

# UL 870

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## Wireways, Auxiliary Gutters, and Associated Fittings



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UL Standard for Safety for Wireways, Auxiliary Gutters, and Associated Fittings, UL 870

Seventh Edition, Dated June 28, 1995

Revisions: This Standard contains revisions through and including August 20, 1999.

Text that has been changed in any manner is marked with a vertical line in the margin. Changes in requirements are marked with a vertical line in the margin and are followed by an effective date note indicating the date of publication or the date on which the changed requirement becomes effective.

UL is in the process of converting its Standards for Safety to the Standard Generalized Markup Language (SGML), and implementing an SGML compliant document management and publishing system. SGML - an international standard (ISO 8879-1986) - is a descriptive markup language that describes a document's structure and purpose, rather than its physical appearance on a page. Significant benefits that will result from UL's use of SGML and these new systems include increased productivity, reduced turnaround times, and data and information consistency, reusability, shareability, and portability. However, the fonts, pagination, and general formatting of UL's new electronic publishing system differ from that of UL's previous publishing system. Consequently, when revision pages are issued for a Standard with the new publishing system, these differences may result in the printing of pages on which no requirements have been changed - these additional pages result from relocation of text due to repagination and reformatting of the Standard with the new publishing system.

The revised requirements are substantially in accordance with UL's Bulletin(s) on this subject dated January 25, 1999. The bulletin(s) is now obsolete and may be discarded.

The revisions dated August 20, 1999 include a reprinted title page (page1) for this Standard.

As indicated on the title page (page 1), this UL Standard for Safety is an American National Standard. Attention is directed to the note on the title page of this Standard outlining the procedures to be followed to retain the approved text of this ANSI/UL Standard.

As indicated on the title page (page1), this UL Standard for Safety has been adopted by the Department of Defense.

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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
1 .....	August 20, 1999
2 .....	June 28, 1995
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## **UL 870**

### **Standard for Wireways, Auxiliary Gutters, and Associated Fittings**

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#### **Seventh Edition**

**June 28, 1995**

Approval as an American National Standard (ANSI) covers the numbered paragraphs on pages dated June 28, 1995 and December 15, 1997. These pages should not be discarded when revised or additional pages are issued if it is desired to retain the ANSI approved text.

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

Approved as ANSI/UL 870-1997, September 30, 1997

The Department of Defense (DoD) has adopted UL 870 on April 14, 1987. The publication of revised pages or a new edition of this Standard will not invalidate the DoD adoption.

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 which conflict with specific requirements of the Standard cannot be judged to comply with the Standard. A product employing materials or having forms of construction not addressed by this Standard may be examined and tested according to the intent of the requirements and, if found to meet the intent of this Standard, 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 wireways, auxiliary gutters, and associated fittings to be employed in accordance with the National Electrical Code, NFPA 70.

1.2 These requirements do not cover rigid or flexible conduit, surface raceways, underfloor raceways, nor other products of a similar nature that are covered by individual requirements.

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

1.3 revised August 20, 1999

### 2 Glossary

2.1 For the purpose of this standard the following definitions apply.

2.2 ASSOCIATED FITTING – A part that is used in the assembly of a complete wireway system, such as an elbow, tee, cross, end closer, or hanger.

2.3 AUXILIARY GUTTER – A section of wireway used to supplement the wiring space at a distribution center, switchboard, or similar location in a wiring system.

2.4 WIREWAY – A sheet-metal trough with a hinged or removable cover for housing and protecting electric wires and cables and in which conductors are laid in place after the wireway system has been installed as a complete system.

2.4 revised August 20, 1999

### 3 Units of Measurement

3.1 If a value for measurement is followed by a value in other units in parentheses, the first stated value is the requirement. The second value may be only approximate.

## CONSTRUCTION

### 4 General

4.1 Wireways, auxiliary gutters, and associated fittings shall employ materials that are acceptable for the particular use, and shall be made and finished with the degree of uniformity and grade of workmanship practicable in a well-equipped factory.

4.2 A wireway system shall include all wireways and fittings required to make a complete installation in accordance with the National Electrical Code, ANSI/NFPA 70-1999.

4.2 revised August 20, 1999

4.3 Unless otherwise noted, auxiliary gutters and fittings shall comply with all of the requirements for wireways.

### 5 Design

5.1 A wireway shall be constructed, such that the interconnection of sections and fittings will provide a rigid mechanical assembly and provide electrical conductivity complying with the requirements for the Electrical Continuity Test, Section 17.

5.2 A wireway shall be formed and assembled so that it will have the strength and rigidity necessary to resist the abuses to which it is likely to be subjected, without resulting in a risk of fire, electric shock, or injury to persons due to total or partial collapse with resulting damage to conductors, loosening or displacement of parts, or other serious defects.

5.3 The interior of the wireway shall be free from burrs and sharp corners or edges that may abrade the insulation on conductors or otherwise damage wiring. Screws and bolts, however used, shall not project into the wireway unless sharp ends and threaded sections are covered or otherwise prevented from coming in contact with wires.

