGW crews physically inspect PE pipe for cuts, scrapes, dents, gouges or other damage before installing or pulling PE pipe in during the directional drilling process. MLGW crews will not install PE pipe with damage that meets or exceeds 10% of the nominal wall thickness. MLGW crews also pressure test all PE pipe with a minimum of 150 psig for twenty minutes and overnight whenever possible.

**6. *Was the installation of subject pipe accomplished in accordance with operator qualifications and was each section of the subject pipe installed using consistently good construction practices?***

All installations of the subject pipe were accomplished following OQ qualifications using consistently good construction practices in accordance with the manufacturer's recommended procedures. All crew members that install PE pipe were OQ qualified to do so through:

- 1) Maintenance and Repair of PE Pipe
- 2) PE Pipe Squeeze Off
- 3) Purging of Gas Mains & Services
- 4) Tapping PE Pipelines Under Pressure
- 5) Locating & Marking Gas Facilities
- 6) Abandonment of Facilities.

**7. *What joining procedures were used for the installed pipe?***

Select individuals are OQ qualified to perform the fusion covered tasks. There are three approved joining methods for PE pipe at MLGW:

- 1) heat fusion
- 2) electro fusion
- 3) mechanical (trap) for sizes 5/8"-2"

The following pages detail the fusion procedures:

# SMALL DIAMETER FUSION QUALIFICATION

## PE 3408 PIPE

Memphis Light Gas & Water Division

### OBSERVERS COPY

Name: \_\_\_\_\_ Employee # \_\_\_\_\_

NAME OF OBSERVER \_\_\_\_\_ Date: \_\_\_\_\_

PASS / FAIL (Circle One) Company: \_\_\_\_\_

#### Directions

Participant must make a 2" and a 4" butt fuse using a 14 LC and or a 2 LC machine and a 2"x 1" saddle fuse using a Sidewinder Fusion machine. Observer must watch each step as participant sets up equipment, makes fusion joints, and demonstrates knowledge of fusion equipment and pipe manufactures procedures. Participant must verbally explain each step while making an acceptable fusion joint.

MUST BE SUCCESSFUL ON ALL STEPS IN SMALL DIAMETER FUSION QUALIFICATION

| BUTT FUSION                                                                                                                                                                                                                                                                                                                                                                     | 2" | 4" |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|
| 1. Check equipment for damage or excessive wear.                                                                                                                                                                                                                                                                                                                                |    |    |
| 2. Check to match pipe size to clamping insert size.                                                                                                                                                                                                                                                                                                                            |    |    |
| 3. Inspect pipe for damage.                                                                                                                                                                                                                                                                                                                                                     |    |    |
| 4. Clean ends of pipe inside and out with clean cotton cloth before clamping.                                                                                                                                                                                                                                                                                                   |    |    |
| 5. Place pipe in fusion machine, tighten clamps while aligning pipe.                                                                                                                                                                                                                                                                                                            |    |    |
| 6. Attach facer and lock onto guide rods. Face off pipe ends to machine stops.<br>CHECK HIGH LOW.<br>If adjustment is necessary, tighten high side, FACE OFF after any adjustment, recheck high-low, if no adjustment is necessary remove any PE trimmings, clean pipe ends with alcohol/cotton cloth.                                                                          |    |    |
| 7. Check heater plate with infrared or surface pyrometer for 500 degrees (plus or minus 10 degrees).<br>Clean surface with dry cotton cloth.                                                                                                                                                                                                                                    |    |    |
| 8. Insert heater plate between pipe ends. Engage locking cam, bring pipe ends against heater firmly, reduce pressure to only maintain contact with heater plates.<br>DO NOT APPLY PRESSURE                                                                                                                                                                                      |    |    |
| 9. Follow pipe manufactures procedures for correct melt bead width,<br>2" pipe - 1/16" - 4" pipe - 1/8"                                                                                                                                                                                                                                                                         |    |    |
| 10. Remove heater after achieving correct melt bead width, quickly inspect heated ends for a uniform melt pattern.                                                                                                                                                                                                                                                              |    |    |
| 11. Bring melted pipe ends together quickly. DO NOT SLAM. Apply fusion pressure to roll melt beads back to the pipe. Hold fusion pressure for 90 seconds on 2" pipe and 120 seconds on 4" pipe, be sure locking cam is holding properly, joint <b>must</b> be allowed to cure under pressure until cooled to below 110 degrees. Wipe heater plates clean with dry cotton cloth. |    |    |
| 12. Pipe must be completely cool (below 100° F) before air testing or any rough handling or backfilling.                                                                                                                                                                                                                                                                        |    |    |

