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An American National Standard

Standard Practice for Qualification of a Combination of Squeeze Tool, Pipe, and Squeeze-Off Procedures to Avoid Long-Term Damage in Polyethylene (PE) Gas Pipe[1]

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

~~1.1This practice covers the qualification of a squeeze process consisting of a combination of a squeeze tool, pipe, and squeeze-off procedures to avoid long-term damage in polyethylene gas pipe. This practice examines the inside and outside surfaces of the pipe near the squeeze to determine the existence of features indicative of long-term cracking. The occurrence of these features depends on the squeeze tool design, the pipe being squeezed, and the squeeze procedures being used. This practice is particularly appropriate for pre-1975 Polyethylene (PE) pipe, and for pipe with diameter greater than or equal to 8 in., because of the greater possibility of long-term damage.~~

~~1.2After the visual screening identifies a viable squeeze process, a sustained pressure test in accordance with Specification D2513 should be used to confirm the viability.~~

~~1.3This practice is for use by squeeze-tool manufacturers and gas utilities for all squeeze tools made in accordance with Specification F1563; pipe manufactured in accordance with Specification D2513, up to and including pipe diameters of 12 in.; and squeeze procedures in accordance with Guide F1041~~

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[2], 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."

~~1.6The values stated in inch-pound units are to be regarded as standard. The values in parentheses are for information only.~~

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 that 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 Fittings

D 3350 Specification for Polyethylene Plastics Pipe and Fittings Materials

F 1041 Guide for Squeeze-Off of Polyolefin Gas Pressure Pipe and ~~Fittings~~[2]Tubing

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[1] This practice is under the jurisdiction of ASTM Committee ~~F-17~~ F17 on Plastic Piping Systems and is the direct responsibility of Subcommittee F17.60 on Gas.
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Current edition approved Aug. 1, 2009. Published September 2009. Originally approved in 1996. Last previous edition approved in 2003 as F 1734 – 03.

~~[2] Annual Book of ASTM Standards, Vol 08.04.~~

[2] Available from ASTM International Headquarters. Order Adjunct No. . Original adjunct produced in 1995.

F 1563 ~~Specification for Tools to Squeeze-Off Polyethylene (PE) Gas Pipe or Tubing[2]~~ Specification for Tools to Squeeze-off Polyethylene (PE) Gas Pipe or Tubing

2.2 *ASTM Adjuncts:*

Interpretation Aid for Squeeze-Off Damage[2]

3. Terminology

3.1 *Definitions:*

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

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

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

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

where:

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

t = ~~average~~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 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

~~4.1Pipe of the size and material of interest is cut into samples at least 1 ft long or 5 diameters long, whichever is greater. The samples are squeezed in the tool of interest, using the procedure of interest, until the desired level of flow control is achieved. Let this level of wall compression be called *S*min. Then, four other samples are squeezed to obtain squeeze levels of (*S*min−5)%, (*S*min+5)%, (*S*min+10)%, and (*S*min+15)%. This squeeze range brackets unacceptable through acceptable levels of wall compression for flow control, with the (*S*min+15)% value selected to allow an adequate operational range.~~

~~4.2The squeezed samples are split along their length at 90 degrees to the squeeze "ears." The area containing the ears is inspected visually. Features such as crazing, small voids, or cracks indicate potential permanent damage for that combination of pipe, tool, and squeeze procedure.~~

~~4.3The results of the visual screening are verified by performing a Sustained Pressure Test in accordance with Specification D2513.~~

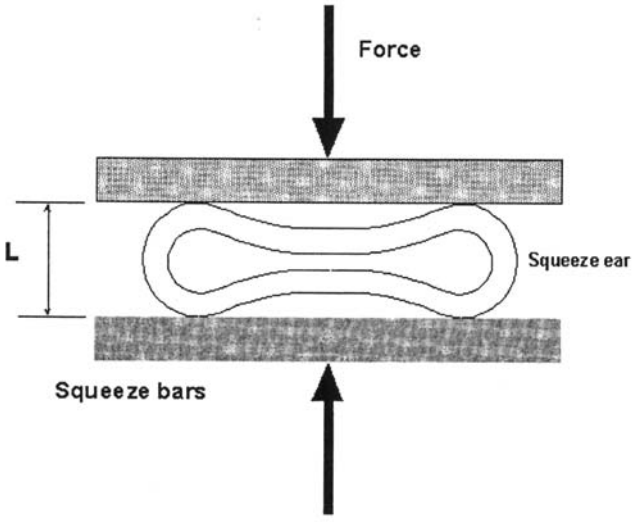

FIG. 1 Definition of Wall Compression

~~5.Significance and Use~~

~~5.1Squeeze-off is widely used to control the flow of gas in PE pipe. Squeeze tools vary depending on the size of the pipe and the source of the tool.~~

~~5.2Experience indicates that some combinations of resin type, resin supplier, extruder, vintage, percent squeezed, and tool can cause damage leading to failure.~~

~~5.3Studies of pipe extruded in the late 1980s and thereafter show that damage does not develop for wall compression less than 30%, for temperatures above 50°F, and squeeze and release rates typical of field conditions for screw-driven tools. With modern tools, flow control at typical service pressures is achieved at squeeze levels between 10 and 20% for pipe diameters less than 6 in.~~[3]

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 *WCnom*. Additional specimens are squeezed to obtain squeeze levels that are 5 % greater, 10 % greater, 5 % less and 10 % less than *WCnom*. 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 ft^3/h was considered equivalent to stopping the flow.[3,4] ~~Because damage does not develop in these materials at such squeeze levels, the cited references validate that current practice is effective for modern tools and materials for the smaller pipe sizes.~~[3]

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.

4.3 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 *WCnom* less 5 % or *WCnom* 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.[3] 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.[3,4]

~~5.4For pipe extruded before 1975, and for pipe diameters greater than or equal to 8 in., a method is needed to qualify the combination of squeeze tool, pipe size and material, and squeeze procedure to ensure the absence of long-term damage.~~ 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.[3,4]

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

[3] 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.

[4] 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.