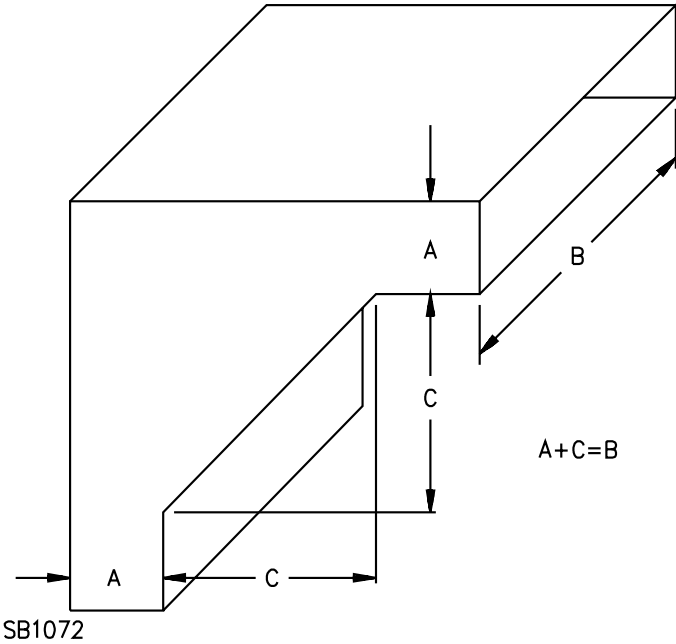
*Exception: A threaded section of a screw or bolt not having a sharp point need not be prevented from coming in contact with wires provided the screw or bolt does not project more than 1/32 inch (0.8 mm) into the wireway.*

5.4 A flatwise elbow or tee or a similar fitting for a wireway having a rectangular cross section shall be of the sweep type; that is, such a fitting for a right-angle bend shall have the internal corner replaced by a diagonal wall – see Figure 5.1 – to permit a larger bending radius for installed conductors. Sweep fittings may also be used in wireways of square cross section.

5.5 In a flatwise sweep fitting for a wireway of rectangular cross section, dimension A plus dimension C (the length of leg cut off by the diagonal wall) shall be equal to or exceed dimension B. See Figure 5.1.

**Figure 5.1**  
**Flatwise sweep elbow**

Figure 5.1 revised June 3, 1998



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5.6 Metal straps not less than 1/2 inch (12.7 mm) wide and of the same thickness as the wireway, or metal rods not less than 1/4 inch (6.4 mm) in diameter may be provided at intervals across the width of the wireway to serve as wire-retaining means.

## 6 Conductor Size

6.1 The maximum conductor size for which a wireway is constructed is to be based on the bending space for conductors that enter or leave the wireway through connections in the sides or bottom in accordance with Table 6.1.

**Table 6.1**  
**Conductor size based on bending space**

Smaller inside dimension of wireway, inches (mm) <sup>a</sup>		Maximum conductor size, AWG or MCM (mm <sup>2</sup> )	
2	(50.8)	3	(26.7)
2-1/2	(63.5)	2	(33.6)
3	(76.2)	1	(42.4)
3-1/2	(88.9)	2/0	(67.4)
4	(102)	4/0	(107.2)
4-1/2	(114)	250	(127)
5	(127)	350	(177)
6	(152)	500	(253)
8	(203)	900	(456)
10	(254)	1250	(633)
12	(305)	2000	(1013)

<sup>a</sup> A minus tolerance of 1/8 inch (3.2 mm) is allowed for manufacturing variations. The inside dimensions of the wireway are to be measured at a point where there is no fitting or fastening.

## 7 Material

7.1 A wireway shall be of metal and shall be constructed to provide sufficient strength and rigidity so that the wireway will retain its shape and the covers will fit as intended.

7.2 In an auxiliary gutter, the use of insulating material to replace a portion of one wall of the auxiliary gutter where the wiring goes through meets the intent of the requirement in 7.1 when the insulating material and the assembly of the material to the auxiliary gutter supplies strength and rigidity equivalent to that of the auxiliary gutter without the substitution.

7.2 revised August 20, 1999

## 8 Thickness of Metal

8.1 A sheet-metal enclosure shall have a thickness not less than that specified in Table 8.1. If a metal other than steel, aluminum, or copper is used, it shall be of sufficient thickness to provide strength and rigidity equivalent to that of steel in the thickness specified.

**Table 8.1**  
Minimum acceptable thickness of sheet metal

Maximum inside width of widest surface in inches (mm)		Steel, inch (mm)				Aluminum or copper, inch (mm)
More than	Not more than or equal to	Uncoated		Galvanized <sup>a</sup>		
0	6 (152)	0.053 (1.35)	0.056 (1.42)	0.075 (1.91)		
6 (152)	12 (305)	0.060 (1.52)	0.063 (1.60)	0.095 (2.41)		
12 (305)	18 (457)	0.067 (1.70)	0.070 (1.78)	0.095 (2.41)		
18 (457)	30 (762)	0.093 (2.36)	0.097 (2.46)	0.122 (3.10)		
30 (762)		0.123 (3.12)	0.126 (3.20)	0.153 (3.89)		

<sup>a</sup>See 15.8 for requirements for sheet steel that employs hot-dipped mill galvanized A60, G60, or G90 coatings.