|                                                                                                                                                                                                                                                                                                    |                   |                       |                     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-----------------------|---------------------|
| <b>PROCEDURE FOR MAKING A SADDLE FUSION JOINT - TAPPING TEE 2" X 1"</b>                                                                                                                                                                                                                            |                   |                       |                     |
| When fusing on a pressurized main, the risk of blow-out can be reduced by using equipment that is in proper working order, following the manufacture's operating instructions, using recommended fusion procedures and by using relieved-center heater faces when fusing High Volume Tapping Tees. |                   |                       |                     |
| 1. Assemble application unit according to manufacturer's instructions and position on the pipe.                                                                                                                                                                                                    |                   |                       |                     |
| 2. Remove surface skin from the melt areas of the clean, dry pipe and saddle fitting by roughening with utility cloth (50 to 60 grit). Brush away residue with dry rag after roughening.                                                                                                           |                   |                       |                     |
| <b>HEATING</b>                                                                                                                                                                                                                                                                                     |                   |                       |                     |
| 3. With the heating surfaces of the tool at 500° +/- 10°F place the tool in position on pipe. Place fitting against heater faces and apply <b>PRESSURE</b> during <b>heating and fusing</b> .                                                                                                      |                   |                       |                     |
| Standard Tapping Tees, Heating 60-80 lbs Fusion & Cooling 60-80 lbs on all sizes.                                                                                                                                                                                                                  |                   |                       |                     |
| High Volume Tapping Tees, Heating 120-140 lbs Fusion & Cooling 2" 120-140 lbs<br>4"-8" 120-140 lbs                                                                                                                                                                                                 |                   |                       |                     |
| Keep handle from dropping as this will enlarge the melt pattern on the pipe.                                                                                                                                                                                                                       |                   |                       |                     |
| 4. After proper melt is achieved on the top of the main, remove fitting from heater and heater from the main, being careful not to damage either fusion area.                                                                                                                                      |                   |                       |                     |
| Check melt pattern on pipe and fitting – heating surfaces on fitting and pipe should be 100% melted with no cold spots.                                                                                                                                                                            |                   |                       |                     |
| <b>FUSION AND COOLING</b>                                                                                                                                                                                                                                                                          |                   |                       |                     |
| 5. If melt patterns are satisfactory, press the fitting on the pipe very quickly ( within 3 seconds after removing the heater) with firm pressure until a melt bead appears around the entire base of the fitting. For a 2" tee the bead thickness should be 1/8".                                 |                   |                       |                     |
| Maintain constant fusion pressure for 70 seconds.                                                                                                                                                                                                                                                  |                   |                       |                     |
| Allow the 2" fusion joint to cool to 110° F before releasing pressure.                                                                                                                                                                                                                             |                   |                       |                     |
| If melt pattern on fitting or pipe is unsatisfactory after heating, apply fitting to pipe and let cool. Remove cutter from the tapping tee and cut off fitting top to avoid misuse later.                                                                                                          |                   |                       |                     |
| 6. After letting joint cool, remove application unit from pipe.                                                                                                                                                                                                                                    |                   |                       |                     |
| Visually check fitting for fusion melt bead around entire fitting base. If fusion joint quality is Unacceptable or doubtful, cut off fitting top and apply a new fitting to a new section of pipe.                                                                                                 |                   |                       |                     |
| 7. For standard tapping tees, let fusion cool an additional 10 minutes prior to pressure testing and tapping the main. Allow an additional 30 minutes before pressure testing or tapping a HVTT. <b>FUSION AREA MUST BE COMPLETELY COOL BEFORE AIR TESTING OR TAPPING.</b>                         |                   |                       |                     |
| 8. Clean heater faces carefully after each fusion with wood or 100% cotton rag.                                                                                                                                                                                                                    |                   |                       |                     |
| <b>TESTING</b>                                                                                                                                                                                                                                                                                     |                   |                       |                     |
|                                                                                                                                                                                                                                                                                                    | Visual Inspection | Ultrasonic Inspection | Destructive Testing |
| 2"                                                                                                                                                                                                                                                                                                 |                   |                       |                     |
| 4"                                                                                                                                                                                                                                                                                                 |                   |                       |                     |
| 2"x1" Tee                                                                                                                                                                                                                                                                                          |                   |                       |                     |
| <b>ABNORMAL OPERATING CONDITIONS</b>                                                                                                                                                                                                                                                               |                   |                       |                     |
| <ul style="list-style-type: none"> <li>• Burn through in fusing process</li> <li>• Failure To Follow Procedures</li> </ul>                                                                                                                                                                         |                   |                       |                     |
| As Observer, I certify Participant has demonstrated the proper and correct Saddle Fusion and Butt Fusion procedure in a timely manor using the manufacture's recommended procedures.                                                                                                               |                   |                       |                     |
| LOCATION _____                                                                                                                                                                                                                                                                                     |                   |                       |                     |
| EMPLOYEE SIGNATURE _____                                                                                                                                                                                                                                                                           |                   |                       |                     |

## LARGE DIAMETER FUSION QUALIFICATION

### PE PIPE 3408

#### FIELD EVALUATION

Memphis Light Gas & Water Division

#### OBSERVERS COPY

Name: \_\_\_\_\_ Employee# \_\_\_\_\_

NAME OF OBSERVER \_\_\_\_\_

PASS / FAIL (CIRCLE ONE) Area #: \_\_\_\_\_ Date \_\_\_\_\_

**Directions** Participant must setup machine to fuse correct size pipe with no help from Observer. Observer must watch each step as the Participant sets up machine, makes fusion joints and demonstrates knowledge of fusion equipment and pipe manufactures procedures. Participant must verbally explain each step while making an acceptable joint.

