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Underwriters Laboratories Inc. (UL)
333 Pfingsten Road
Northbrook, IL 60062-2096

UL Standard for Safety
for

Pipe and Couplings, Polyvinyl Chloride (PVC), for Underground Fire Service, UL 1285

Third Edition, Dated April 17, 1995

Revisions: This Standard contains revisions through and including July 15, 1996.

A change is indicated by a note following the affected item. The note is preceded and followed by an asterisk.

The new and/or revised requirements are substantially in accordance with UL's Bulletin on this subject dated March 15, 1996. The bulletin is now obsolete and may be discarded.

The revisions dated July 15, 1996 include a reprinted title page (page 1) for this Standard.

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The requirements in this Standard are now in effect, except for those paragraphs, sections, tables, figures, and/or other elements of the Standard having future effective dates as indicated in the note following the affected item. The prior text for requirements that have been revised and that have a future effective date are located after the Standard, and are preceded by a "SUPERSEDED REQUIREMENTS" notice.

New product submittals made prior to a specified future effective date will be judged under all of the requirements in this Standard including those requirements with a specified future effective date, unless the applicant specifically requests that the product be judged under the current requirements. However, if the applicant elects this option, it should be noted that compliance with all the requirements in this Standard will be required as a condition of continued Listing and Follow-Up Services after the effective date, and understanding of this should be signified in writing.

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This Standard consists of pages dated as shown in the following checklist:

Page	Date
tr1, tr2	July 15, 1996
1	April 17, 1995 (Reprinted July 15, 1996)
2, 3	July 15, 1996
4 – 6	April 17, 1995
7 – 9	July 15, 1996
10 – 14	April 17, 1995

APRIL 17, 1995

(Title Page Reprinted: July 15, 1996)

1

UL 1285

Standard for

**Pipe and Couplings, Polyvinyl Chloride (PVC),
for Underground Fire Service**

First Edition – January, 1982

Second Edition – March, 1991

Third Edition

April 17, 1995

An effective date included as a note immediately following certain requirements is one established by Underwriters Laboratories Inc.

Revisions of this standard will be made by issuing revised or additional pages bearing their date of issue. A UL Standard is current only if it incorporates the most recently adopted revisions, all of which are itemized on the transmittal notice that accompanies the latest set of revised requirements.

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FOREWORD

A. This Standard contains basic requirements for products covered by Underwriters Laboratories Inc. (UL) under its Follow-Up Service for this category within the limitations given below and in the Scope section of this Standard. These requirements are based upon sound engineering principles, research, records of tests and field experience, and an appreciation of the problems of manufacture, installation, and use derived from consultation with and information obtained from manufacturers, users, inspection authorities, and others having specialized experience. They are subject to revision as further experience and investigation may show is necessary or desirable.

B. The observance of the requirements of this Standard by a manufacturer is one of the conditions of the continued coverage of the manufacturer's product.

C. A product which complies with the text of this Standard will not necessarily be judged to comply with the Standard if, when examined and tested, it is found to have other features which impair the level of safety contemplated by these requirements.

D. A product employing materials or having forms of construction differing from those detailed in the requirements of this Standard may be examined and tested according to the intent of the requirements and, if found to be substantially equivalent, may be judged to comply with the Standard.

E. UL, in performing its functions in accordance with its objectives, does not assume or undertake to discharge any responsibility of the manufacturer or any other party. The opinions and findings of UL represent its professional judgment given with due consideration to the necessary limitations of practical operation and state of the art at the time the Standard is processed. UL shall not be responsible to anyone for the use of or reliance upon this Standard by anyone. UL shall not incur any obligation or liability for damages, including consequential damages, arising out of or in connection with the use, interpretation of or reliance upon this Standard.

F. Many tests required by the Standards of UL are inherently hazardous and adequate safeguards for personnel and property shall be employed in conducting such tests.

Table 5.1
Dimension ratio (DR)

Pipe type	Pipe class/ pressure rating	Dimension ratio (DR)
Distribution [Sizes 4 – 12 inches (nominal 100 – 300 mm)]	100	25
	150	18
	200	14
Transmission [Sizes 14 – 36 inches (nominal 350 – 900 mm)]	100	41
	125	32.5
	160	26
	165	25
	200	21
	235	18

6 Imperfections

6.1 Pipe shall be homogeneous throughout and shall have no voids, cracks, inclusions, or other defects that would impair the intended performance of the product.

6.2 Axial dents, gouges, bruises, tool marks, or grooves in the gasket seating area of a pipe section or coupling shall not be deeper than 1/32 inch (0.8 mm).