## 9 Flanges and Reinforcing Strips

9.1 All seams, joints, or splices at a corner or a back edge of a wireway, or between abutting wireway sections or fittings shall be closed and reinforced by flanges formed of the material from which the wireway is made, or by separate strips, angles, or continuous welding so as to produce a construction substantially equivalent in strength to an integral flanged construction.

9.2 Reinforcing strips or angles shall have a thickness not less than that specified in Table 9.1.

**Table 9.1**  
Minimum acceptable thickness of sheet metal for reinforcing strips or angles

Maximum inside width of widest surface in inches (mm)		Steel, inch (mm)				Aluminum or copper, inch, (mm)
More than	Not more than or equal to	Uncoated		Galvanized		
0	6 (152)	0.043 (1.09)	0.047 (1.19)	0.060 (1.52)		
6 (152)	18 (457)	0.054 (1.37)	0.058 (1.47)	0.077 (1.96)		
18 (457)	30 (762)	0.068 (1.73)	0.071 (1.80)	0.098 (2.49)		
30 (762)	—	0.097 (2.46)	0.100 (2.54)	0.124 (3.15)		

9.3 A flange, separate strip, or angle shall overlap at least 1/2 inch (12.7 mm), and shall extend approximately the full length of the seam, joint, or splice.

9.4 A flange, separate strip, or angle at a seam, joint, or splice between abutting wireway sections or between a wireway section and an attached fitting shall have fastenings located not more than 1-1/2 inches (38.1 mm) from each end of the seam and at points not more than 6 inches (152 mm) apart between these end fastenings.

*Exception: A single fastening may be employed for a seam not more than 4 inches (102 mm) long if it is located within 1/2 inch (12.7 mm) of the center if in the bottom of the wireway, or between the center of the seam and the top if on the side of the wireway.*

9.5 With reference to 9.4 and its exception, if separate strips are employed, fastenings shall be provided on both sides of the seam.

9.6 Rivets, spot-welds, bolts, and screws are considered to be acceptable forms of fastenings. See also 5.1 and 14.2.

9.7 At least two full threads shall be provided in metal into which screws are to be threaded. Fastenings in sheet metal shall have a diameter at least fifty percent greater than the thickness of the finished sheet metal with which they are used.

9.8 Sheet metal may be extruded at a tapped hole to provide at least two full threads, if the thickness of the metal before extrusion is not less than the pitch of a single thread.

## **10 Openings in Enclosure**

### **10.1 Connections for wiring systems**

10.1.1 An opening for connection of a wiring system in a wireway intended for stock and not for a particular installation shall be closed with a knockout, cover, or plug having a thickness not less than 0.053 inch (1.35 mm) if of uncoated steel, 0.056 inch (1.42 mm) if of galvanized steel, and no less than 0.077 inch (1.96 mm) if of aluminum or copper. The knockout, cover, or plug shall be so secured in place that it can be readily removed but will not be displaced with ordinary handling. For a raintight wireway see 16.2.

10.1.2 A hole or a knockout shall be located so that adequate space will be provided for the installation of a locknut, a conduit bushing, an armored-cable connector, or other similar fitting.

### **10.2 Other openings**

10.2.1 An open hole or a slot shall not be provided unless it will be closed in the final assembly and installation of the wireway.

*Exception: See 16.2 and 16.3.*

## 11 Covers

11.1 A cover shall be provided with means for securely holding it in place on the trough.

11.2 Fastenings for a flat or flanged cover shall comply with the requirements in 9.7 and 9.8 for screws and tapped holes or nuts, and with the requirements in 11.3 for other types of fastenings. The fastenings shall be located not more than 6 inches (152 mm) from each end of the cover and spaced not more than 12 inches (305 mm) apart at points between the end fastenings.

*Exception: If the straps or rods mentioned in 5.6 are spaced not more than 30 inches (762 mm) apart along the length of the wireway after assembly, a flat or flanged cover may be held by fastenings located not more than 6 inches (152 mm) from each end of the cover and spaced not more than 24 inches (160 mm) apart at points between these end fastenings.*

11.3 A fastening device other than a tapped hole or nut may be employed with a screw. A type of fastening other than a screw may be employed if it is of adequate strength and is otherwise suitable for the application.

11.4 Unless a cover complies with the requirements in 11.5, a hinged or screw-on cover shall have flanges that overlap the side walls of the trough not less than 7/16 inch (11.1 mm) throughout the full length of the cover. The ends of such a cover shall:

- a) Be flanged or otherwise formed to overlap the trough at least 1/2 inch (12.7 mm),
- b) Provide a 1/4-inch (6.4-mm) rabbet, or
- c) Employ a construction affording an equivalent closure of the trough.

11.5 A flat, unhinged cover may be used if

- a) Each side wall of the trough is flanged at right angles to the wall to overlap the cover not less than 1/2 inch (12.7 mm),
- b) Each end of the cover forms a 1/4-inch (6.4-mm) rabbet with the adjoining cover, and
- c) The cover is fastened to the trough as required by 11.2.

## 12 Hinges and Latches

12.1 A hinge for a door or cover shall be of metal not less than 0.054 inch (1.37 mm) thick if made of steel, and not less than 0.077 inch (1.96 mm) thick if made of copper or aluminum.

