

TR-22/2000

**Polyethylene Piping Distribution
Systems for Components of
Liquid Petroleum Gases**

Foreword

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The purpose of this technical report is to provide important information available to PPI on a particular aspect of polyethylene piping systems for distribution of liquid petroleum gases. This report has been prepared by PPI as a service of the industry. The information in this report is offered in good faith and believed to be accurate at the time of its preparation, but is offered without any warranty, expressed or implied, including WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Any reference to or testing of a particular proprietary product should not be construed as an endorsement by PPI, which does not endorse the proprietary products or processes of any manufacturer. The information in this report is offered for consideration by industry members in fulfilling their own compliance responsibilities. PPI assumes no responsibility for compliance with applicable laws and regulations.

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1. INTRODUCTION

Polyethylene (PE) gas piping is the most widely used plastic piping material for the distribution of natural gas. PE has a well-documented inertness to both the external soil environment and to natural gas. Extensive testing and over 40 years of successful field experience confirm that the long-term strength of polyethylene is unaffected by natural gas and its common constituents.

Polyethylene (PE) piping systems complying with ASTM D2513 have been successfully used in all types of fuel gas piping applications since the mid 1960s. These PE piping materials have been continually improved throughout the ensuing three decades assuring the safe, cost effective, transport of fuel gases in residential, commercial and industrial applications.

PE piping is the only approved plastic piping under NFPA 58, *Liquefied Petroleum Gas Code*, and is commonly used in the piping of liquefied petroleum gases (vapor LP-Gas). Vapor LP-Gas is one of those fuel gases, which can be safely piped in PE gas piping systems. The use of D2513 PE piping for the transport of vapor LP-Gas is permitted and codified under US DOT CFR Title 49 Part 192. By reference, Part 192 identifies ANSI/NFPA 58 –as the installation standard for PE vapor LP-Gas piping systems.

NFPA 54 / ANSI Z223.1 – *National Fuel Gas Code* paragraph 2.6.4 also refers the user to ANSI/NFPA 58 by stating “The use of plastic pipe, tubing and fittings in undiluted liquefied petroleum gas piping systems shall be in accordance with *Standard for the Storage and Handling of Liquefied Petroleum Gases [Liquefied Petroleum Gas Code], NFPA 58.*”

NFPA 58 places certain restrictions on the use of PE piping for vapor LP-Gas distribution. NFPA limits the size of PE piping to 2” NPS piping with a nominal OD of 2.375”. Furthermore, NFPA 58 limits the maximum operating pressure of PE vapor LP-Gas piping systems to 30 psig. The reader should refer to NFPA 58 for the details of these and other installation requirements.

2. BACKGROUND

The components of liquid LP-Gas are known to have short-term, reversible effects on PE gas piping. At low temperatures and high pressures, vapor LP-Gas will condense into a liquid state. The effect of liquid LP-gas is to lower the long-term strength capabilities (hydrostatic design basis) of PE gas piping, as

summarized in Table I and shown in Figures 1 to 4. These data were obtained on a PE 2306 piping material. It is therefore prudent to limit the operating pressure (stress) when using PE gas piping to transport vapor LP-Gas. In addition, vapor LP-Gas systems operating within particular temperature and pressure guidelines are less likely to produce condensation. Many PE gas-piping materials have been evaluated to determine their long-term strength using vapor LP-Gas as the pressurizing medium. A design factor of 0.25 (chemical design factor of 0.5 times service design factor of 0.5) has thus been established for PE piping in vapor LP-Gas service. As stated above, NFPA 58 prescribes the established pressure and design limitations.

3. USE RECOMMENDATIONS

- a) Any plastic material to qualify for use as a vapor LP-Gas piping system should be recommended by the manufacturer for such use, should be qualified using vapor LP-Gas as the medium, and have a hydrostatic design basis (HDB) category of at least 1,000 psi (6.9 MPa) at 73°F (23°C) as determined by test method ASTM D2837. Most PE piping systems complying with ASTM D2513 meet these criteria.
- b) The vapor LP-Gas PE piping system shall be made from PE materials specified in and manufactured in accordance with ASTM D2513.
- c) To determine the maximum use pressure in vapor LP-Gas distribution, a design factor of 0.25 is recommended (see also PPI TR-9 on recommended design factors) to derate the PE material's hydrostatic design basis (HDB) as listed in PPI TR4 and determined in accordance with ASTM D2837. This design factor is more conservative than the 0.32 design factor used for PE piping used in natural gas (methane) distribution systems.
- d) With the exception of PE piping in anodeless risers, PE gas piping and fittings should only be used in underground distribution systems designed to operate at internal pressures and temperatures such that condensation will not occur. Condensation is unlikely at the temperature and pressure combinations shown in Table 2.

Table 1

Summary of Stress Rupture Data for PE 2306 Pipe from Figures 1-4

Test Medium	NPS, Pipe Sizing	Wall Thickness	LTHS, psi	HDB, psi
Methane Vapor	2	0.070", (SDR 34)	1390	1250
Propane Vapor	2	0.070", (SDR 34)	1140	1000
Propane Liquid	1	0.119", (SDR 11)	800	800
Propylene Vapor	2	0.070", (SDR 34)	1210	1250
Butane Liquid	1	0.119", (SDR 11)	850	800

Table 2

Temperature and pressure Combinations Where Condensation Will Not Occur

Temperature °F (°C)	Maximum Pressure, psig (kPa)	Maximum Pressure, psig (kPa)
	Propane	Butane
10 (-12.2)	30 (207)	
20 (-6.7)	40 (276)	
30 (-1.1)	50 (345)	
40 (4.4)	60 (414)	2.5 (17)
50 (10.0)	75 (517)	5 (35)
60 (15.6)	90 (621)	10 (67)
>65 (>18.3)	100 (690)	14 (97)

4. APPLICABLE CODES AND STANDARDS

- 4.1. *ASTM D2513, Standard Specification for Thermoplastic Gas Pressure Pipe, Tubing and Fittings.*
- 4.2. *NFPA 58, Liquefied Petroleum Gas Code*