

# **ASTM D-2513**

## COMPARISON OF 1999 VS. 2009 EDITIONS

### SUMMARY DOCUMENT

#### **BACKGROUND:**

Over the past fifty years or more, the natural gas distribution industry in the U.S. has made a remarkable transformation from a near-exclusive metallic distribution piping network to a near-exclusive thermoplastic piping distribution network, primarily driven by the development, implementation and constant upgrading of one standard, ASTM-D-2513, "Thermoplastic Gas Pressure Pipe, Tubing, and Fittings" (D-2513) This transformation from metal to plastic has significantly enhanced the safety and reliability of gas distribution piping systems and saved US natural gas utilities in excess of \$10 Billion in installation and maintenance costs over this period of time.

In the past ten (10) years specifically, very significant changes have occurred to D-2513 yet the Code of Federal Regulations (CFR) has not kept pace with these changes and thus denies the industry the advantages of these most recent developments. Specifically, Part 192 "TRANSPORTATION OF NATURAL AND OTHER GAS BY PIPELINE: MINIMUM FEDERAL SAFETY STANDARDS" that regulates all gas distribution still refers to the 1999 and 1987 edition.

This document highlights the major changes to D-2513 and explains the significance thereof and appended to this document is a 62 page detailed comparison of every paragraph of D-2513. The objective is to help regulators understand the significance of these changes and encourage them to act without further delay to incorporate the 2009 edition of D-2513 into the CFR Part 192.

#### **DISCUSSION:**

ASTM-D-2513 has a title and 8 primary Sections plus Annex's as listed below:

Title

- 1.0 Scope
- 2.0 Reference Documents
- 3.0 Terminology
- 4.0 Materials
- 5.0 Requirements
- 6.0 Test Methods
- 7.0 Marking
- 8.0 Quality Assurance

Annexes

Below is a summary of changes within each Section of the standard.

**Title:**

No change. The title is the same in both editions.

**Scope:**

The Scope changed significantly. In 1999 the standard covered “**plastic pipe**” but in 2009 the Scope was limited to “**polyethylene pipe**”. Many believe this is the most significant difference in the two editions. Polyethylene has always been the predominant plastic pipe used in gas distribution but until 2009, D-2513 contained other materials as well, with proposals to add even more materials. All had similar requirements but there were many “exceptions” or “alternative requirements” due to the nature of the different materials. In turn, these “exceptions” and “alternatives” made it more difficult to use the standard. Requirements that previously were very clear were now confusing and required both a detailed reading and understanding of the standard and this reduced its utility as a guide to the use of polyethylene, the dominant material. If for no other reason, the 2009 edition should be referenced so that the requirements for polyethylene piping systems are clear, easy to understand and use.

Another critical change to the Scope was the addition of “**rapid crack resistance**” requirements because the ability of plastic pipe to resist rapid cracks is critical to its long-term performance. These rapid crack resistance requirements add significantly to the overall safety of polyethylene piping systems.

**Referenced Documents:**

As expected, additional reference standards and other documents are included in the 2009 edition. Notable additions include:

- F2620 – “Practice For Heat Fusion Joining of Polyethylene Pipe and Fittings”
- D2683 – “Specification for Socket-Type Polyethylene Fittings...”
- D3261 – “Specification for Butt Heat Fusion Polyethylene Fittings... “
- F1055 – “Specification for Electrofusion Fittings...”
- F2138 – “Specification for Excess Flow Valves...”

One can hardly imagine constructing a modern polyethylene gas distribution system without utilizing these practices and product standards.

Further, six (6) ISO standards are now included where none were referenced in 1999. These deal primarily with determination of the properties of materials including Hydrostatic Strength and Resistance to Rapid Crack Propagation, critical performance characteristics of polyethylene materials.

In addition, four (4) Plastic Pipe Institute (PPI) documents are now included where none were referenced in 1999. These documents provide utilities with the best industry advice regarding heat fusion practices and recommended design factors for polyethylene pipe.

### **Terminology:**

The terminology section was updated to delete references to materials such as PVC that are no longer in D2513. Also, the material designation “PE-2406” was changed to “PE-2708” because PE-2406 has been eliminated and replaced with the higher performing material.

### **Materials:**

Many changes were made to this Section, not only to delete materials other than polyethylene but to enhance the performance of polyethylene. The detailed changes listed in the attachment to this Summary provide the specifics but some highlights are:

1. The use of “rework” material is now limited to 30% whereas in 1999 there was no limit.
2. The higher performance PE-2708 and PE-4710 materials replaced the previous PE-2406 and PE-3408. The major significance is the newer materials have at least an order of magnitude improved resistance to slow crack growth, the principal cause of failure in polyethylene pipe.
3. Rapid Crack Propagation requirements were added to avoid potential catastrophic failures.
4. Some information previously included in Annexes was moved to the body of the document.

### **Requirements:**

Many of the changes to this Section were editorial to move information from the Annexes to the body of the document because the standard is now exclusively polyethylene.

Requirements for resistance to rapid crack propagation were added to enhance the overall safety of polyethylene piping systems. Also, a requirement was added to insure the pipe inside diameter has not been oxidized during processing.