*Exception: A wireway cover may employ a continuous piano-type hinge made of steel not less than 0.047 inch (1.2 mm) thick.*

12.2 Hinges shall not be spaced more than 24 inches (610 mm) apart, measured center to center, and not more than 15 inches (381 mm) from each end of the cover. At least two hinges shall be used for each cover.

*Exception: A single hinge that extends the full length of the cover may be used.*

12.3 A hinged door or cover shall be provided with at least one latch or the equivalent for each 30 inches (762 mm) or less of cover length. Latches shall not be located more than 12 inches (305 mm) from each end of the cover and shall be evenly spaced not more than 36 inches (914 mm) apart at points between the end latches.

12.4 Latches shall be positive in action.

12.5 A screw fastening is considered to be equivalent to a latch.

12.6 A button latch consisting of a projection stamped on the edge of the trough and engaging a corresponding indentation in the cover flange is not acceptable.

12.7 A spring latch consisting of a strip of steel fastened to the wall of a trough and cooperating with a slot in the cover shall be formed and attached so that the latch engages the edge of the cover slot away from the trough wall.

12.8 An arrangement of hinges or latches, or both, that does not fully comply with the requirements in 12.1 – 12.5, may be acceptable if, when subjected to an appropriate investigation, it is found to provide the necessary mechanical strength and rigidity of the complete assembly.

### **13 Expansion Joints and Telescoping Sections**

13.1 An expansion joint or telescoping section shall have the necessary mechanical strength to support the conductors that may be installed in it and shall be provided with one or more bonding conductors to provide electrical continuity.

*Exception: A telescoping section that can be made immovable at the time of installation by bolted fastenings equivalent to the fastenings required between straight lengths of wireway need not be provided with a bonding conductor.*

13.2 The size of the bonding conductors, or the total cross section of the conductors if two or more are in parallel, shall be in compliance with Table 13.1.

*Exception: A smaller conductor may be used if the expansion joint or telescoping section is marked to indicate a maximum circuit ampere rating for which the smaller conductor is adequate in accordance with Table 13.2. See 21.6.*

**Table 13.1**  
**Full-size bonding conductor**

Cross section of wireway in square inches (cm <sup>2</sup> )		Minimum size of bonding conductor, awg or mcm (mm <sup>2</sup> )		Minimum cross section of bonding means in square inches (cm <sup>2</sup> )	
More than	Not more than	Copper	Aluminum	Copper	EC aluminum
—	4 (26)	3 (26.7)	1 (42.4)	0.041 (0.26)	0.068 (0.44)
4 (26)	6.25 (40.3)	1 (42.4)	2/0 (67.4)	0.068 (0.44)	0.104 (0.67)
6.25 (40.3)	9 (58)	1/0 (53.5)	3/0 (85.0)	0.083 (0.54)	0.138 (0.84)
9 (58)	11.11 (71.7)	2/0 (67.4)	4/0 (107.2)	0.104 (0.67)	0.166 (1.07)
11.11 (71.7)	20.25 (130.6)	4/0 (107.2)	350 (177)	0.166 (1.07)	0.274 (1.77)
20.25 (130.6)	25 (161)	350 (177)	500 (253)	0.274 (1.77)	0.393 (2.53)
25 (161)	36 (232)	400 (203)	600 (304)	0.314 (2.02)	0.471 (3.04)
36 (232)	64 (413)	700 (355)	1000 (507)	0.550 (3.55)	0.785 (5.06)
64 (413)	100 (645)	800 (405)	1200 (608)	0.628 (4.05)	0.942 (6.08)
100 (645)	144 <sup>a</sup> (929)	800 (405)	1200 (608)	0.628 (4.05)	0.942 (6.08)

<sup>a</sup>it is assumed no circuit rating will exceed 6000 amperes.

**Table 13.2**  
**Reduced-size bonding conductor**

Maximum circuit ampere rating marked on wireway	Minimum size of bonding conductor AWG or MCM (mm <sup>2</sup> )			
	Copper		Aluminum	
15	14	(2.1)	12	(3.3)
20	12	(3.3)	10	(5.3)
30	10	(5.3)	8	(8.4)
40	10	(5.3)	8	(8.4)
60	10	(5.3)	8	(8.4)
100	8	(8.4)	6	(13.3)
200	6	(13.3)	4	(21.2)
400	3	(26.7)	1	(42.4)
600	1	(42.4)	2/0	(67.4)
800	1/0	(53.5)	3/0	(85.0)
1000	2/0	(67.4)	4/0	(107.2)
1200	3/0	(85.0)	250	(127)
1600	4/0	(107.2)	350	(177)
2000	250	(127)	400	(203)
2500	350	(177)	500	(253)
3000	400	(203)	600	(304)
4000	500	(253)	800	(405)
5000	700	(355)	1000	(507)
6000	800	(405)	1200	(608)

13.3 The connection of a bonding conductor shall have metal-to-metal contact with the enclosure over an area not less than the cross section of the conductor.

