UL 2420

STANDARD FOR SAFETY

Belowground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings

UL Standard for Safety for Belowground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings, UL 2420

First Edition, Dated July 30, 2009

Summary of Topics

This revision of ANSI/UL 2420 dated April 30, 2021 includes the following:

– Clarification on where to measure the minimum inside diameter of socket specified in Table 5 to Table 8

– Editorial updates to replace the reference to "CEC" with "CE Code"; 1.1, 2.4 and 3.1.1

Text that has been changed in any manner or impacted by UL's electronic publishing system is marked with a vertical line in the margin.

The revised requirements are substantially in accordance with Proposal (s) on this subject dated December 18, 2020.

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Belowground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings

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Commitment for Amendments

This standard is issued jointly by the Canadian Standards Association (operating as "CSA Group") and Underwriters Laboratories Inc. (UL). Comments or proposals for revisions on any part of the standard may be submitted to CSA Group or UL at anytime. Revisions to this standard will be made only after processing according to the standards development procedures of CSA Group and UL. CSA Group and UL will issue revisions to this standard by means of a new edition or revised or additional pages bearing their date of issue.

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This ANSI/UL Standard for Safety consists of the First Edition including revisions through April 30, 2021.

The most recent designation of ANSI/UL 2420 as an American National Standard (ANSI) occurred on April 30, 2021. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page (front and back), or the Preface.

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PREFACE

This is the harmonized CSA Group and UL standard for belowground reinforced thermosetting resin conduit (RTRC) and fittings. It is the first edition of CSA C22.2 No. 2420, and the first edition of UL 2420. This harmonized standard has been jointly revised on April 30, 2021. For this purpose, CSA Group and UL are issuing revision pages dated April 30, 2021.

This harmonized standard was prepared by the CSA Group and Underwriters Laboratories Inc. (UL). The efforts and support of the conduit manufacturing industry and the Technical Harmonization Subcommittee for Conduit and Tubing, of the Council of the Harmonization of Electrotechnical Standards for the Nations of the Americas (CANENA), are gratefully acknowledged.

This standard is considered suitable for use for conformity assessment within the stated scope of the standard.

This standard was reviewed by the CSA Integrated Committee on Nonmetallic Conduit, Tubing, and Fittings, under the jurisdiction of the CSA Technical Committee on Wiring Products and the CSA Strategic Steering Committee on Requirements for Electrical Safety, and has been formally approved by the CSA Technical Committee. This standard has been developed in compliance with Standards Council of Canada requirements for National Standards of Canada. It has been published as a National Standard of Canada by CSA Group.

Application of Standard

Where reference is made to a specific number of samples to be tested, the specified number is to be considered a minimum quantity.

Note: Although the intended primary application of this standard is stated in its scope, it is important to note that it remains the responsibility of the users of the standard to judge its suitability for their particular purpose.

Level of Harmonization

This standard is published as an equivalent standard for CSA and UL. An equivalent standard is a standard that is substantially the same in technical content, except as follows: Technical deviations are allowed for codes and governmental regulations and those recognized as being in accordance with NAFTA Article 905, for example, because of fundamental, climatic, geographical, technological or infrastructural factors, scientific justification, or the level of protection that the country considers appropriate. Presentation is to be word for word except for editorial changes.

Interpretations

The interpretation by the standards development organization of an identical or equivalent standard is based on the literal text to determine compliance with the standard in accordance with the procedural rules of the standards development organization. If more than one interpretation of the literal text has been identified, a revision is to be proposed as soon as possible to each of the standards development organizations to more accurately reflect the intent.

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Belowground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings

1 Scope

1.1 This Standard specifies the requirements for low-halogen belowground (Type BG) reinforced thermosetting resin conduit (RTRC) and fittings, for installation and use in accordance with CSA C22.1, Canadian Electrical Code (CE Code), Part I, and NFPA 70, National Electrical Code (NEC).

1.2 The products specified in this Standard are intended for use at -40°C (-40°F) to 110°C (230°F).

1.3 Type BG conduit has not been evaluated for directional boring applications.

1.4 This Standard covers ID (dimensions based on inside diameters) and IPS (dimensions based on outside diameters of iron pipe sizes) conduit and fittings. Trade sizes (metric designators) are 1/2 (16) to 6 (155).

Note: The values in parenthesis are metric size designations of conduits and fittings and do not necessarily reflect metric trade sizes

1.5 This Standard covers conduit with designations EB (encased burial) and DB (direct burial), which refer to specific wall thicknesses. EB conduit, is suitable for encasement in concrete. DB conduit is suitable for encasement in concrete and direct burial.

1.6 Fittings specified in this Standard include, but are not limited to, straight couplings, 5° angle couplings, adapters, and elbows with plain ends or integral belled ends at one or both ends.

2 Definitions

2.1 The following definitions apply in this standard:

2.2 Integral belled end – a belled end installed at the factory, either integrally wound or a permanently attached coupling.

2.3 Low-halogen – a material having not more than 0.2% by weight of total halogen content.

2.4 Type BG – conduit and associated fittings that have been evaluated for underground use only, for direct burial with or without being encased in concrete.

Note: For other definitions, refer to NEC and/or CE Code.

3 Reference publications and units of measurement

3.1 Reference publications

3.1.1 This Standard refers to the following publications; where such reference is made to CSA or UL Standards, it shall be considered to refer to the latest edition and all amendments published thereto; and where such reference is made to other publications, it shall be to the edition listed below.

CSA Standard

C22.1-09
Canadian Electrical Code (CE Code), Part I

ANSI/NFPA* Standard

NFPA 70-2008
National Electrical Code (NEC)

ASTM† Standard

D 638-08
Standard Test Method for Tensile Properties of Plastics

** American National Standards Institute/National Fire Protection Association*

† American Society for Testing and Materials.