|                                                                                                                                                                                                                                                                                                                                                                    |  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| <b>INSPECT FUSION EQUIPMENT</b>                                                                                                                                                                                                                                                                                                                                    |  |
| 1. Check equipment for damage or excessive wear. Check oil level. Connect to electrical power source. Check generator engine oil level, and fill fuel tank. Check electrical cords for damage.                                                                                                                                                                     |  |
| <b>SET HYDRAULIC PRESSURE</b>                                                                                                                                                                                                                                                                                                                                      |  |
| 2. Turn on pump, note pressure at the relief valve. Set pressure to 900 psi for machines with hydraulic facer, machines with electric facer set to 800 psi.                                                                                                                                                                                                        |  |
| 3. Set up McElroy # 28 or # 28 DIPS fusion machine by selecting and installing appropriate clamping inserts. Adjust fusion pressure to pipe manufacture's specifications, set facing pressure to not more than 90 psi, if facer stalls reduce pressure. Set heating pressure to "0", (30 psi drag pressure may show on some gauges).                               |  |
| 4. Inspect pipe for damage.                                                                                                                                                                                                                                                                                                                                        |  |
| 5. Clean ends of pipe inside and out with clean cotton cloth before clamping. Load pipe in machine. Tighten outside clamps first to hold pipe, tighten inside clamps to adjust high / low alignment. Always tighten high side.                                                                                                                                     |  |
| <b>FACING THE PIPE</b>                                                                                                                                                                                                                                                                                                                                             |  |
| 6. Apply fusion pressure to make sure pipe will not slip. Move selector up to Facing pressure. Face off pipe ends to machine stops. Check high / low, if adjustment is necessary tighten high side. Face-Off after any adjustment, recheck high-low, if no adjustment is necessary remove all PE trimming, clean ends with 99% ISOPROPYL alcohol and cotton cloth. |  |
| <b>HEATING THE PIPE</b>                                                                                                                                                                                                                                                                                                                                            |  |
| 7. Check heater plate with infrared or surface pyrometer, 500 +/- 10 degrees, adjust if necessary. Clean heating surface with cotton cloth.                                                                                                                                                                                                                        |  |
| 8. Insert heater between pipe ends.<br>A. With SELECTOR VALVE in the FUSING position, move carriage to the LEFT, bringing the pipe ends into contact with the heater plate.<br>B. Move the SELECTOR VALVE into HEATING position<br>C. Allow the pressure to stabilize at zero and return carriage control to NEUTRAL.                                              |  |

|                                                                                                                                                                                                                                         |                         |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| <b>PROPER MELT BEAD ACCORDING TO MANUFACTURER'S RECOMMENDATION:</b>                                                                                                                                                                     |                         |
| 6" PE Pipe 3408 SDR 11                                                                                                                                                                                                                  | 3/16" melt bead         |
| 8" PE Pipe 3408 SDR 11                                                                                                                                                                                                                  | 3/16" to 1/4" melt bead |
| *12" PE Pipe 3408 SDR 17                                                                                                                                                                                                                | 1/4" to 5/16" melt bead |
| 6" Phillips 8000 Pipe SDR 11                                                                                                                                                                                                            | 3/16" – 1/4" melt bead  |
| 8" Phillips 8000 Pipe SDR 11                                                                                                                                                                                                            | 3/16" – 1/4" melt bead  |
| 9. Shift the selector valve down to FUSION POSITION. Move carriage to the right just enough to remove the heater. QUICKLY REMOVE HEATER AND BRING PIPE ENDS TOGETHER under FUSION PRESSURE.<br>Pipe Manufacture's recommended pressure: |                         |
| 6" PE Pipe 3408 SDR 11                                                                                                                                                                                                                  | @ <b>224 psi</b>        |
| 8" PE Pipe 3408 SDR 11                                                                                                                                                                                                                  | @ <b>358 psi</b>        |
| *12" PE Pipe 3408 SDR 17                                                                                                                                                                                                                | @ <b>383 psi</b>        |
| 6" Phillips 8000 Pipe SDR 11                                                                                                                                                                                                            | @ <b>393 psi</b>        |
| 8" Phillips 8000 Pipe SDR 11                                                                                                                                                                                                            | @ <b>645 psi</b>        |
| 10. Allow joint to cool to below 110 degrees under FUSION PRESSURE. Before air testing, backfilling or rough handling, joint must be allowed to cool completely. Clean heater surface with clean cotton cloth.                          |                         |
| VISUAL INSPECTION                                                                                                                                                                                                                       |                         |
| ULTRASONIC INSPECTION                                                                                                                                                                                                                   |                         |
| DESTRUCTIVE TESTING                                                                                                                                                                                                                     |                         |
| <b>ABNORMAL OPERATING CONDITIONS</b>                                                                                                                                                                                                    |                         |
| • FAILURE TO FOLLOW PROCEDURES                                                                                                                                                                                                          |                         |

- \* Using the McElroy # 412 high velocity fusion machine and/or the McElroy # 618 high velocity fusion machine.

As Observer, I certify Participant has demonstrated the proper Butt Fusion Procedures using the McElroy # 28 machine in a timely manor using the manufacture's recommended procedures.

LOCATION \_\_\_\_\_

EMPLOYEE SIGNATURE \_\_\_\_\_

**ELECTROFUSION, FIELD EVALUATION**  
**BUTT AND SIDEWALL PROCEDURES FOR PE 3408 PIPE**  
 Memphis Light, Gas and Water Division  
 OBSERVERS COPY

Print Name \_\_\_\_\_ Employee# \_\_\_\_\_

NAME OF OBSERVER \_\_\_\_\_

PASS / FAIL (circle) Area # \_\_\_\_\_ Date \_\_\_\_\_

**INSTRUCTIONS** Observer may hand a check list copy to Participant. Observer shall check each item as Participant completes each check and/or demonstrates skill requirements. Participant must complete test without any help from Observer. Participant must orally explain to the Observer what and how checks are performed while performing checks. During each explanation, for example pipe to fitting alignment, Participant may use pencil and paper and illustrate requirements as Participant is verbally explaining to Observer. Participant must conduct electrofusion procedure in correct sequence. Observer must attentively watch Participant set up for butt and sidewall fusion and destructive testing.