## 14 Supports

14.1 A wireway shall be provided with means for support at intervals not exceeding 5 feet (1.5 m) along its length.

*Exception No. 1: The means for support (excluding auxiliary gutters) may be at intervals not exceeding 15 feet (4.6 m) if the wireway is intended for vertical installation.*

*Exception No. 2: The means for supporting a wireway (excluding auxiliary gutters) intended for horizontal installation may be at intervals exceeding 5 feet but not exceeding 10 feet (3.0 m), if the wireway complies with the Support Test, Section 20, and the wireway is marked in accordance with 21.7.*

14.2 Fastening means for supports may consist of factory drilled holes in the enclosure for use with screws or bolts, or the wireway may be provided with instructions for drilling and spacing such holes (see 14.1) in the field, provided that the resulting construction will not result in any sharp corners or edges in the wireway. See 5.3.

## 15 Protection Against Corrosion

15.1 Unless a wireway enclosure is made of metal that will resist corrosion, both inside and outside surfaces of the trough and the cover shall be protected against corrosion by enameling, galvanizing, plating, or other equivalent means.

15.2 For a wireway made of iron or steel, both inside and outside surfaces of each length of wireway shall be thoroughly cleaned of all scale and rust. The cleaning process shall leave the surface of the wireway in a condition such that the protective coating – see 15.1, 15.4, and 15.5 – will adhere firmly and have a smooth surface.

15.3 A hinge or other attachment of a raintight wireway shall be resistant to corrosion. Metals shall not be used in combinations as to cause galvanic action that will adversely affect any part of the wireway.

15.4 The enclosure of a raintight wireway shall be protected against corrosion by one of the following coatings:

- a) Hot-dipped mill-galvanized sheet steel conforming with the coating Designation G90 in Table I of ASTM Designation A653-94, with not less than 40 percent of the zinc on any side, based on the minimum single-spot test requirement in this ASTM designation. The weight of the zinc coating may be determined by any suitable method; however, in case of question, the weight of coating is to be established in accordance with the Test Method of ASTM Designation A90-93. See 15.7 and 15.8.
- b) A zinc coating, other than that provided on hot-dipped mill-galvanized sheet steel, uniformly applied to an average thickness of not less than 0.00061 inch (15.5  $\mu\text{m}$ ) on each surface with a minimum thickness of 0.00054 inch (13.7  $\mu\text{m}$ ). The thickness of coating shall be established by the Metallic Coating Thickness Test, Section 19. An annealed coating shall comply with 15.5 and 15.6.
- c) A zinc coating conforming with item 1 or 2 below and with one coat of an organic finish of the epoxy or alkyd-resin type or other outdoor paint applied after forming on each surface. The suitability of the paint may be determined by consideration of its composition or by corrosion tests if these are considered necessary.
  - 1) Hot-dipped mill-galvanized sheet steel conforming with the coating Designation G60 or A60 in Table I of ASTM Designation A653-94, with not less than 40 percent of the zinc on any side, based on the minimum single-spot test requirement in this ASTM designation. The weight of zinc coating may be determined by any suitable method; however, in case of question the weight of coating is to be established in accordance with the Test Method of ASTM Designation A90-93.
  - 2) A zinc coating, other than that provided on hot-dipped mill-galvanized sheet steel, uniformly applied to an average thickness of each surface with a minimum thickness of 0.00034 inch (8.6  $\mu\text{m}$ ). The thickness of the coating shall be established in accordance with the Metallic Coating Thickness Test, Section 19.

d) A cadmium coating not less than 0.0010 inch (25  $\mu\text{m}$ ) thick on both surfaces. The thickness of coating shall be established in accordance with the Metallic Coating Thickness Test, Section 19.

e) A cadmium coating not less than 0.00075 inch (19.1  $\mu\text{m}$ ) thick on both surfaces with one coat of outdoor paint on both surfaces; or not less than 0.00051 inch (13.0  $\mu\text{m}$ ) thick on both surfaces with two coats of outdoor paint on both surfaces. The thickness of the cadmium coating shall be established in accordance with the Metallic Coating Thickness Test, Section 19.

f) Other finishes, including paints, metallic finishes, or combination of the two may be accepted when comparative tests with galvanized sheet steel – without annealing, wiping, or other surface treatment – conforming with (a), indicate they provide equivalent protection. Among the factors that are taken into consideration when judging the suitability of such coating systems are exposure to salt spray, moist carbon dioxide-sulphur dioxide-air mixtures, moist hydrogen sulfide-air mixtures, ultraviolet light, and water.

15.5 An annealed coating on sheet steel that is bent or similarly formed or extruded or rolled at the edge of a hole after annealing shall be additionally painted in the affected area if the process damages the zinc coating.

15.6 If flaking or cracking of the zinc coating at the outside radius of the bent or formed section is visible at 25 power magnification, the zinc coating is considered to be damaged. Simple sheared or cut edges and punched holes are not required to be additionally protected.

15.7 A hot-dipped mill-galvanized A60, G60, or G90 coating shall not be damaged during handling or fabrication to the extent that the base steel is exposed.

*Exception: Uncoated cross-section surfaces at cut edges and drilled openings are acceptable.*

15.8 Sections of sheet steel that employ hot-dipped mill-galvanized A60, G60, or G90 coatings and formed, extruded, or rolled shall not be less than 90 percent of the minimum thickness specified in Table 8.1.

