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January 2, 1996

Revision pages for

Standard for

Liquid-Tight Flexible Nonmetallic Conduit

UL 1660, Second Edition

Attached to this transmittal notice is a revision of the second edition of UL 1660.

A CHANGE ON A PAGE DATED JANUARY 2, 1996 IS INDICATED BY A SMALL PRINT NOTE FOLLOWING THE AFFECTED ITEM, PRECEDED AND FOLLOWED BY AN ASTERISK.

THESE NEW AND REVISED REQUIREMENTS ARE NOW IN EFFECT.

The new and revised requirements are substantially in accordance with UL's bulletin on this subject dated January 10, 1991. The bulletin is now obsolete and may be discarded.

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

With the inclusion of the accompanying material, the standard consists of pages dated as shown in the following checklist:

Page	Date
1	December 21, 1994 (Reprinted January 2, 1996)
2	—
3	January 2, 1996
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UL 1660

Standard for

Liquid-Tight Flexible Nonmetallic Conduit

First Edition – September, 1987

Second Edition

December 21, 1994

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 published set of revision pages.

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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.

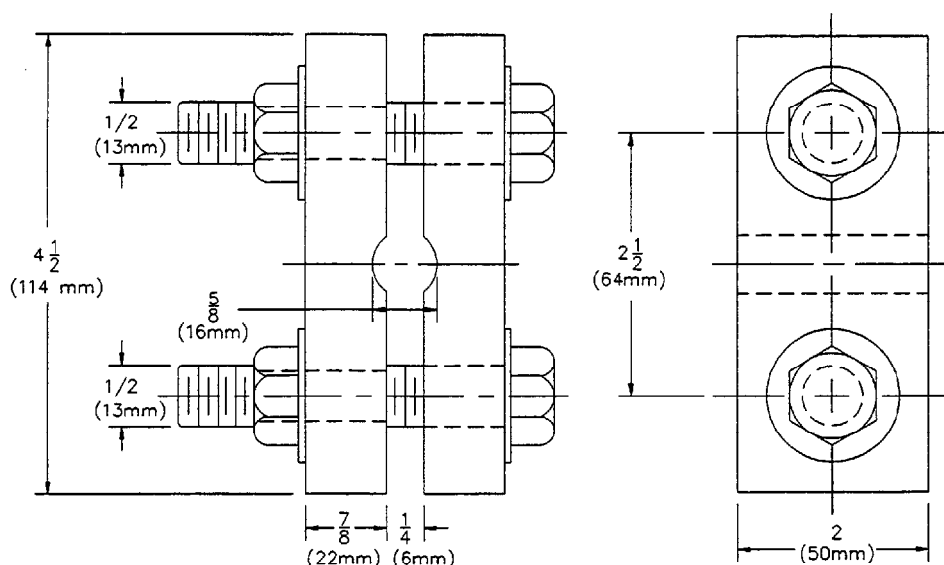
D. A product employing materials or having forms of construction differing from those detailed in the requirements of this Standard may be examined and tested according to the intent of the requirements and, if found to be substantially equivalent, may be judged to comply with the Standard.

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.

Figure 10.2
Clamp for tension test

Dimensions are shown in inches (millimeters)



SB1078

10.3 For a test using a weight and either a block and tackle or a differential pulley, the clamps are to be made of hard wood, and the two pieces comprising each clamp are to be fastened together by two bolts, enabling the conduit to be clamped tightly between the jaws without being crushed (see Figure 10.2). Two such clamps are to be provided.

10.4 For a test using a weight and either a block and tackle or a differential pulley, a 44 inch or 1115 mm specimen of the conduit is to be fastened in the clamps so that its ends project about 2 inches or 50 mm beyond the edges of each clamp, thus providing a specimen 36 inches or 915 mm long between the clamps, which are then to be tightened to keep the specimen from slipping but not any farther.

10.5 For a test using a testing machine, an 18 inch or 457 mm specimen is to be gripped in the jaws of the machine. If necessary to keep the jaws from crushing the specimen, round metal plugs are to be inserted into the ends of the specimen. The jaws are then to be separated at the rate of 2.0 ± 0.2 inch/min or 50 ± 5 mm/min until the specimen is under a tension of 300 lbf or 1334 N or 136 kgf. This level of tension is to be maintained for 60 s and is then to be released at the same rate at which it was applied. For any adjustment necessary for maintaining the tension during the 60 s, the jaws are to be separated at the rate of $1/2 \pm 1/8$ inch/min or 10.0 ± 2.5 mm/min.