6.3 For the purposes of this standard, a gasket-seating area of a pipe section or coupling is defined as an area that is, or could be, in contact with the sealing surfaces of the gasket in intended assemblies.

7 Sealing Gaskets

7.1 A sealing gasket shall be made of a vulcanized natural rubber or a synthetic rubber compound and shall have uniform dimensions and sufficient thickness to provide a compression-like seal. See Elastomeric Parts Test, Section 9A.

7.1 revised July 15, 1996

PERFORMANCE

8 General

8.1 Representative samples of each class, pressure rating and size of PVC pipe and couplings shall be subjected to the tests described in Sections 9 – 18.

9 Rubber Materials Tests

Section 9 deleted July 15, 1996

9A Elastomeric Parts

9A.1 An elastomeric part used to provide a seal shall have the following properties when tested as specified in the Standard for Gaskets and Seals, UL 157:

a) Single material and sealing (soft) portion of dual material gaskets:

- 1) Minimum tensile strength — 2000 psi (13.8 MPa), and minimum ultimate elongation — 300 percent [1 to 4 inches (25.4 to 102 mm)].
- 2) Maximum set of 3/16 inch (4.8 mm) when 1 inch (25.4 mm) marks are stretched to 3 inches (76.2 mm), held for 2 minutes, released, and measured 2 minutes after release.
- 3) Those properties relating to minimum tensile strength and elongation after oven aging; and hardness after oven aging, all as specified in UL 157. The maximum service temperature used to determine the oven time and temperature for oven aging is considered to be 60°C (140°F).
- 4) The compression set of samples of rubber seals shall not exceed 20 percent of the original thickness after being compressed to three-fourths of the original thickness.

b) Retaining (hard) portion of dual material gaskets:

- 1) Minimum tensile strength — 1200 psi (8.3 MPa), and minimum ultimate elongation — 125 percent [1 to 2.25 inches (25.4 to 57.2 mm)].
- 2) Those properties relating to minimum tensile strength and elongation after oven aging as specified in UL 157. The maximum service temperature used to determine the oven time and temperature for oven aging is considered to be 60°C (140°F).

9A.1 added July 15, 1996

10 Hydrostatic-Pressure Test

10.1 Pipe and couplings (if provided) shall withstand for 5 seconds, without rupture, an internal hydrostatic pressure as specified in Table 10.1 based on the minimum wall thickness of the pipe, when tested as specified in 10.2 and 10.3.

Table 10.1
Hydrostatic test pressures

Pipe type	Multiple of rated pressure
Distribution [4 – 12 inches (nominal 350 – 900 mm)]	5
Transmission [14 – 36 inches (nominal 100 – 300 mm)]	3.2

10.2 Representative samples of each pressure class and size of pipe and couplings are to be prepared for hydrostatic pressure testing for short-time rupture strength in accordance with the Test Method for Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing, and Fittings, ASTM D1599-88. The minimum wall thickness, average wall thickness (minimum of six points), outside diameter and length of the samples are to be measured and recorded. The test pressure is to be determined based on the calculated hoop stress for the minimum wall thickness and minimum test pressure (5 times rated working pressure) using the measured minimum wall thickness. For sizes up to and including 6 inches (152.4 mm), the sample length (between end caps) is to be at least five times the nominal diameter; for sizes 8 to 12 inches (203.2 to 304.8 mm), the length is to be at least three times the nominal diameter; and for sizes larger than 12 inches, the pipe sample is to be at least 36 inches (0.91 m) in length.

10.3 The ends of the sample are to be sealed with gaskets or end caps. The sample is then to be connected to the hydrostatic-pressure testing equipment and all air is to be expelled from the pipe or fitting. The internal water pressure is to be increased at a uniform rate until the calculated test pressure has been developed. The calculated test pressure is to be held for 5 seconds. The pressure is then to be increased at a uniform rate, so that termination of the test occurs between 60 and 70 seconds after the initial application of pressure.

11 Leakage Test for Joints

11.1 Pipe joints having maximum clearances between the pipe spigot and pipe bell or coupling, with clearances determined by the manufacturer's tolerances, shall not leak and shall not exhibit damage when subjected to a hydrostatic pressure of two times the rated pressure as specified in 11.2 – 11.4.

11.2 Pipe samples used in each test are to be representative of each class, pressure rating, and size. Joints having the maximum clearances are to be installed in accordance with the manufacturer's instructions and deflected to the maximum deflection recommended by the manufacturer. Joints may be machined to the maximum clearance allowed by the manufacturer's tolerances. The ends of the test sample are to be restrained to prevent longitudinal separation at the joints.

