



Standard Practice for Qualification of a Combination of Squeeze Tool, Pipe, and Squeeze-Off Procedures to Avoid Long-Term Damage in Polyethylene (PE) Gas Pipe¹

This standard is issued under the fixed designation F 1734; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice covers qualifying a combination of a squeeze tool, a polyethylene gas pipe, and a squeeze-off procedure to avoid long-term damage in polyethylene gas pipe. Qualifying is conducted by examining the inside and outside surfaces of pipe specimens at and near the squeeze to determine the existence of features indicative of long-term damage. If indicative features are absent, sustained pressure testing in accordance with Specification D 2513 is conducted to confirm the viability of the squeeze-off process. For assistance with specimen examination, an Adjunct, ADJF1734, is available from ASTM.

1.2 This practice is appropriate for any combination of squeeze tool, PE gas pipe and squeeze-off procedure, and is particularly appropriate for pre-1975 Polyethylene (PE) pipe, and for pipe sizes of 8 in. or above, because of a greater possibility of long-term damage.

1.3 This practice is for use by squeeze-tool manufacturers, pipe manufacturers and gas utilities to qualify squeeze tools made in accordance with Specification F 1563; and squeeze-off procedures in accordance with Guide F 1041 with pipe manufactured in accordance with Specification D 2513.

1.4 Governing codes and project specifications should be consulted. Nothing in this practice should be construed as recommending practices or systems at variance with governing codes and project specifications.

1.5 Where applicable in this guide, “pipe” shall mean “pipe and tubing.”

1.6 *Units*—The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units, which are provided for information only and are not considered standard.

1.7 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:

D 2513 Specification for Thermoplastic Gas Pressure Pipe, Tubing, and Fittings²

D 3350 Specification for Polyethylene Plastics Pipe and Fittings Materials²

F 1041 Guide for Squeeze-Off of Polyolefin Gas Pressure Pipe and Fittings²

F 1563 Specification for Tools to Squeeze-Off Polyethylene (PE) Gas Pipe or Tubing²

ADJF1734 Adjunct: Interpretation Aid for Squeeze-Off Damage³

3. Terminology

3.1 Definitions:

3.1.1 *squeeze-off, n*—a technique used to temporarily control the flow of gas in a polyethylene gas pipe by flattening the pipe with a mechanical or hydraulic device.

3.1.2 *squeeze process, n*—the combination of the squeeze tool, the pipe being squeezed, and the squeeze-off procedure being used.

3.1.3 *wall compression (WC), n*—the percentage extent to which the pipe walls are compressed when the pipe is squeezed. (See Fig. 1.) It is defined as:

$$WC, \% = \left(1 - \frac{L}{2t}\right) \times 100 \quad (1)$$

where:

L = distance between the squeeze tool bars as shown in Fig. 1, and

t = uncompressed pipe wall thickness, expressed in the same units as L .

3.1.3.1 *Discussion*—When the distance between the squeeze tool bars is greater than twice the wall thickness, the pipe walls are not compressed, which yields a negative value for the wall compression percentage. The value becomes positive when the L value is less than the $2t$ value. Typical squeeze tool stops are set for 30 % or less wall compression

¹ This practice is under the jurisdiction of ASTM Committee F17 on Plastic Piping Systems and is the direct responsibility of Subcommittee F17.60 on Gas.

Current edition approved August 10, 2003. Published September 2003. Originally approved in 1996. Last previous edition approved in 1996 as F 1734 – 96.

² Annual Book of ASTM Standards, Vol 08.04.

³ Available from ASTM Headquarters. Order Adjunct:ADJF1734.

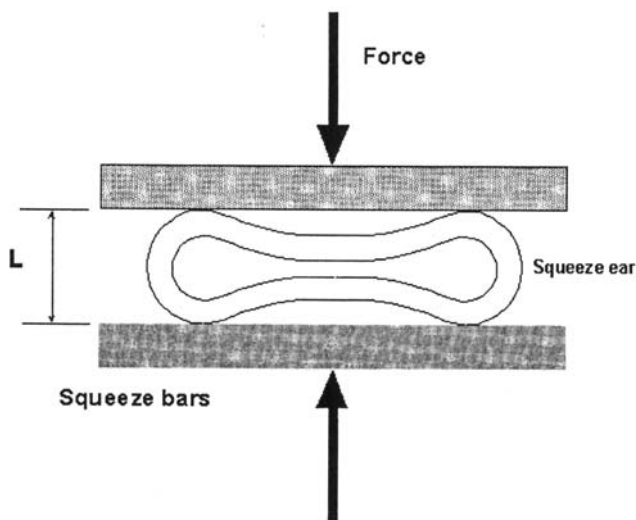


FIG. 1 Definition of Wall Compression

based on maximum wall thickness (a distance that is 70 % of twice maximum wall thickness when the squeeze tool is closed to the stops). Maximum wall thickness is the minimum wall thickness plus the wall thickness tolerance.