10.6 For a test using a weight and either a block and tackle or a differential pulley, the specimen is to be suspended by the upper clamp with a loop of rope passing over the hook of the block and tackle or differential pulley assembly, and a weight exerting 300 lbf or 1334 N or 136 kgf is to be attached to the lower

clamp. The specimen is to hang vertically for its full length and at right angles to the faces of the clamps. The specimen, clamps, and weight are then to be raised gently so that tension is applied to the specimen as evenly as possible. The total weight is to be applied within 30 s so that the weight just clears the floor and hangs freely in the air. The weight is to be kept by hand from rotating. The weight is to be supported by the specimen for 60 s, and then is to be lowered to the floor, and the weight and clamps are to be removed.

10.7 The conduit is not acceptable if there are any splits, cracks, tears, or other openings in the outside or inside surfaces.

10A Pipe Stiffness for Conduit Intended for Direct-Burial

10A.1 Conduit which is intended for direct burial use shall have a minimum pipe stiffness of 120 psi (827 Pa) at 10 percent deflection when determined in accordance with the Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading, ASTM D2412.

10A.1 added January 2, 1996

11 Test for Secureness of Fittings

11.1 Specimens of finished conduit shall withstand the pull described in 11.2 without damage to the conduit.

11.2 Three conduit specimens are to be assembled to fittings intended for the conduit and are then to be tested by a weight exerting 150 lbf or 667 N or 68 kgf between each fitting and the conduit for 5 min. The conduit is not acceptable if any specimen shows damage to the conduit. Elongation or stretching of the conduit that is not permanent is not to be considered as damage.

12 Flexibility Tests

12.1 Six specimens of the finished conduit are to be tested (three at room temperature and three at a cold temperature) using mandrels having diameters as specified in Table 12.1. The cold temperature is to be -20.0°C , $+3.0^{\circ}\text{C}$, -2.0°C (-4.0°F , $+5.4^{\circ}\text{F}$, -3.6°F) for conduit that is marked "outdoor" and is to be $-10.0 \pm 2.0^{\circ}\text{C}$ ($+14.0 \pm 3.6^{\circ}\text{F}$) for conduit that is not so marked. The cold specimens are to be exposed to air precooled to and circulating at the indicated low temperature for 60 min before being tested. Each specimen is to be wrapped for 180° around the applicable mandrel with tension applied to the specimen causing the specimen to conform closely to the curved surface of the mandrel.

12.2 The conduit is not acceptable if any splits, cracks, tears, or other openings are visible in the outside or inside surfaces of any of the six specimens using normal or corrected vision without magnification.

Table 12.1
Flexibility test mandrels

Trade size of conduit in inches	Mandrel diameters	
	Inch	mm
3/8	4.0	102
1/2	6.5	165
3/4	8.5	216
1	13.0	330
1-1/4	16.0	406
1-1/2	18.0	457
2	22.2	564

MARKINGS

19 General

19.1 All markings shall be clearly legible. Markings that are in addition to the surface legend and other markings required in this standard are acceptable if the additional markings do not conflict with and cannot be confused with the required markings.

20 Legend on the Outside Surface of the Conduit

20.1 The surface markings required in 20.4 shall be permanent. Ink printing is acceptable if it complies with the test described in 18.1 – 18.5. Raised (embossed) lettering is acceptable. Indent printing is acceptable on layered conduit if the thicknesses of the jacket are not reduced below the minimums indicated in Table 6.2. Indent printing is acceptable on integral conduit if the thickness of the flexible PVC integral lining and jacket measured between the convolutions is not reduced below the minimum indicated in Table 6.4.

20.2 The sequence of surface markings is not specified.

20.3 The surface markings required in 20.4 shall appear throughout the length of every piece of the conduit that is made and shall be repeated at intervals that are not longer than 24 inches or 610 mm.

20.4 The outside surface of every length of liquid-tight flexible nonmetallic conduit produced shall be marked with each of the following:

- a) Words such as "Liquid-tight flexible nonmetallic conduit Type ____ (use "A" for layered conduit and "B" for integral conduit) or letters such as "FNMC-A" for layered conduit and "FNMC-B" for integral conduit. The words or letters shall identify the conduit and distinguish it from the liquid-tight flexible metal conduit that is mentioned in 1.6 and from the electrical nonmetallic tubing (ENT) that is mentioned in 1.8. While it is necessary to identify layered conduit as "A" and integral conduit as "B" to aid in the application of similarly marked fittings, it is not required that the means of reinforcement (fibrous or rigid) be identified.
- b) The trade size of the conduit from 1.1.
- c) The name or trademark of the conduit manufacturer, that manufacturer's trade name for the conduit, both, or any other distinctive marking by means of which the organization that is responsible for the conduit can readily be identified. If the organization that is responsible for the conduit is different from the actual manufacturer, both the responsible organization and the actual manufacturer shall be identified by name or by coding such as by trade name, trademark, or the assigned electrical reference number. The meaning of any coded identification shall be made available. A private labeler may also be identified.
- d) A distinctive identification of the factory if the organization that is responsible for the conduit operates more than one factory in which liquid-tight flexible nonmetallic conduit is made. The factory identification may be in code, the meaning of which shall be made available.
- e) "80 C dry, 60 C wet" or "105 C dry, 60 C wet" may be marked on conduit whose separate jacket or integral lining and jacket complies with the 113°C (for the 80°C rating) or 136°C (for the 105°C rating) oven aging requirements in Table 17.1. Conduit that complies with one of these oven

aging requirements but is not marked is acceptable for only 60°C dry or wet use. Conduit whose separate jacket or integral lining and jacket complies with the 100°C oven aging requirements in Table 17.1 may be marked "60 C dry or wet" but this use is understood without the marking. See as specified in (g).

f) "70 C oil res" or "70 C oil resistant" may be marked on 80°C or 105°C conduit (but not on 60°C conduit) whose separate jacket or integral lining and jacket complies with the 70°C oil requirements in Table 17.1. Conduit that complies but is not marked is not acceptable for exposure to mineral oil at 60°C (140°F) and lower temperatures.

g) "80 C dry, 60 C wet, 60 C oil res" or "80 C dry, 60 C wet, 60 C oil resistant" may be marked on conduit whose separate jacket or integral lining and jacket complies with the 60°C oil and 113°C oven aging requirements in Table 17.1. Conduit that complies but is not marked is not acceptable for the industrial-machinery use (NFPA 79) described in 1.4.

h) "Outdoor" may be marked on conduit whose separate jacket or integral lining and jacket complies with the carbon-arc-radiation and water-spray exposure test requirements in 16.1 – 16.7, with the cold impact test at -10°C (+14°F) in 8.1 – 8.5, and with the cold flexibility test at -25°C (-13°F) in 12.1 and 12.2. Conduit that complies but is not marked is not acceptable for outdoor use.

i) Finished conduit that complies with the requirements of Pipe Stiffness for Conduit Intended for Direct-Burial, Section 10A, shall be surface marked with one of the following designations:

- 1) direct burial,
- 2) burial,
- 3) dir burial, or
- 4) dir bur

at intervals that are not longer than 24 inches or 610 mm.

20.4 revised January 2, 1996

21 Tag, Label, Reel, or Carton Markings

21.1 A tag or an adhesive label on which the following information is indicated plainly shall be affixed to every shipping length of the finished conduit. If the conduit is wound on a reel or coiled in a carton, the tag or label may be affixed to the reel or carton instead of to the conduit or the tag or label may be eliminated and the information may be printed or stenciled directly on the reel or carton. The sequence of these markings is not specified.

- a) All of the information as specified in 20.4 (a) – (h).
- b) The date of manufacture, or the dating period of manufacture. The dating period shall not exceed any three consecutive calendar months. The date or dating period may be abbreviated or coded. Any code used shall be either a nationally accepted code or a code that is affirmed by the organization responsible for the conduit. Both of the following apply to any code that is used:
 - 1) The code shall not repeat in less than 20 years.

- 2) Reference to the manufacturer's production records shall not be necessary to determine when the conduit was made.
- c) For layered conduit, "Use fittings identified specifically for Type A conduit" or other wording to the same effect. Fittings intended solely for layered conduit are marked directly "FNMC-A only." See 1.5(a).
- d) For integral conduit, "Use fittings identified for Type B conduit or use fittings for liquid-tight flexible metal conduit" or other wording to the same effect. "FNMC-B only" is marked directly on nonmetallic fittings that are intended for integral conduit. Fittings (metal) for liquid-tight flexible metal conduit are not marked "FNMC-B" but other metal fittings for integral conduit have a marking such as "FNMC-B." See 1.5(b).
- e) For layered and integral conduit, "Ground metal fittings through metal box or grounding lug" or other wording to the same effect.
- f) For layered and integral conduit, "Install an equipment-grounding conductor per NEC" or other wording to the same effect.

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December 21, 1994

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UL 1660, Second Edition

Accompanying this transmittal notice is a copy of the Second edition of UL 1660.

THIS EDITION OF THE STANDARD IS NOW IN EFFECT.

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DECEMBER 21, 1994

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