11.3 Each test sample is to be connected to the hydrostatic-pressure test equipment and all air is to be expelled from the system. The water pressure is to be increased in 50 psig (345 kPa) increments until twice the rated pressure is attained. At each increment of pressure increase, measurements are to be made of distortion at a joint, protrusion of gasket material (if any), or other factors which may cause leakage after continued use of the pipe in service. During the test, the pressure is not to be increased to the next increment until the line and connections have become stable, as evidenced by no further movement of gasket material.

11.4 After the pressure has been increased to twice the rated pressure, the pressure is to be decreased to 0 psig, while observations are made for leakage. The pressure is then again to be slowly increased to twice the rated pressure while observations are made for leakage.

12 Assembly Test

12.1 Pipe joints made with minimum clearances between the pipe spigot and bell or coupling, determined in accordance with the manufacturer's tolerances, shall, when assembled as specified in 12.2, exhibit no damage to gaskets, pipe, or coupling sections. Cut or torn gasket materials and chipped or broken pipe or coupling sections, are considered to be damaged and do not comply with the requirement.

12.2 Representative samples of each class, pressure rating, and size of pipe and couplings are to be machined as required. Two pipe sections are to be joined together in accordance with the manufacturer's instructions, using a nonmineral-base lubricant, or the equivalent, and normal installation tools such as pike bars, jack and chain, and the like.

13 Flattening Test

13.1 Pipe, when flattened to 40 percent of the original outside diameter, shall exhibit no evidence of splitting, cracking, or breaking, when tested as specified in 13.2.

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North Carolina • (919) 549-1400



Subject 1285

12 Laboratory Drive
Research Triangle Park, NC 27709
June 21, 1996

TO: Fire Council of Underwriters Laboratories Inc.,
Subscribers to UL's Standards Service for Polyvinyl Chloride (PVC) Pipe and Couplings
for Underground Fire Service

SUBJECT: Announcement of a New Product Category for Polyvinyl Chloride Oriented (PVCO) Pipe

UL announces a new product category to cover Polyvinyl Chloride Oriented (PVCO) Pipe. The CCN for the category is HGAB. The establishment of this new category will provide additional services to the PVC pipe industry. Appendix A contains the Guide and Model Information Pages for the new category.

Questions regarding interpretation of requirements should be directed to the responsible UL Staff. Please see Appendix B of this bulletin regarding designated responsibility for the subject product category.

UNDERWRITERS LABORATORIES INC.

REVIEWED BY:

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SR:SMB

1285ANN.001

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APPENDIX AGUIDE INFORMATION FOR
POLYVINYL CHLORIDE ORIENTED PVCO PIPE, HGABPolyvinyl Chloride Oriented PVCO Pipe
HGAB

May 2, 1996

Polyvinyl chloride oriented, PVCO, pressure pipe is intended for use in underground fire service systems where the working pressure does not exceed that indicated in the individual listings. This category includes PVCO distribution pressure pipe in sizes ranging from 4 to 12 inches. These pipes are intended to be installed in accordance with the manufacturer's installation instructions.

The basic standard used to investigate products in this category is UL 1285, "Polyvinyl Chloride (PVC) Pipe and Couplings for Underground Fire Service".

The Listing Mark of Underwriters Laboratories Inc. on the product is the only method provided by UL to identify products manufactured under its Listing and Follow-Up Service. The Listing Mark for these products includes the name and/or symbol of Underwriters Laboratories Inc. (as illustrated in the Introduction of this Directory) together with the work "LISTED", a control number, and the following product name "PVCO Pipe For Underground Water Mains".

LOOK FOR THE LISTING MARK ON PRODUCT
Underwriters Laboratories Inc.

Subject 1285

-A2-

June 21, 1996

MODEL CARD INFORMATION

HGAB

May 2, 1996

[Fire Main Equipment] (Pipe) Polyvinyl Chloride Oriented PVCO Pipe

COMPANY NAME,

EX99999 (N)

CITY, STATE, ZIP CODE

Polyvinyl chloride oriented, PVCO, pressure pipe, sizes 4 to 8 inches for working pressures not exceeding 150 psi.

STREET ADDRESS

LOOK FOR THE LISTING MARK ON PRODUCT
Underwriters Laboratories Inc.

APPENDIX BDESIGNATED RESPONSIBILITY FOR UL
PRODUCT CATEGORY
HGAB, POLYVINYL CHLORIDE ORIENTED PVCO PIPE

The individuals shown in the following table are involved with the investigation of products covered under the subject category. The Primary Designated Engineer (**shown in UPPERCASE letters**) coordinates the establishment and uniform interpretation of UL requirements applicable to the product category. The Designated Engineers (**shown in lowercase letters**) work with the Primary Designated Engineer to interpret requirements and maintain standards.