4. Summary of Practice

4.1 Pipe of the size and material of interest is cut into specimens at least 1 ft long or 3 diameters long whichever is greater, and attached to a supply of pressurized gas. With pressurized gas flowing through the specimen, the specimens are squeezed with the tool of interest, using the procedure of interest, until the desired level of flow control is achieved. Using Eq 1, the wall compression percentage at the desired level of flow control is determined. Let this level of wall compression be called WC_{nom} . Additional specimens are squeezed to obtain squeeze levels that are 5 % greater, 10 % greater, 5 % less and 10 % less than WC_{nom} . This squeeze range brackets levels of wall compression for flow control.

NOTE 1—For example, if the desired level of flow control were achieved at 25 % wall compression, additional specimens would be prepared at 35 %, 30 %, 20 % and 15 % wall compression. In research tests, a flow of 0.1 ft³/h was considered equivalent to stopping the flow.^{4,5}

4.2 The squeezed samples are split along their length at 90 degrees to the squeeze “ears” (See Fig. 1). The area containing the ears is examined visually using the unaided eye, then magnification. Features such as crazing, small voids, or cracks indicate permanent damage and disqualify the squeeze-off process.

⁴ Stephens, D. R., Leis, B. N., Francini, R. B., and Cassady, M. J., *Volume 1: Users' Guide on Squeeze-Off of Polyethylene Gas Pipes*, Topical Report GRI-92/0147.1, NTIS PB93-161032, Battelle Columbus for Gas Research Institute, February 1992.

⁵ Stephens, D. R., Leis, B. N., Francini, R. B., and Cassady, M. J., *Volume 2: Technical Reference on Squeeze-Off of Polyethylene Gas Pipes*, Topical Report GRI-92/0147.2, NTIS PB93-161040, Battelle Columbus for Gas Research Institute, October 1992.

4.3 Where the results of the visual screening do not indicate permanent damage, additional specimens are squeezed at the WC level where damage is not indicated, and sustained pressure tests in accordance with Specification D 2513 are performed. When sustained pressure test specimens meet the requirements of Specification D 2513, the squeeze-off process has been verified.

4.3.1 When damage is identified at WC_{nom} less 5 % or WC_{nom} less 10 % levels, a wall compression percentage where damage does not occur should be identified. Prepare additional specimens by lessening wall compression in 5 % increments, and then examine the specimens to identify a wall compression percentage that does not indicate damage.

NOTE 2—This practice uses flow through the squeezed-off pipe as a parameter. For some combinations of tool, pipe and procedure, it is not possible to stop flow completely without causing permanent damage to the pipe, particularly for pipes greater than 2 in, nominal size.

4.4 Using a desired squeeze-off procedure, tests conducted at different pipe temperatures with various sizes of tools and pipes can be used to verify a range of temperatures, tool sizes, and pipe sizes for which the squeeze-off process is applicable.

5. Significance and Use

5.1 Squeeze-off is widely used to temporarily control the flow of gas in PE pipe. Squeeze tools vary depending on the size of the pipe and the design of the tool. Squeeze-off procedures vary depending on the tool design, pipe material, and environmental conditions.

5.2 Experience indicates that some combinations of polyethylene material, temperature, tool design, wall compression percentage and procedure can cause damage leading to failure.

5.3 Studies of polyethylene pipe extruded in the late 1980s and thereafter show that damage typically does not develop when the wall compression percentage is 30 % or less, when temperatures are above 50°F (10°C), and when closure and release rates are typical of field conditions for screw-driven tools.⁴ With tools meeting Specification F 1563, acceptable flow control at typical gas service pressures is achieved at wall compression percentages between 10 and 20 % for pipe diameters less than 6 in.^{4,5} Because damage does not develop in these materials at such squeeze levels, the references cited indicate that squeeze-off flow control practices using tools meeting Specification F 1563 and qualified procedures meeting Practice F 1041 are effective for smaller pipe sizes.^{4,5}

NOTE 3—Specification F 1563 provides a procedure for evaluating tool flow control performance.

5.4 This practice provides a method to qualify a combination of squeeze tool, pipe size and material, and squeeze-off procedure to ensure that long-term damage does not occur. This practice is useful for polyethylene gas pipe manufactured before 1975, for new or revised polyolefin gas pipe materials, for pipe diameters of 8 in. or above, for new or revised squeeze tool designs, and for new or revised squeeze-off procedures.

6. Interpretation of Results

6.1 This practice relies on a screening process using visual inspection followed by sustained pressure testing as described in Specification D 2513 to qualify a squeeze-off process.