Also added were specific requirements for electrofusion joints, socket fittings, butt fusion fittings, electrofusion fittings and excess flow valves. None of these requirements are contained in the 1999 edition. The addition of these product requirements helps insure not just safe pipe but rather safe piping systems.

### **Test Methods:**

Most of the changes to this Section are editorial. One test expanded was the long-term fiber stress test. Previously, testing was done to 90% of the materials Hydrostatic Design Basis (HDB) whereas now the requirement is to test to 100% of the HDB, or 80% of the 100,000 hour intercept, whichever is greater. This is a more severe test of material properties and again enhances the safety of the piping system.

### **Marking:**

Several editorial changes were made. In addition, marking on pipe must now be repeated at 2 ft intervals whereas in 1999, a 5 foot interval was permitted. A yellow marking is now required for gas service. A record retention requirement of 50 years was added. The melt index code must now be marked on the pipe.

### **Quality Assurance:**

No changes.

### **Annexes:**

Annexes referring to materials other than polyethylene were deleted. Many of the polyethylene requirements formally in the Annex are now in the body of the standard.

### **SUMMARY:**

As mentioned in the Background material above, ASTM D-2513 has served as the guiding document for the expanded use of polyethylene in natural gas distribution systems. Natural gas utilities were not ready to commit to plastic pipe without a product standard such as D-2513; but, more importantly, they needed confidence that products that satisfy D-2513 also satisfy their needs. For over 50 years the focus has been on satisfying gas industry needs.

This focus on the gas industry is accomplished in several unique ways:

1. The chairperson of F17.60 Gas has almost always been a gas utility engineer (User), not a Producer or General Interest member. He or she continues to monitor all proposed additions or changes to the standard to insure it is both applicable to and a benefit to the industry. Many times a proposed project to update D-2513 is accelerated because the resulting benefits are apparent to the Users.
2. The American Gas Association, Plastic Materials Committee (PMC) has technical members participating from a significant number of utilities. They bring to the attention of the industry their concerns about the need for improving D-2513. They also recommend and monitor specific research and/or test programs to insure the best possible products, processes and practices are employed by the industry. Their concerns and recommendations are brought directly to F17.60 for inclusion into D-2513. This is an ongoing activity as shown by the fact that over the years, D-2513 has been revised, i.e., improved, at least 58 times. Not once has D-2513 gone through the simple R & R (review and reissue) process because changes are always forthcoming.
3. The Plastic Pipe Institute (PPI) oversees the Hydrostatic Stress Board (HSB) that develops and specifies the testing protocols required to obtain a Hydrostatic Design Basis (HDB) for a piping material. The materials' HDB, in turn, determines the long-term pressure rating of the plastic material. The gas utilities use the HDB of the material as the basis for designing the pressure capability of their distribution piping systems. PPI maintains a listing of the HDB values it has approved and all materials claiming compliance with D-2513 must have a valid HDB listing. To demonstrate equivalent performance for minor changes to a resin formulation, the material supplier must retest his material on an ongoing basis maintain a HDB listing with PPI.
4. Organizations such as the Gas Research Institute, Southwest Research, Battelle Institute, the University of Pennsylvania and others have done extensive research on the behavior of plastic pipes and quantified the improvements achieved over the years. One test in particular, called the PENT Test, measure the resistance of the material to slow crack growth, the most likely cause of pipe failure long-term. The higher the resistance, or longer time to failure during this test, the better the material for resistance to slow crack growth. Early materials developed in the 60's and early '70s had a PENT test result of 1 hour or so. Today's "high performance" polyethylene pipe material must have a PENT value > 500 hours and some exceed 2,000 hours

or more. This 500 + hour PENT result equates theoretically to an in-service life in excess of 100 years. Our great-grandkids will have to tell us how well we've done.

5. D-2513 is not just a pipe standard but rather a piping system standard. Pipe alone is worthless unless you can connect a source to one end and a customer to the other end and maintain control in between. Thus, D-2513 not only addresses the specific requirements for plastic pipe, but it also addresses the requirements for all valves and fittings used in plastic natural gas piping systems. D-2513 includes mandatory requirements for valves and various fittings by specific reference to the appropriate product standards for these various items. When D-2513 changes impact another product standard, this standard is then updated as well to maintain the overall harmony of all related standards. With control over all aspects of the plastic gas distribution system, weak links are eliminated and confidence in the performance of the overall system is achieved.
6. State regulators such as the various state Public Utility Commissions rely on D-2513 for guidance when overseeing and enforcing gas distribution system design, installation and maintenance.

### **CONCLUSION:**

This standard D-2513 is so highly regarded that it has become the law of the land. Natural gas safety is regulated by the U.S. Department of Transportation, Office of Pipeline Safety. Regulations are written and contained in the United States Code of Federal Regulations, Part 192: "Transportation of Natural and Other Gas By Pipeline: Minimum Federal Safety Standards". This regulation contains a requirement that states that all thermoplastic plastic pipe in natural gas service be in accordance with D-2513. It is now time to update the law of the land to take advantage of the significant improvements in D2513 from 1999 to 2009 and beyond.

### **Report Prepared By:**

**Richard W. Conley, PE**

**Chief Engineer**

**Kerotest Manufacturing Corp.**

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