Should you have questions regarding any adopted requirements that affect your product, you are encouraged to contact the individual at the office to which you normally submit your products.

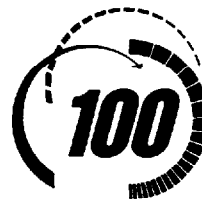
The Responsible Department Manager for the subject category is Bill Metes at UL's Northbrook office. The Responsible Department Manager oversees the significant interpretations made by the Primary Designated Engineer and arbitrates any differences regarding interpretation of UL requirements.

CCN	Office/Subsidiary	Responsible Engineer	Extension
HGAB	Northbrook	EMIL MISICHKO	42036
	RTP	Steve Corrado	11433

UL 1285

ISBN 1-55989-807-0

Pipe and Couplings, Polyvinyl Chloride (PVC), for Underground Fire Service



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April 17, 1995

Standard for

Pipe Couplings, Polyvinyl Chloride (PVC), for Underground Fire Service

UL 1285, Third Edition

Accompanying this transmittal notice is a copy of the Third edition of UL 1285.

THIS EDITION OF THE STANDARD IS NOW IN EFFECT.

Revised and/or additional pages may be issued from time to time.

APRIL 17, 1995

1

UL 1285

Standard for

**Pipe and Couplings, Polyvinyl Chloride (PVC),
for Underground Fire Service**

First Edition – January, 1982
Second Edition – March, 1991

Third Edition

April 17, 1995

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B. The observance of the requirements of this Standard by a manufacturer is one of the conditions of the continued coverage of the manufacturer's product.

C. A product which complies with the text of this Standard will not necessarily be judged to comply with the Standard if, when examined and tested, it is found to have other features which impair the level of safety contemplated by these requirements.

D. A product employing materials or having forms of construction differing from those detailed in the requirements of this Standard may be examined and tested according to the intent of the requirements and, if found to be substantially equivalent, may be judged to comply with the Standard.

E. UL, in performing its functions in accordance with its objectives, does not assume or undertake to discharge any responsibility of the manufacturer or any other party. The opinions and findings of UL represent its professional judgment given with due consideration to the necessary limitations of practical operation and state of the art at the time the Standard is processed. UL shall not be responsible to anyone for the use of or reliance upon this Standard by anyone. UL shall not incur any obligation or liability for damages, including consequential damages, arising out of or in connection with the use, interpretation of, or reliance upon this Standard.

F. Many tests required by the Standards of UL are inherently hazardous and adequate safeguards for personnel and property shall be employed in conducting such tests.

INTRODUCTION

1 Scope

1.1 These requirements cover polyvinyl chloride (PVC) pressure pipe, couplings, and gaskets for use in underground, nonpotable fire service systems and connections to such systems. The pipe is either the distribution or transmission type.

1.2 Distribution pipe covered by these requirements is designated as Classes 100, 150, and 200 for rated working pressures of 100, 150, and 200 psig (0.69, 1.03, 1.38 MPa), respectively, and has a nominal inside diameter of 4 to 12 inches.

1.3 Transmission pipe covered by these requirements is designated as Pressure Rating 100, 125, 160, 165, 200, and 235 for rated working pressures of 100, 125, 160, 165, 200, and 235 psig (0.69, 0.86, 1.10, 1.14, 1.38, and 1.62 MPa), respectively, and has a nominal inside diameter of 14 to 36 inches.

1.4 Requirements for the installation and use of PVC pressure pipe and couplings are specified in the Standard for Installation of Private Fire Service Mains, NFPA 24-1992.

1.5 A product that contains features, characteristics, components, materials, or systems new or different from those covered by the requirements in this Standard, and that involve a risk of fire, electric shock, or injury to persons shall be evaluated using the appropriate additional component and end-product requirements as determined necessary to maintain the acceptable level of safety as originally anticipated by the intent of this Standard. A product whose features, characteristics, components, materials, or systems conflict with specific requirements or provisions of this Standard cannot be judged to comply with this Standard. Where considered appropriate, revision of requirements shall be proposed and adopted in conformance with the methods employed for development, revision, and implementation of this Standard.

2 General

2.1 Units of measurement

2.1.1 If a value for measurement as given in this Standard is followed by an equivalent value in other units, in parentheses, the second value may be only approximate. The first stated value is the requirement.

2.2 Components

2.2.1 Except as indicated in 2.2.2, a component of a product covered by this standard shall comply with the requirements for that component.

2.2.2 A component need not comply with a specific requirement that:

- a) Involves a feature or characteristic not needed in the application of the component in the product covered by this standard; or
- b) Is superseded by a requirement in this standard.