**PARTICIPANT MUST KNOW AND/OR PERFORM ALL STEPS BOLDED = PASS**

**PARTICIPANT MUST KNOW ALL ABNORMAL OPERATING CONDITIONS**

|                                                                                             |  |
|---------------------------------------------------------------------------------------------|--|
| <b>State How to Use the Electronic Device in a Gaseous Atmosphere</b>                       |  |
| <b>Eliminate any leaking gas</b>                                                            |  |
| <b>JOINING &amp; REPAIR PROCEDURE</b>                                                       |  |
| Demonstrates How to Prepare Out-of-Round Pipe for Fusion Process                            |  |
| Use butt fusion machine                                                                     |  |
| Fuse a straight piece of pipe on coiled pipe                                                |  |
| Cut Main Pipe Ends Square and Even                                                          |  |
| Removed Burrs and Shavings From Main Pipe Ends                                              |  |
| Properly Measured Repair Replacement Pipe Section to Plus/Minus 1/16"                       |  |
| Pipe Repair Section Cut Square and Even                                                     |  |
| Properly Cleans Blades Area of Scraping Tool                                                |  |
| Properly Attaches Scraping Tool to Pipe                                                     |  |
| Properly Prepares Pipe Ends by Using Scraping and Cleaning Procedures                       |  |
| Use alcohol and 100% cotton rags when necessary                                             |  |
| Accurately Scrapes Pipe End Until Surface Material is Removed and New Material is Exposed   |  |
| Explains What is Meant by the Fitting's Stabbing Depth                                      |  |
| Demonstrates How to Measure the Fitting's Stab Depth                                        |  |
| Use ruler or use coupling to measure from the center of coupling                            |  |
| Correctly Follows Procedure to Remove Internal Fitting Stops                                |  |
| Use a board on striking end and bump fitting onto pipe to let pipe break off internal stops |  |

|                                                                                                                                                                            |  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Properly Slides Coupling Over Pipe and Aligns with Measurement Marks                                                                                                       |  |
| Properly applies Clamping Tools to Secure the Pipe from Movement During Fusion Cycle                                                                                       |  |
| Correctly Places Clamps as Close to the Fitting as Possible                                                                                                                |  |
| Explain the Use of Two Clamps on Each Side of Coupling for Coiled Pipe or Binding Installations<br>For assisting in re-rounding coiled pipe                                |  |
| The Sequence Processor is Connected to an Adequate AC Power Source                                                                                                         |  |
| If Generator is Being Used for Power Source, Is Generator Started Before Sequence Processor Function<br>Generator has to have enough gasoline to complete any fusion cycle |  |
| Correctly Reads the Diagnostic Check on the Operational Function Of the Sequence Presser                                                                                   |  |
| Properly Attaches Sequence Processor Leads to Fitting Terminals                                                                                                            |  |
| State the Proper voltage Read Out for Proper ElectroFusion                                                                                                                 |  |
| State the Recommended Clamped Cooling Time for Various Pipe Sizes After Fusion is Complete                                                                                 |  |
| State the Additional Fusion Cooling Time for Various Pipe Sizes After Clamps are Removed                                                                                   |  |
| Demonstrate Where to Find the Recommended Cooling Times for Various Pipe Size and Type of Fitting Used                                                                     |  |
| Document date and other necessary information on fitting<br>Time<br>Initials of person fusing<br>ID # of fusion<br>Fusion machine ID #                                     |  |
| <b>SADDLE JOINING PROCEDURE</b>                                                                                                                                            |  |
| Properly Cleaned and Scraped Pipe & Saddle Fitting<br>Use alcohol and 100% cotton rags when necessary                                                                      |  |
| Properly Installed and Secured Clamp for Saddle                                                                                                                            |  |
| Connected Sequence Processor to an Adequate AC Power Source                                                                                                                |  |
| If Generator is Being Used for Power Source, Is Generator Started Before Sequence Processor Function<br>Generator has to have enough gasoline to complete any fusion cycle |  |
| Correctly Reads the Diagnostic Check on the Operational Function Of the Sequence Processor                                                                                 |  |
| Properly Attaches Sequence Processor Leads to Fitting Terminals                                                                                                            |  |
| State the Proper voltage Read Out for Proper ElectroFusion                                                                                                                 |  |
| State the Additional Fusion Cooling Time for Various Pipe Sizes After Clamps are Removed                                                                                   |  |
| Document date and other necessary information on fitting<br>Time<br>Initials of person fusing<br>ID # of fusion<br>Fusion machine ID #                                     |  |

|                                                                                                                                                            |          |
|------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| <b>GENERAL</b>                                                                                                                                             |          |
| Fusion specimen joined according to Company and manufacturer's approved procedure by Participant                                                           |          |
| Visual examination of joint acceptable.                                                                                                                    | Butt     |
| Butt fusion joint (coupling)                                                                                                                               |          |
| Sidewall Fusion joint                                                                                                                                      | Sidewall |
| Visual inspection of all 3 test specimens indicate no voids or discontinuities on the cut specimen surface area                                            |          |
| All test specimens are acceptable after destructively tested.                                                                                              | Butt     |
| Butt fusion joint                                                                                                                                          |          |
| Sidewall Fusion joint                                                                                                                                      | Sidewall |
| <b>ABNORMAL OPERATING CONDITIONS</b>                                                                                                                       |          |
| <ul style="list-style-type: none"> <li>• Failure to follow procedures</li> <li>• Burn through in fusing process</li> <li>• Flammable atmosphere</li> </ul> |          |

AS OBSERVER , I CERTIFY PARTICIPANT HAS DEMONSTRATED THE PROPER AND CORRECT BUTT AND SIDEWALL ELECTROFUSION IN A TIMELY MANNER USING COMPANY AND MANUFACTURER'S PROCEDURES.