## **16 Raintight Wireways**

16.1 A raintight wireway shall be constructed to exclude a beating rain.

16.2 A hole in the top, side, or back of a raintight wireway shall be suitable for use with an acceptable raintight hub.

16.3 There shall be provision for drainage of a raintight wireway.

*Exception: Instructions for drilling holes in the field may be provided with a wireway. Such instructions shall indicate the proper positioning of the wireway.*

16.4 A raintight wireway shall be provided with external fastening means for mounting.

*Exception: A wireway may be provided with internal fastening means for mounting if the resulting construction prevents water from entering the enclosure.*

## PERFORMANCE

### 17 Electrical Continuity Test

17.1 The resistance of the connection between adjacent sections of wireway or auxiliary gutter, and the connection between a wireway or auxiliary gutter and a fitting shall not be more than 0.005 ohm.

17.2 The wireway or gutter and fittings are to be installed in the intended manner. A direct current of 30 amperes is then to be passed between adjacent sections of wireway or gutter, and between the wireway or gutter and the fitting. The resulting voltage drop is to be measured between a point (file mark) on the wireway 1/16 inch (1.6 mm) from the connection and a similar point on the far end of an adjacent wireway or on the fitting, if of the ending-fitting type. In the case of a fitting of the feed-through type, the resulting drop in potential is to be measured between points on the two adjacent pieces of wireway or gutter 1/16 inch from the connections. The resistance in ohms is to be determined by dividing the drop in potential in volts by the current in amperes passing through the raceway.

### 18 Raintightness Test

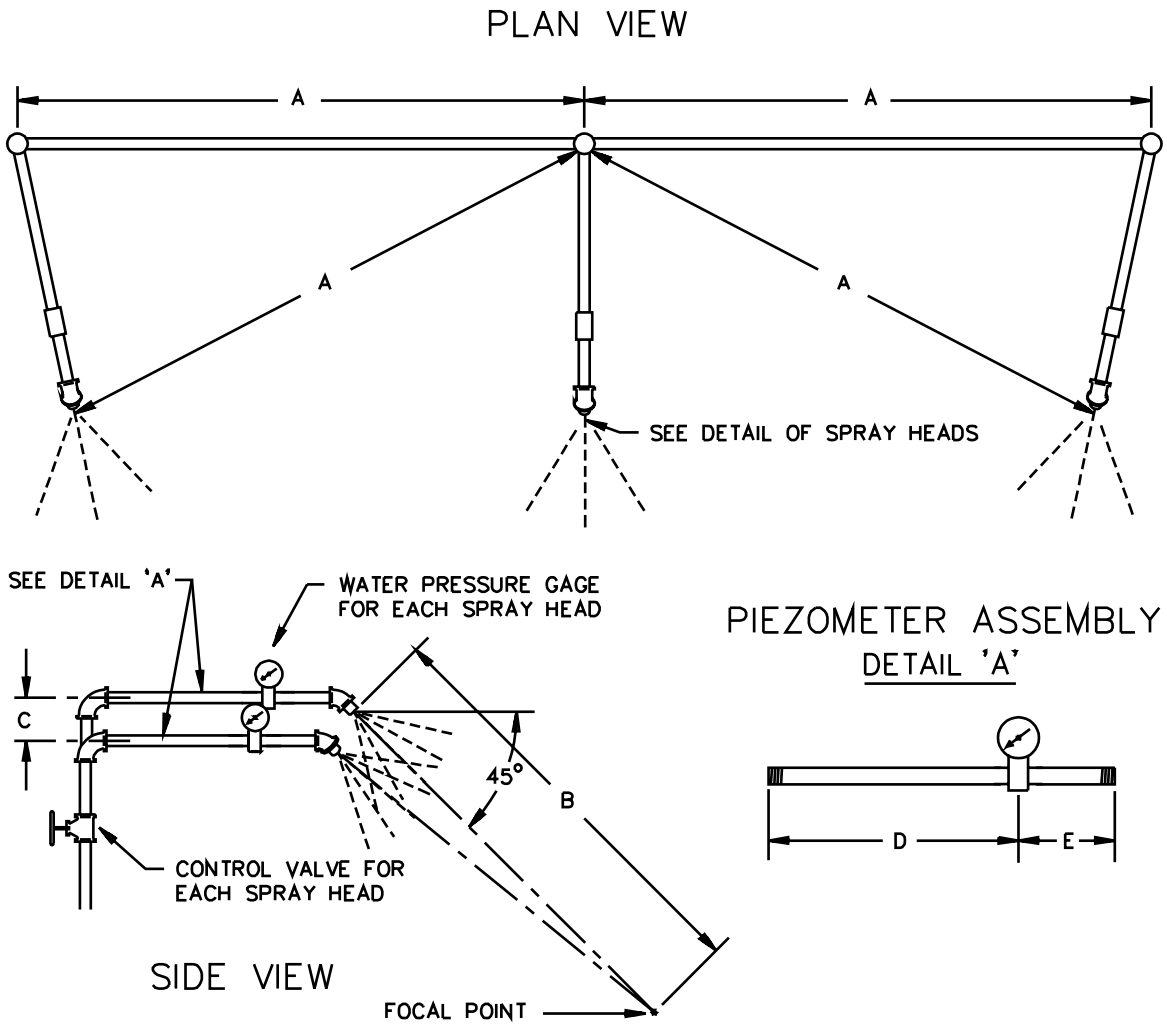
#### 18.1 General

18.1.1 To determine if a raintight wireway complies with the requirement in 16.1, two sections of the wireway are to be assembled in the intended manner if the wireway is designed to be so assembled; otherwise, the test is to be performed on a single section. Conduit connections, without pipe-thread compound, are to be as in actual service. When a water spray as described in 18.1.2 is applied to the wireway for 1 hour, there shall be no entrance of water.