2.2.3 A component shall be used in accordance with its recognized rating established for the intended conditions of use.

2.2.4 Specific components are recognized as being incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as certain temperatures not exceeding specified limits, and shall be used only under those specific conditions for which they have been recognized.

CONSTRUCTION

3 Materials

3.1 PVC pipe and couplings shall:

- a) Be made from Class 12454-A or Class 12454-B virgin compounds, as defined in the Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds, ASTM D1784-92;
- b) Have an established hydrostatic-design-basis (HDB) rating of 4000 psig (27.6 MPa) for water at 73.4°F (23.0°C); and
- c) Comply with the outside diameter (OD) dimensions of cast-iron pipe.

Exception: Noncontaminated PVC pipe from the manufacturer's own production that is reground, or pelletized, and that may be dry blended by the manufacturer with the same grade and class of PVC virgin material, may be used provided that the processed material is of the same class of PVC pipe material and the finished product complies with the requirements of this standard.

4 Pipe Joints

4.1 If a coupling is used to join the pipe ends, the coupling with sealing ring gaskets shall be furnished with each length of pipe. Each coupling shall be of the same composition, trade size, and class or pressure rating as the pipe.

4.2 If a bell-and-spigot joint is used, a sealing gasket shall be furnished with each length of pipe.

5 Dimension Ratio

5.1 The dimension ratio (DR) which is the ratio of outside diameter to wall thickness, is to be as specified in Table 5.1.

Table 5.1
Dimension ratio (DR)

Pipe type	Pipe class/ pressure rating	Dimension ratio (DR)
Distribution [Sizes 4 – 12 inches (nominal 100 – 300 mm)]	100	25
	150	18
	200	14
Transmission [Sizes 14 – 36 inches (nominal 350 – 900 mm)]	100	41
	125	32.5
	160	26
	165	25
	200	21
	235	18

6 Imperfections

6.1 Pipe shall be homogeneous throughout and shall have no voids, cracks, inclusions, or other defects that would impair the intended performance of the product.

6.2 Axial dents, gouges, bruises, tool marks, or grooves in the gasket seating area of a pipe section or coupling shall not be deeper than 1/32 inch (0.8 mm).

6.3 For the purposes of this standard, a gasket-seating area of a pipe section or coupling is defined as an area that is, or could be, in contact with the sealing surfaces of the gasket in intended assemblies.

7 Sealing Gaskets

7.1 A sealing gasket shall be made of a vulcanized natural rubber or a synthetic rubber compound.

PERFORMANCE

8 General

8.1 Representative samples of each class, pressure rating and size of PVC pipe and couplings shall be subjected to the tests described in Sections 9 – 18.

9 Rubber Materials Tests

9.1 General

9.1.1 A rubber gasket used to effect the seal at the gasketed joint shall be made of a rubber compound and of such size, shape, and resiliency to comply with the following.

a) Single material and sealing (soft) portion of dual material gaskets:

1) Minimum tensile strength – 2000 psi (13.8 MPa), and minimum ultimate elongation – 300 percent [1 to 4 inches (25.4 to 102 mm)].

- 2) Maximum set of 3/16 inch (4.8 mm) when 1 inch (25.4 mm) marks are stretched to 3 inches (76.2 mm), held for 2 minutes, released, and measured 2 minutes after release.
- 3) After 96 hours in oxygen at 70°C (158°F) and at 300 psi (2068 kPa): 60 percent, minimum, of original tensile strength; 60 percent, minimum, of original elongation; and 5 units maximum change in Shore durometer hardness (Type A gauge).
- 4) The compression set of samples of rubber seals shall not exceed 20 percent of the original thickness after being compressed to three-fourths of the original thickness as described in the Test Methods for Rubber Property – Compression Set, ASTM D395-89 (Method B), using a conditioning temperature of $70 \pm 2^\circ\text{F}$ ($21 \pm 1^\circ\text{C}$).

b) Retaining (hard) portion of dual material gaskets:

- 1) Minimum tensile strength – 1200 psi (8.3 MPa), and minimum ultimate elongation – 125 percent [1 to 2.25 inches (25.4 to 57.2 mm)].
- 2) After 96 hours in oxygen at 70°C (158°F) and at 300 psi (2068 kPa): 60 percent, minimum, of original elongation; and 60 percent, minimum, of original tensile strength.

9.2 Tensile strength and elongation tests

9.2.1 Tensile strength and elongation shall be determined using the test methods and the type of power operated machine described in the Test Method for Rubber Properties in Tension, ASTM D412-92.

9.2.2 Specimens for test are to be cut using Die C for Method A described in the Test Method for Rubber Properties in Tension, ASTM D412-92.