LOCATION \_\_\_\_\_

EMPLOYEE SIGNATURE \_\_\_\_\_

**8. According to your waiver, it does not appear that MLGW intends to perform any long term monitoring or reporting on the installed pipe outside of the current requirements in the Minimum Federal Safety Standard. Please specify if this is correct.**

MLGW currently performs various activities that provide long term monitoring of all pipe installed in the MLGW system. MLGW performs long term monitoring on all installed pipe by patrolling and leak surveying, in accordance with 49 C.F.R. §§ 192.511, 192.513, 192.721 and 192.723, respectively and no incidence of pipe fatigue or failure has been recorded. MLGW participates each month in the AGA Plastic Pipe Data Collection Project. No material failures or leaks have been found on the identified PE pipe. All high density PE pipe purchased is manufactured with a minimum of 2% finely dispersed carbon black to provide the highest degree of protection possible from UV exposure. All Street Main Records reporting repairs and replacements are reviewed each month. MLGW data on failures and testing does not indicate a need for any different long term monitoring or reporting on the installed suspect pipe. MLGW current practices go above and beyond the "Minimum Federal Safety Standard". If at any time data is received on the suspect pipe that would indicate a change, MLGW monitoring and reporting procedures would be reevaluated.

The pipe manufacturer clearly supports that its black PE pipe can be stored outside for ten years and even supports use of their product for outdoor applications. The Plastic Pipe Institute has published documents stating that black PE pipe with 2% carbon black may be used for continuous outdoor service.

Short-term testing has demonstrated that black PE pipe stored outdoors for eight years meets the requirements of ASTM D 2513. Long-term testing has demonstrated the black PE pipe stored outdoors for eight years has a projected life of over twenty-seven years at three times the operating pressure of 99 psig.

ASTM D 2513 is being revised to reflect that black PE pipe may be stored outdoors up to ten years with no effect on performance.

MLGW requests that this Petition to Permit the Continued Use of Plastic Piping, which is in service and had a Outdoor Storage Period in Excess of 2 Years prior to Installation be extended to include pipe currently in inventory that has been exposed to UV for up to ten years.

2" (40' lengths) - 55,480', three years outside exposure  
4" (40' lengths) - 2,960', three years outside exposure  
6" (40' lengths) - 2,200', five years, four years, two years outside exposure  
6" (coil) - 1,000', two years, five years outside exposure  
8" (40' lengths) - 3,160', three years outside exposure  
12" (52' lengths) - 1,161', 4 years, 10 years outside exposure  
Total footage - 65,961'

For this black PE pipe with 2% carbon black in inventory that has been stored outdoors for up to ten years. MLGW proposes to conduct a heat fusion melt pattern test. This test determines if the outside surface of the PE pipe has been degraded by UV radiation. Based on previous experience, it is very unlikely that only ten years of outdoor exposure would have affected the pipe, but MLGW proposes to conduct this test until the ASTM D2513 Standard becomes official.

**Heat Fusion Melt Pattern Test for Black HDPE Pipe Stored Outdoors for Over Two Years From Date of Manufacture**

1. Select pipe in inventory that has been stored outdoors for over two years from date of manufacture.
2. Remove a one foot sample.
3. Select appropriate saddle fusion heating iron for the size of pipe.
4. Using standard saddle fusion procedures, apply the heating iron to the pipe with the aid of a wooden block to achieve the desired force.
5. Remove heating iron after recommended time or after development of recommended bead size.
6. Immediately examine the appearance of the melt pattern and look for the presence of any wax.
7. Poke the melt pattern with a small wooden stick to determine the integrity of the melt, i.e., any signs of a waxy substance.
8. If no waxy substance is observed, the pipe is suitable for use.
9. Record results.

Respectfully submitted this the 23<sup>rd</sup> day of March 2009.

Memphis Light, Gas and Water

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Fred E. Jones, Jr.  
Staff Attorney  
220 South Main Street  
Memphis, TN 38103  
(901) 528-4721



# Palermo Plastics Pipe (P<sup>3</sup>) Consulting

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## I. Consultant Services Offered

### A. Manufacturers

Palermo Plastics Pipe (P<sup>3</sup>) Consulting will aid plastic pipe manufacturers (resin companies and pipe companies) to achieve HDB (Hydrostatic Design Basis) and MRS (Minimum Required Strength) pressure ratings through the Hydrostatic Stress Board (HSB), assist with HSB special cases, develop or revise industry standards (ASTM, CSA, AASHTO, ISO), write petitions to the DOT, and/or aid in marketing plastic pipe products to the end user.

### B. End users

Palermo Plastics Pipe (P<sup>3</sup>) Consulting will aid end users, primarily gas utilities, to evaluate or qualify plastic pipe products (primarily polyethylene and polyamide 11), revise industry standards, and/or conduct failure analysis of plastic pipe products. P<sup>3</sup> Consulting will also present technical seminars at gas company locations to provide background on polyethylene pipe, polyamide 11 pipe or new plastic piping materials for the gas industry.

### C. Laboratories

Palermo Plastics Pipe (P<sup>3</sup>) Consulting will work with laboratories or research organizations to keep abreast of domestic and international standard test methods and standard specifications, and/or write proposals for and then guide research projects for

plastic pipe.

#### **D. Litigation Cases**

Palermo Plastics Pipe (P<sup>3</sup>) Consulting is available for litigation cases involving plastic pipe products, particularly plastic pipe used for natural gas distribution.

### **II. Dr Gene Palermo**

Dr. Gene Palermo received a Bachelor of Science in Chemistry from St. Thomas College in St. Paul, MN in 1969 and a Ph.D. in Analytical Chemistry from Michigan State University in 1973.

Dr. Palermo has been in the plastic piping industry for over 30 years. He worked for the Dupont Company from 1976 to 1995 in the Aldyl "A" polyethylene (PE) pipe business for natural gas distribution. Dr. Palermo developed the initial use of polyamide (PA) 11 for high-pressure gas distribution, up to 300 psig, to replace metal pipe while with Elf AtoChem during 1995 and 1996.