18.1.2 The water spray test apparatus is to consist of three spray heads mounted in a water supply pipe rack as shown in Figure 18.1. The spray heads are to be constructed in accordance with the details shown in Figure 18.2. The water pressure for all tests is to be maintained at 5 psi (34 kPa) at each spray head. The distance between the center nozzle and the unit is to be approximately 5 feet (1.5 m). The wireway is to be brought into the focal area of the three spray heads in such a position and under such conditions that are most likely to result in entrance of water into the wireway. The spray is to be directed at an angle of 45 degrees to the vertical toward the joints and openings of the wireway.

**Figure 18.1**  
**Rain-test spray-head piping**

Figure 18.1 revised June 3, 1998



Item	inch	mm
A	28	710
B	55	1400
C	2-1/4	55
D	9	230
E	3	75

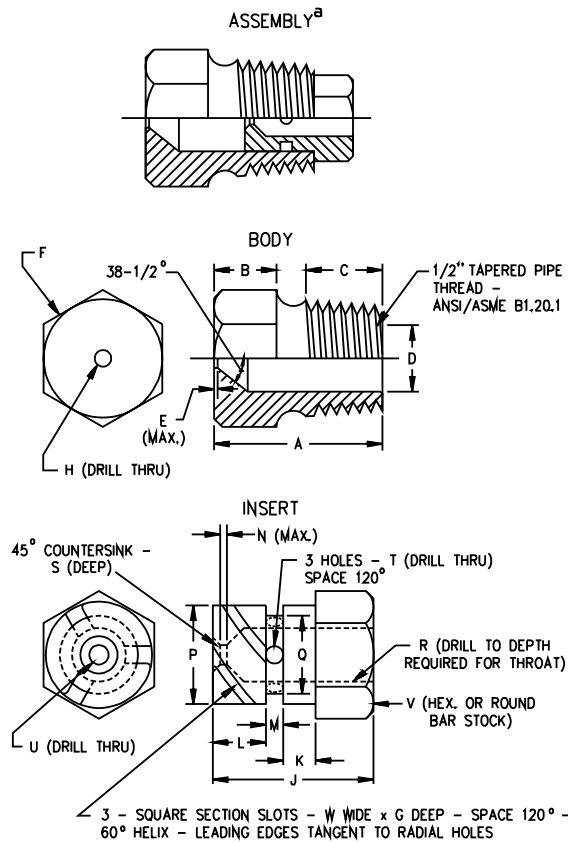
RT101E

## 18.2 Gaskets

18.2.1 After exposure to a temperature of 69 – 70°C (156 – 158°F) in an air-circulating oven for 168 hours, a gasket of rubber or rubberlike material provided with a raintight wireway shall have a tensile strength not less than 75 percent and an elongation not less than 60 percent of the corresponding values of unaged samples.

**Figure 18.2**  
**Rain-test spray head**

Figure 18.2 revised June 3, 1998



RT100C

Item	inch	mm	Item	inch	mm
A	1-7/32	31.0	N	1/32	0.80
B	7/16	11.0	P	.575	14.61
C	9/16	14.0	Q	.576	14.63
D	.578	14.68		.453	11.51
	.580	14.73		.454	11.53
E	1/64	0.40	R	1/4	6.35
F	c	c	S	1/32	0.80
G	.06	1.52	T	(No. 35) <sup>b</sup>	2.80
H	(No. 9) <sup>b</sup>	5.0	U	(No. 40) <sup>b</sup>	2.50
J	23/32	18.3	V	5/8	16.0
K	5/32	3.97	W	0.06	1.52
L	1/4	6.35			
M	3/32	2.38			

<sup>a</sup> Nylon Rain - Test Spray Heads are available from Underwriters Laboratories Inc.

<sup>b</sup> ANSI B94.11M Drill size.

<sup>c</sup> Optional - To serve as wrench grip.

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## 19 Metallic Coating Thickness Test

19.1 The method of determining the thickness of a zinc or cadmium coating by the metallic coating thickness test is described in 19.2 – 19.9. The aforementioned applies only if the required thickness is specified.

19.2 The solution to be used for the test is to be made from distilled water and is to contain 200 grams per liter of reagent grade chromic acid ( $\text{CrO}_3$ ) and 50 grams per liter of reagent grade concentrated sulfuric acid ( $\text{H}_2\text{SO}_4$ ). The latter is equivalent to 27 milliliters per liter of reagent grade concentrated sulfuric acid, specific gravity 1.84, containing 96 percent of  $\text{H}_2\text{SO}_4$ .

19.3 The test solution is to be contained in a glass vessel such as a separatory funnel with the outlet equipped with a stopcock and a capillary tube of approximately 0.025 inch (0.64 mm) inside bore and 5.5 inches (140 mm) long. The lower end of the capillary tube is to be tapered to form a tip, the drops from which are about 0.05 milliliter each. To preserve an effectively constant level, a small glass tube is inserted in the top of the funnel through a rubber stopper and its position is to be adjusted so that when the stopcock is open, the rate of dropping is  $100 \pm 5$  drops per minute. If desired, an additional stopcock may be used in place of the glass tube to control the rate of dropping.