9.3 Permanent set

9.3.1 The sample is to be prepared as specified in 9.2.2. Two marks, 1 inch (25.4 mm) apart, are to be stamped on the sample.

9.3.2 The sample is then to be placed in the jaws of the machine specified in 9.2.1 and stretched at a uniform rate of 20 ± 1 inches (508 \pm 25 mm) per minute until an elongation of 200 percent is attained. The specimen is to be held in the stretched position for 2 minutes, and then released immediately, without being allowed to snap back. The sample is to be removed from the machine and placed on a surface having low thermal conductivity. Two minutes after release of tension, the distance between the gage marks is to be measured to the nearest 0.1 inch (2.5 mm) and recorded.

9.4 Accelerated oxygen-pressure aging test

9.4.1 Three samples are to be prepared as specified in 9.2.2 except that the marks, 1 inch (25.4 mm) apart, are not to be stamped on the samples until the tensile strength and elongation tests are completed. The oxygen-pressure exposure is then to be conducted using the test procedures and the type of apparatus outlined in the Test Method for Rubber Deterioration by Heat and Oxygen, ASTM D572-88.

9.4.2 Following the accelerated oxygen-pressure aging test, the specimens are again to be subjected to tensile strength and elongation tests as described in 9.2.1 and 9.2.2, and results are to be compared with results of the corresponding tests of samples in the as-received condition.

9.5 Hardness tests

9.5.1 The durometer hardness of sealing gasket material is to be determined using the test methods and Type A durometer apparatus described in the Test Method for Rubber Property-Durometer Hardness, ASTM D2240-91.

9.5.2 The test samples are to be cut from a sample sealing gasket so as to be at least 0.25 inch (6 mm) thick unless it is known that comparable results can be obtained from a thinner sample. If comparable results will not be obtained, thinner pieces may be plied together to provide a specimen at least 0.25 inch (6 mm) thick.

9.5.3 The samples and the durometer apparatus are to be conditioned at a temperature of $23 \pm 2^{\circ}\text{C}$ ($73.4 \pm 3.6^{\circ}\text{F}$) for at least 1 hour before testing.

9.5.4 The average of five measurements made at different points on the sample is to be taken as the hardness of the sealing gasket material. Each measurement shall be read 1 second after application of the apparatus.

10 Hydrostatic-Pressure Test

10.1 Pipe and couplings (if provided) shall withstand for 5 seconds, without rupture, an internal hydrostatic pressure as specified in Table 10.1 based on the minimum wall thickness of the pipe, when tested as specified in 10.2 and 10.3.

Table 10.1
Hydrostatic test pressures

Pipe type	Multiple of rated pressure
Distribution [4 – 12 inches (nominal 350 – 900 mm)]	5
Transmission [14 – 36 inches (nominal 100 – 300 mm)]	3.2

10.2 Representative samples of each pressure class and size of pipe and couplings are to be prepared for hydrostatic pressure testing for short-time rupture strength in accordance with the Test Method for Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing, and Fittings, ASTM D1599-88. The minimum wall thickness, average wall thickness (minimum of six points), outside diameter and length of the samples are to be measured and recorded. The test pressure is to be determined based on the calculated hoop stress for the minimum wall thickness and minimum test pressure (5 times rated working pressure) using the measured minimum wall thickness. For sizes up to and including 6 inches (152.4 mm), the sample length (between end caps) is to be at least five times the nominal diameter; for sizes 8 to 12 inches (203.2 to 304.8 mm), the length is to be at least three times the nominal diameter; and for sizes larger than 12 inches, the pipe sample is to be at least 36 inches (0.91 m) in length.

10.3 The ends of the sample are to be sealed with gaskets or end caps. The sample is then to be connected to the hydrostatic-pressure testing equipment and all air is to be expelled from the pipe or fitting. The internal water pressure is to be increased at a uniform rate until the calculated test pressure has been developed. The calculated test pressure is to be held for 5 seconds. The pressure is then to be increased at a uniform rate, so that termination of the test occurs between 60 and 70 seconds after the initial application of pressure.

11 Leakage Test for Joints

11.1 Pipe joints having maximum clearances between the pipe spigot and pipe bell or coupling, with clearances determined by the manufacturer's tolerances, shall not leak and shall not exhibit damage when subjected to a hydrostatic pressure of two times the rated pressure as specified in 11.2 – 11.4.

11.2 Pipe samples used in each test are to be representative of each class, pressure rating, and size. Joints having the maximum clearances are to be installed in accordance with the manufacturer's instructions and deflected to the maximum deflection recommended by the manufacturer. Joints may be machined to the maximum clearance allowed by the manufacturer's tolerances. The ends of the test sample are to be restrained to prevent longitudinal separation at the joints.