Dr. Palermo was the Technical Director for the Plastics Pipe Institute (PPI) from 1996 until 2003. As Technical Director, Dr. Palermo was chairman of the Hydrostatic Stress Board (HSB) on which he has served for 20 years to develop pressure rating methods for plastic pipe; and chairman of the Technical Advisory Group for ISO/TC 138 for international plastic piping systems. Dr. Palermo has developed standards for plastic pipe and fittings in several standards bodies; ASTM F17, CSA, AASHTO, and ISO/TC 138.

Most of Dr. Palermo's expertise has been in the natural gas distribution industry. He has been a member of the AGA Plastic Materials Committee for 20 years, the Gas Pipe Technology Committee for seven years, an instructor for the DOT inspector training school for 15 years, and a member of the Plastic Pipe Database Committee since its inception four years ago. Dr. Palermo also developed PPI's one day Technical Seminar for the gas distribution industry.

Dr. Palermo currently serves as a member of PPI, AGA, GPTC, ASTM F 17 and D 20, CSA, TRB and ISO/TC 138.

### **III. Awards Received**

Dr. Gene Palermo just received the **AGA (American Gas Association) Platinum Award of Merit** from the American Gas Association. This is the highest award given by AGA to its members. Dr. Gene Palermo had previously received the **AGA Award of Merit** in 1995 in recognition of several presentations made at plastic gas pipe industry meetings, and also serving as moderator at AGA Operations Conferences and Plastic Pipe Symposiums. Dr. Palermo also received the **AGA Silver Award of Merit** in 2002 for having faithfully and constructively served the American gas industry, and for making continuous and extensive

contributions to further the interests and promote the welfare of the gas industry and of the public.

Within ASTM F 17, Dr. Palermo has received two Awards of Appreciation in recognition of his many years of outstanding service and active participation in the plastic piping standards work of ASTM F 17, and a Special Service Award for his many technical contributions and development of plastic piping standards. Dr. Palermo received the Paul Finn Memorial Award in 1995 for his distinguished and continuous service to ASTM F 17 (plastic pipe standards), and particularly for steadfast contributions to the development of sound engineering standards, particularly for plastic gas pipe standards. Dr. Palermo received the Rinehart Kuhlmann Award in 2002 in acknowledgment of faithful and significant contributions in furthering the cause of sound and effective plastics piping standardization. Most recently, in 2005 Dr. Palermo received the ASTM Award of Merit, which is the highest award given within ASTM.

Dr. Palermo was also recognized by the US Department of Transportation (Transportation Safety Institute) for outstanding performance as an associate staff in the Pipeline Safety Division in teaching DOT inspectors about plastic gas pipe standards in ASTM and ISO, plastic pipe pressure ratings methods from ASTM and ISO, plastic pipe failure analysis and new plastic pipe materials for the natural gas industry.

#### **IV. Gas Pipe Industry Experience**

For over 30 years Dr. Gene Palermo has been primarily involved in plastic piping systems for the natural gas distribution industry. Most of those years were with the Dupont Company where he worked with Aldyl "A" polyethylene gas pipe. He presented several industry papers on the use of the Rate Process Method (RPM) to forecast the life expectancy of polyethylene gas pipe and fittings. At Plastics Pipe XII in Milan (April 2004) Dr. Palermo presented a paper correlating RPM projections with actual field performance for polyethylene gas pipe materials. While with DuPont, Dr. Palermo also conducted several failure analyses of Aldyl "A" polyethylene pipe components and wrote several failure analysis reports for gas companies.

Dr. Palermo was hired by Elf AtoChem in 1995 to develop an all plastic piping system made from polyamide (PA) 11 to be used for high-pressure gas distribution systems as a replacement for metal pipe. He wrote several ASTM and CSA standards for the polyamide 11 piping system. He worked with PPI member companies to develop polyamide 11 pipe, butt fusion fittings, mechanical fittings, meter risers, transition fittings, and valves and also developed a butt fusion procedure for joining polyamide 11 pipe and fittings using the same butt fusion equipment that gas companies use for polyethylene pipe and fittings.

He has been actively involved in the AGA Plastic Materials Committee (PMC) since 1981. He presented several papers at various AGA PMC Winter Workshops. He has provided PMC members with liaison reports for PPI and ISO activities and served as the chairman of the Code, Standards and Regulatory task group for AGA PMC. Dr. Palermo has also been an active member of the AGA Gas Pipe Technology Committee (GPTC) since 1995. He

has chaired several projects in the Plastics task group and the Design task group. He is currently a voting member on the Main Body Committee of GPTC.

Dr. Palermo served on the Plastic Pipe Database Committee, which is a joint government/industry committee to develop a database of plastic pipe and fitting failures that occurred in the gas industry. This database will confirm that industry standards for plastic pipe systems used in the gas industry result in outstanding performance for the end user.

More recently, Dr. Palermo has developed a one-day technical seminar for plastic pipe materials used in the gas industry. This seminar is intended to provide a background on plastic pipe materials, primarily polyethylene, to update gas engineers on recent developments in ASTM and ISO standards for the gas industry, and to provide information on new plastic pipe materials for the gas industry. These include polyamide 11 for high pressure gas applications to replace metal pipe, crosslinked polyethylene for niche applications that require increased slow crack growth resistance, PE 100 materials that are considered the next new generation of polyethylene materials and multiplayer pipe for higher pressure gas applications.