19.4 The sample and the test solution are to be kept in the test room long enough to acquire the temperature of the room, which is to be noted and recorded. The test is to be conducted at a room temperature of 70 – 90°F (21 – 32°C).

19.5 Each sample is to be thoroughly cleaned before testing. All grease, lacquer, paint, and other nonmetallic coatings are to be removed completely by means of suitable solvents. Samples are then to be thoroughly rinsed in water and dried with clean cheesecloth. Care should be exercised to avoid contact of the cleaned surface with the hands or any foreign material.

19.6 The sample to be tested is to be supported from 0.7 – 1 inch (17.8 – 25.4 mm) below the orifice, so that the drops of solution strike the point to be tested and run off quickly. The surface to be tested should be inclined about 45 degrees from horizontal.

19.7 After cleaning, the sample to be tested is to be put in place under the orifice. The stopcock is to be opened and the time in seconds is to be measured with a stop watch until the dropping solution dissolves the protective metal coating, exposing the base metal. The end point is the first appearance of the base metal recognizable by the change in color at that point.

19.8 Each sample of a test lot is to be subjected to the test at three or more points, excluding cut, stenciled, and threaded surfaces, on the inside surface and at an equal number of points on the outside surface at places where the metal coating may be expected to be the thinnest. On enclosures made from precoated sheets, the external corners that are subjected to the greatest deformation are likely to have thin coatings.

19.9 To calculate the thickness of the coating being tested, select from Table 19.1 the thickness factor appropriate for the temperature at which the test was conducted and multiply by the time in seconds required to expose base metal as noted in 19.7.

**Table 19.1**  
**Coating thickness factors**

Temperature, degrees		Thickness factors, 0.00001 inch (0.0003 mm) per second	
F	C	Cadmium platings	Zinc platings
70	21.1	1.331	0.980
71	21.7	1.340	0.990
72	22.2	1.352	1.000
73	22.8	1.362	1.010
74	23.3	1.372	1.015
75	23.9	1.383	1.025
76	24.4	1.395	1.033
77	25.0	1.405	1.042
78	25.6	1.416	1.050
79	26.1	1.427	1.060
80	26.7	1.438	1.070
81	27.2	1.450	1.080
82	27.8	1.460	1.085
83	28.3	1.470	1.095
84	28.9	1.480	1.100
85	29.4	1.490	1.110
86	30.0	1.501	1.120
87	30.6	1.513	1.130
88	31.1	1.524	1.141
89	31.7	1.534	1.150
90	32.2	1.546	1.160

## 20 Support Test

20.1 A wireway as mentioned in Exception No. 2 to 14.1 shall be tested as described in 20.2 without rupture or permanent distortion.

20.2 A wireway is to be supported as specified by the manufacturer with the supports spaced at the maximum interval for which the wireway is marked. A load as determined by the following equation is to be applied midway between the supports, and is to be maintained for 1 minute.

$$W = 0.064 (AL)$$

*In which:*

*W is the load to be applied in pounds,*

*A is the inside cross-sectional area of the wireway in square inches,*

*L is the distance between supports in inches.*

If the wireway is intended to be supported at points other than the joints, two sections of wireway sufficient length are to be joined and supported as intended with the joint midway between the supports, and the load is to be applied at the joint.

20.2 revised June 3, 1998

## MARKING

### 21 Details

21.1 Each length of wireway or auxiliary gutter and each fitting shall be plainly marked where it will be visible after installation, with the manufacturer's name, trademark, or other descriptive marking by which the organization responsible for the product may be identified – hereinafter referred to as the manufacturer's name.

21.2 A raintight wireway shall be marked "Raintight" in such a location on the enclosure that the marking will be conspicuous. If this marking is applied to the wireway on an individual nameplate, label, or the like, the manufacturer's name shall be included on the nameplate or the like.

21.3 A raintight wireway having an opening in the top or in a side shall be marked to indicate the hub or hubs and the cover plate or plates that have been found to be suitable for use with the wireway unless such components are factory-installed.

21.4 A raintight wireway provided with drain holes shall be marked "Install with drain holes down," or the equivalent, to clearly indicate the mounting position necessary for adequate drainage.

21.5 Each length of wireway shall be marked to indicate the maximum size of conductor for which it is designed as follows: "Maximum conductor size \_\_\_\_AWG (or MCM)."

*Exception: Conductors that enter only at the ends of the run are limited in size only by the 20 percent fill requirements of the National Electrical Code. The conductor size specified in the marking shall be in compliance with Table 6.1.*

21.6 An expansion joint or telescoping section with a reduced-size bonding conductor in compliance with the Exception to 13.2, shall be marked with the circuit ampere rating for which it is acceptable.

21.7 Each length of wireway intended for horizontal installation with supports at intervals exceeding 5 feet (1.5 m) but not exceeding 10 feet (3.0 m) in accordance with Exception No. 2 to 14.1 shall be marked to indicate the maximum acceptable support interval for the wireway.

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