11.3 Each test sample is to be connected to the hydrostatic-pressure test equipment and all air is to be expelled from the system. The water pressure is to be increased in 50 psig (345 kPa) increments until twice the rated pressure is attained. At each increment of pressure increase, measurements are to be made of distortion at a joint, protrusion of gasket material (if any), or other factors which may cause leakage after continued use of the pipe in service. During the test, the pressure is not to be increased to the next increment until the line and connections have become stable, as evidenced by no further movement of gasket material.

11.4 After the pressure has been increased to twice the rated pressure, the pressure is to be decreased to 0 psig, while observations are made for leakage. The pressure is then again to be slowly increased to twice the rated pressure while observations are made for leakage.

12 Assembly Test

12.1 Pipe joints made with minimum clearances between the pipe spigot and bell or coupling, determined in accordance with the manufacturer's tolerances, shall, when assembled as specified in 12.2, exhibit no damage to gaskets, pipe, or coupling sections. Cut or torn gasket materials and chipped or broken pipe or coupling sections, are considered to be damaged and do not comply with the requirement.

12.2 Representative samples of each class, pressure rating, and size of pipe and couplings are to be machined as required. Two pipe sections are to be joined together in accordance with the manufacturer's instructions, using a nonmineral-base lubricant, or the equivalent, and normal installation tools such as pike bars, jack and chain, and the like.

13 Flattening Test

13.1 Pipe, when flattened to 40 percent of the original outside diameter, shall exhibit no evidence of splitting, cracking, or breaking, when tested as specified in 13.2.

13.2 Three samples of each pressure class, pressure rating, and size pipe are to be tested. The test sample is to be at least 2 inches (50.8 mm) long and placed between two rigid parallel plates. The pipe is to be flattened until the distance between the plates is 40 percent of the original outside diameter of the pipe. The rate of loading is to be uniform and the total compression is to be completed within 2 to 5 minutes.

14 Impact Resistance Test

14.1 Pipe shall withstand an impact of 100 foot-pounds (135.6 N·m) without breaking, cracking or splitting, when tested as specified in 14.2.

14.2 Three samples of each pressure class, pressure rating, and size are to be conditioned to 70°F (21°C) and tested for impact resistance in accordance with the Test Method for Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight), ASTM D2444-93 using Tup B and a flat plate, Holder B.

15 Longitudinal Tensile-Strength Test

15.1 Machined specimens from the pipe shall have a minimum tensile strength of 7000 psi (48.2 MPa).

15.2 Samples of each pressure class, pressure rating, and size are to be tested for tensile strength in accordance with the Test Method for Tensile Properties of Plastics, ANSI/ASTM D638-91 or Test Method for Tensile Properties of Plastics, Metric, ANSI/ASTM D638M-91.

16 Long-Term Hydrostatic-Pressure Test

16.1 The pipe shall not rupture, permanently distort, or weep when subjected to the pressure specified in Table 16.1 for 1000 hours. The samples are to be prepared in accordance with the Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure, ASTM D1598-86. Either constrained-end or free-end enclosures may be used. Samples of the distribution pipe constructed of similar material and process as the transmission pipe is to be considered representative of the transmission pipe.

Table 16.1
Long term hydrostatic test pressures

Pipe type	Pipe class	Test pressure	
		Psig	MPa
Distribution	100	350	2.41
	150	500	3.45
	200	650	6.48

16.2 The test samples are to be maintained at a test temperature of 73.0 ± 4°F (22.8 ± 2°C).

17 Extrusion Quality Test

17.1 Pipe, when immersed in acetone, shall show no evidence of flaking or disintegration when tested as specified in 17.2.

17.2 Pipe specimens representative of the class and size range are to be tested for extrusion quality in accordance with the Test Method for Degree of Fusion of Extruded PVC Pipe and Molded Fittings by Acetone Immersion, ASTM D2152-80(1986).

18 Light and Water Test

18.1 After exposure to ultraviolet light and water for 360 hours as specified in 18.2 – 18.4, the apparent tensile strength of sample pipe rings shall not be reduced by more than 30 percent.

18.2 Samples of the pipe rings for the determination of the apparent tensile strength (split disc) are to be prepared and tested as specified in the Test Method for Apparent Tensile Strength of Ring or Tubular Plastics and Reinforced Plastics by Split Disc Method, ASTM D2290-92.

18.3 The apparatus is to provide ultraviolet light from two enclosed carbon-arcs formed between two vertical electrodes 1/2 inch (50.8 mm) in diameter, located at the center of a revolvable vertical metal cylinder 31 inches (787 mm) in diameter and 17-3/4 inches (451 mm) high. The arcs are to be enclosed by clear globes of No. 9200-PX Pyrex glass or the equivalent.