## **V. Plastic Pipe Standards Activities**

### **A. ASTM**

1. Dr. Gene Palermo has been a member of ASTM F 17 since 1982, and D 20 since 1999. He has been primarily involved in the following F 17 plastic pipe standards subcommittees:

|        |              |
|--------|--------------|
| F17.10 | Fittings     |
| F17.20 | Joining      |
| F17.26 | Olefins      |
| F17.38 | ISO          |
| F17.40 | Test Methods |
| F17.60 | Gas          |
| F17.61 | Water        |
| F17.90 | Executive    |
| F17.94 | Terminology  |

Dr. Palermo has served as chairman of F17.94 on Terminology and F17.38 on ISO. He is also a member of the F17.90 Executive Committee for F17. Dr. Palermo is currently the Chairman of ASTM F17 Division I.

2. New plastic piping standards that Dr. Palermo developed or existing plastic piping standards that Dr. Palermo revised include:

- Added 80°C sustained pressure requirements to water pipe standards to assure slow crack growth resistance.

- Revised D 2513 quick burst requirement to be a ductile failure mode for polyethylene gas pipe instead of a minimum pressure because it is more meaningful.
  - Developed a new annex in D 2513 for polyamide pipe and fittings
  - Wrote a new standard for polyamide butt fusion fittings (F 1733)
  - Added 50-year substantiation for polyethylene materials to D 2513 for gas pipe
  - Included pressure design basis protocol in ASTM D 2837
  - Added polyethylene validation requirement to D 2837
  - Included a crosslinked polyethylene pipe material designation code in F 876
  - Wrote a new ASTM standard test method for rapid crack propagation based on the ISO standard (F 1583)
  - Wrote a new ASTM standard test method for an 80°C notch pipe test based on the ISO method (F 1474)
  - Introduced 80°C requirements for polyethylene heat fusion socket fittings (D 2683) and polyethylene butt fittings (D 3261) consistent with ISO TC 138 requirements
  - Wrote a new ASTM test method to measure slow crack growth resistance of polyethylene materials used in corrugated pipe (F 2136)
3. Dr. Palermo led an ASTM workshop to review differences and similarities between the ASTM plastic pipe pressure rating method – D 2837 and the ISO plastic pipe pressure rating method – ISO 9080.
4. Dr. Palermo gave a “spotlight presentation” on ASTM F17.38 ISO standards activities during an ASTM Committee Week.

## **B. ISO**

Dr. Palermo was chairman of the Technical Advisory Group (TAG) for ISO (International Standards Organization)/TC 138 for plastic pipe materials for over 10 years and has attended ISO meetings since 1983. As chairman, Dr. Palermo represented the US plastic pipe industry at all ISO/TC 138 meetings. Dr. Palermo also formulated the US position on all standards ballots from ISO/TC 138. Within TC 138, Dr. Palermo was primarily active in SC 2 for water plastic pipe, SC 4 for gas plastic pipe and SC 5 for plastic pipe test methods. Dr. Palermo has provided ISO liaison reports at various ASTM F 17 subcommittee meetings, and also provided ASTM F 17 liaison reports at ISO/TC 138 meetings.

## **C. HSB and PPI**

Dr. Palermo became a member of the PPI Hydrostatic Stress Board (HSB) in 1985 and was chairman of the HSB for seven years. HSB is responsible for establishing the policy for pressure rating of plastic pipe materials in North America. While with PPI, Dr. Palermo continually updated both TR-2 and TR-4. TR-2 is a public listing of the various ingredients that are qualified for the PPI PVC generic formulation. TR-4 is a public listing of the pressure rating of plastic pipe materials obtained using ASTM D 2837. Dr. Palermo was also instrumental in listing the pressure rating of plastic piping materials obtained using the

international pressure rating system (ISO 9080) in TR-4. These MRS (Minimum Required Strength) ratings were added to TR-4 in 1999. Under his leadership, the PDB (pressure design basis) for composite or multiplayer pipes and the SDB (Strength Design Basis) for molding materials were also added to TR-4. Dr. Palermo has attended PPI meetings since 1990 and served as the PPI Technical Director from 1996 until 2003.

#### **D. AASHTO**

Dr. Palermo has also assisted with revision of AASHTO standards for polyethylene corrugated plastic pipe used in highway applications. His key contribution was development of an ASTM test method to measure the slow crack growth resistance of the polyethylene material used in corrugated plastic pipe. Through a PPI task group, round robin testing was conducted to establish the precision of the test method known as NCLS (notched constant ligament stress). AASHTO now references this NCLS test as a requirement in their M 294 corrugated pipe standard.

#### **E. CSA**

Dr. Palermo is a member of CSA (Canadian Standards Association) B137 Technical Committee for plastic piping systems and also a member of CSA Z662 Clause 12 for gas distribution piping systems. Recent projects that Dr. Palermo has chaired are the addition of the MRS (Minimum Required Strength) ISO pressure rating method for PE 100 materials to B137 and the addition of RCP (rapid crack propagation) requirements to the gas pipe standard B137.4.

#### **F. Plastics Pipes Conferences**

Dr. Palermo has served on the Organizing Committee for Plastics Pipes XII held in Milan, Italy in 2004, for Plastics Pipes XIII held in Washington DC in 2006 and Plastics Pipes XIV, to be held in Budapest, Hungary in 2008.

#### **G. GPTC**

Dr. Palermo has been a member of the Gas Piping Technology Committee (GPTC) since 1995. GPTC provides guide material for the gas industry to comply with US Federal requirements for the gas distribution industry. Dr. Palermo has chaired several projects within GPTC.

#### **H. TRB**

Dr. Palermo has been attending TRB meetings since 1999, and has made several presentations at various committee meetings. Dr. Palermo is currently a member of the Committee on Subsurface Soil-Structure Interaction, AFS40.