18.4 The samples are to be vertically mounted on the inside of the cylinder, facing the arcs, and the cylinder is to be rotated about the arcs at one revolution per minute. A system of nozzles is to be provided so that each sample is sprayed in turn with water as the cylinder revolves. During each 20-minute operating cycle each sample is to be exposed to light from the arcs for 17 minutes and to water spray for 3 minutes. The temperature within the cylinder while the apparatus is in operation is to be $145 \pm 9^{\circ}\text{F}$ ($63 \pm 5^{\circ}\text{C}$).

MANUFACTURING AND PRODUCTION TESTS

19 General

19.1 The manufacturer shall conduct the necessary production control, inspection, and tests. The program shall include at least the Production-Line Hydrostatic-Pressure Test, Section 20.

20 Production-Line Hydrostatic-Pressure Test

20.1 Each length of pipe and each coupling shall withstand for 5 seconds, without leakage or other defect that would impair intended performance of the products, an internal hydrostatic pressure of:

- a) Four times the rated pressure for distribution pipe; and
- b) Two times the rated pressure for transmission pipe.

The standard test temperature is 73.0°F (22.8°C). If test temperatures are greater than 73.0°F (22.8°C), the reduced test pressures specified in Table 20.1 may be used. Intermediate values may be interpolated.

Table 20.1
Test pressure

Pipe temperature °F (°C)	Percent of test pressure at 73°F (22.8°C)
80 (26.7)	88
90 (32.2)	75
100 (37.8)	62
110 (43.3)	50

20.2 The test sample is to be connected to the hydrostatic-pressure testing equipment with gaskets that seal the ends of the pipe or coupling. All air is to be expelled from the sample, and the internal water pressure is to be applied at a uniform rate until the specified pressure is attained. The specified pressure is to be maintained for not less than 5 seconds. Couplings may be tested using a bladder-type tester.

20.3 The apparatus for conducting hydrostatic pressure tests is to be equipped with an instrument to record the pressure to which each length of pipe or coupling was subjected.

20.4 The manufacturer shall keep records of the results of the hydrostatic-pressure tests. Each record shall identify each test as to class, size, test pressure, date, and shift of manufacture.

MARKING

21 General

21.1 All required markings on pipe and couplings shall be legible and shall be not less than 3/8 inch (9.6 mm) high.

21.2 If a manufacturer produces pipe or couplings at more than one factory, each part shall have a distinctive marking or identifying symbol to identify it as the product of a particular factory.

22 Pipe

22.1 Each length of pipe shall be marked on the outside surface with the following:

- Manufacturer's or private labeler's name, or identifying symbol.
- Size and pressure class or pressure rating of pipe.
- Test pressure.
- Date and shift of manufacture.
- Identification of the type of coupling with which it is intended to be used if more than one type of coupling is supplied.

23 Couplings

23.1 Each coupling shall be marked on the outside surface with the following:

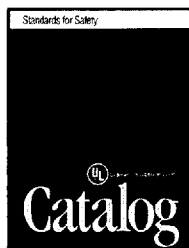
- a) Manufacturer's or private labeler's name, or identifying symbol.
- b) Size and pressure class or pressure rating of coupling.
- c) Test pressure and the letter T to indicate that it has been hydrostatically pressure tested.
- d) Identification of the type of pipe with which it is intended to be used if it may be used with more than one type of pipe.

24 Rubber Gaskets

24.1 The following information shall be legibly molded into, or stamped on, each rubber gasket:

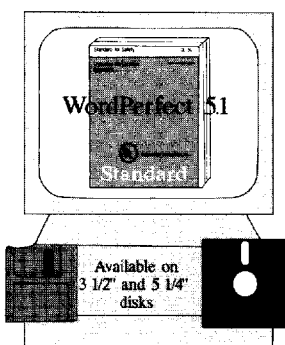
- a) Gasket manufacturer's name or identifying symbol.
- b) Size of pipe with which it is intended to be used.
- c) Class or pressure rating of pipe, only when a specific gasket is used, for each different class or pressure rating of pipe or coupling.
- d) Year of manufacture.
- e) Material identification if more than one material is supplied. This identification may be in code.

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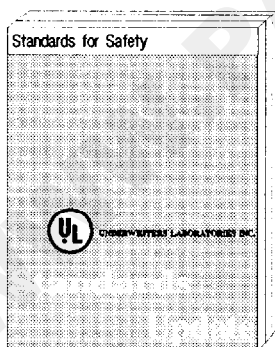


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