## **VI. Plastic Pipe Industry Publications**

1. E. F. Palermo and M. Cassaday, "Comparison of Water/Methane Stress Rupture Testing", AGA PMC Workshop (1982).
2. E. F. Palermo, "Aging of Plastic Pipe", AGA PMC Workshop (1983)
3. E. F. Palermo and I. K. DeBlieu, "Aging of Polyethylene Pipes in Gas Distribution Service", AGA Distribution Conference (1983).
4. E. F. Palermo and I. K. DeBlieu, "Compression Ring Environmental Stress Crack Resistance (Pipe) Precision and Accuracy Round Robin", ASTM Quality Assurance Symposium (1983).
5. E. F. Palermo, "Rate Process Method as a Practical Approach to a Quality Control Method for Polyethylene Pipe", Eighth Plastic Pipe Symposium (1983).
6. E. F. Palermo, "Plastic Piping Material", South Eastern Gas Association Meeting (1984).
7. E. F. Palermo and I. K. DeBlieu, "Rate Process Concepts Applied to Hydrostatically Rating PE Pipe", Ninth Plastic Pipe Symposium (1985).
8. E. F. Palermo, "Battelle Slow Crack Growth Test - DuPont Technical Position", AGA PMC Workshop (1986).
9. E. F. Palermo, "Impact Tests on Saddle Fittings to Determine Conformance to ASTM F905", AGA Distribution Conference (1986).
10. E. F. Palermo, "New ASTM D 2513 Outdoor Storage Requirements", AGA PMC Workshop (1987).
11. E. F. Palermo, "Polyethylene Pipe for Gas Distribution - That Was Then, This is Now", Irish Gas Association Centenary Conference (1987).
12. E. F. Palermo, "Plastic Pipe/Fitting Failure: Cause and Prevention", Pacific Coast Gas Association Workshop (1987).
13. E. F. Palermo, K. G. Toll, G. T. Appleton, "Using Laboratory Tests on PE Piping Systems to Solve Gas Distribution Engineering Problems", Tenth Plastic Pipe Symposium (1987).
14. E. F. Palermo, "Critical Evaluation of Rate Process Method 'Anomalies'", AGA PMC Workshop (1988).
15. E. F. Palermo, K. Gunther, and M. Kanninen, "Progress Toward Designing PE Gas Pipe Against RCP (Rapid Crack Propagation)", AGA PMC Workshop (1989).

16. E. F. Palermo, "Large Diameter Plastic Pipe Damage Investigation", Midwest Gas Association Meeting (1989).
17. E. F. Palermo, K. Gunther, and D. VanDeventer, "Squeeze-Off of Large Diameter Polyethylene Pipe", AGA Distribution Conference (1990).
18. E. F. Palermo, "ASTM/ISO Rating Methods – bridging the gap across the waters", Plastics Pipes IX (1995)
19. E. F. Palermo, "High Pressure Gas Distribution Piping System", AGA Distribution Conference (1996).
20. E. F. Palermo, "Plastic Pipe Design Equation Update", AGA Distribution Conference (1997).
21. E. F. Palermo and D. B. Edwards, "An Alternate Method for Determining the Hydrostatic Design Basis for Plastic Pipe Material", Plastics Pipes X (1998)
22. E. F. Palermo, "Comparison of ASTM and ISO Gas Pipe Standards", AGA Distribution Conference (2001).
23. E. F. Palermo, "PPI Adopts International Pressure Rating Method for Plastic Piping Materials", Plastics Pipes XI (2001)
24. E. F. Palermo, "What's New with ASTM, DOT and ISO?", AGA Distribution Conference (2003).
25. E. F. Palermo, "Correlating Aldyl 'A' and Century PE Pipe RPM Projections With Actual Field Performance", AGA Distribution Conference (2004)
26. E. F. Palermo and Jimmy Zhou, "Can ISO MRS and ASTM HDB Rated Materials be Harmonized", Plastics Pipes XII (2004)
27. E. F. Palermo, "Correlating Aldyl 'A' and Century PE Pipe RPM Projections With Actual Field Performance", Plastics Pipes XII (2004)
28. E. F. Palermo, "High Performance Bimodal PE 100 Materials For Gas Piping Applications", AGA Distribution Conference (2005)
29. E. F. Palermo and Steve Swanstrom, "Reinforced Thermoplastic Pipe (RTP) for High-Pressure (800 psig) Gas Piping Applications", AGA Distribution Conference (2006)
30. E. F. Palermo and E. Lever, "Innovative Methodology for Fitting Lifetime Prediction and Process Control by Correlating Rate Process Method Analysis of Molded Fittings with Notch Ring Test Data", Plastics Pipes XIII (2006)

31. E. F. Palermo et al, "New Test Method to Determine the Effect of Recycled Materials on the Life of Corrugated HDPE Pipe as Projected by the Rate Process Method", Plastics Pipes XIII (2006)
32. E. F. Palermo, "Using the CRS Concept for Plastic Pipe Design Applications", Plastics Pipes XIII (2006)
33. E. F. Palermo and J. M. Kurdziel, "Stress Crack Resistance of Structural Members in Corrugated High Density Polyethylene Pipe", Transportation Research Board (2007)
34. E. F. Palermo et al, "Effect of Elevated Ground Temperature (from Electric Cables) on the Pressure Rating of PE Pipe in Gas Piping Applications", AGA Distribution Conference (2007)
35. E. F. Palermo and S. Chung, "Rate Process Method Applied to Service Life Forecast of PE Molded Fittings", AGA Distribution Conference (2008)
36. E. F. Palermo, "What's New With Plastic Pipes – An Overview", Plastics in Underground Pipes 2008.
37. E. F. Palermo et al, "Increasing Importance of Rapid Crack Propagation (RCP) for Gas Piping Applications - Industry Status", Plastics Pipes XIV (2008).