3.2 Units of measurement

3.2.1 The values given in SI (metric) units are mandatory. Any other values are for information only.

4 Construction

4.1 General

4.1.1 Conduit and fittings shall be fiber impregnated with a cured thermosetting resin compound. The conduit shall have a uniform wall, a smooth interior, and shall not contain any features that can damage wiring installed in the conduit.

4.1.2 Conduit shall be straight, and both ends of each length of conduit shall be perpendicular to the longitudinal axis of the conduit.

4.1.3 Integral and non-integral connections shall provide a mechanically secure and watertight joint.

4.2 Conduit with an integral belled end

4.2.1 The dimensions of conduit with an integral coupling on one end shall be in accordance with Table 1 to Table 4. They shall also meet the requirements of Clauses 5.6 and 5.7.

4.3 Couplings

4.3.1 Couplings shall be straight with belled ends, or 5° angle couplings. Dimensions of couplings shall be in accordance with Table 5 to Table 8. Couplings shall also meet the requirements of Clauses 5.6 and 5.7.

4.4 Elbows

4.4.1 Elbows shall be provided with plain ends or have an integral belled end at one or both ends. Elbows shall also meet the requirements of Clause 5.6.

4.4.2 The radius and dimension of an elbow shall be as shown in Table 9 and Figure 1.

4.4.3 The straight-end portions (see dimension L_s on Figure 1) of an elbow shall be at least 13 mm (1/2 in) longer than the maximum socket depth.

4.5 Adapters

4.5.1 Threaded adapters and threaded box connectors

4.5.1.1 Adapters for joining conduit to other threaded systems shall be as specified in Table 10.

4.5.2 Other adapters

4.5.2.1 Other adapters shall meet the watertightness test specified in Clause 5.6 and the joint separation requirements specified in Clause 5.7.

4.5.3 Bore of conduit and elbows

4.5.3.1 The internal diameter of a finished elbow shall be such that a round ball or an equivalent mandrel will pass freely through the bore of the conduit and elbow. The diameter of the ball or equivalent mandrel shall be 90% of the original internal diameter for conduit and 85% of the original internal diameter for elbows.

Note: As an alternative to using a ball to check the bore of conduit and elbows, an inside micrometer gauge or a telescopic gauge and micrometer caliper may be used.

5 Qualification tests

5.1 Conditioning

5.1.1 Unless specified otherwise in the description of the test, all specimens shall be preconditioned for at least 24 h in still air at a temperature of 23 ±2°C (73 ±4°F).

5.2 Compression

5.2.1 General

5.2.1.1 The internal diameter of conduit shall not decrease by more than 25% during application of the force specified in Table 11 and Table 12 when tested in accordance with Clauses 5.2.2 to 5.2.4. The conduit shall show no evidence of cracking or buckling after removal from the compression machine.

5.2.2 Apparatus

5.2.2.1 The apparatus for this test shall consist of:

a) an inside micrometer or telescopic gauges and a micrometer caliper; and

b) a compression machine having 2 steel platens at least 150 mm (6.0 in) long and 10 mm (0.4 in) thick, and capable of running at a speed within the range of 10 to 15 mm/min (0.4 to 0.6 in/min).

5.2.3 Specimens

5.2.3.1 The specimens shall consist of three 150 ±3 mm (6.0 ±0.125 in) lengths of conduit.

5.2.4 Procedure

5.2.4.1 The inside diameter of the specimen shall be measured and recorded. The specimen shall be placed between the plates of the compression machine such that the measured inside diameter is perpendicular to the platens. The machine shall be set in motion until the force specified in Table 11 and Table 12 has been applied to the specimen. The machine shall be stopped and the inside diameter re-measured. The percent decrease in the internal diameter shall be calculated and recorded.

5.3 Impact resistance at low temperature

5.3.1 When tested in accordance with Clauses 5.3.2 to 5.3.4, there shall not be any fracture or break in the laminate surface of seven out of ten 200 mm (8.0 in) long specimens of the finished conduit. A fracture or break shall be considered to have occurred where a broken section of the laminate forms a protrusion within the inside diameter or extends beyond the outside diameter of the conduit. The portions of the conduit within 51 mm (2.0 in) from the cut ends of the specimen shall not be examined.

5.3.2 The specimens shall be cut from finished lengths of each trade size of conduit. The specimens, the test apparatus, and the surrounding air shall be in thermal equilibrium with one another at a temperature of -40° ±1°C (-40° ±2°F) during the test. Each specimen shall be tested separately while resting on a solid, flat steel plate that is at least 13 mm (1/2 in) thick and shall be firmly anchored with its upper surface horizontal.

5.3.3 When it is necessary to remove the specimen from the low-temperature chamber due to handling difficulties, the impact test shall commence as soon as possible and shall be completed within 15 s of the time of removal.

5.3.4 The impact energy shall be provided by a weight of 9 kg (20 lbs) in the form of a 51 mm (2.0 in) solid, right-circular, steel cylinder with a flat impact face having rounded edges, as shown in Figure 2, falling freely through a vertical guide with the impact force as specified in Table 13 and Table 14. The flat face of the weight shall strike the center of the specimen. Provision shall be made for keeping the weight from striking the specimen more than once.

5.4 Water absorption

5.4.1 Conduit shall not absorb water more than 0.25 percent of its weight while immersed for 24 h in distilled water when tested in accordance with Clauses 5.4.2 to 5.4.4.

5.4.2 The cut edges of a specimen shall be sealed with epoxy cement. The cement shall cure at room temperature for 24 h. Specimens shall be preconditioned by drying in a full-draft circulating-air oven at a temperature of 50 ±3°C (122 ±5°F) for 24 h, after which they shall remain in still air at a temperature of 23 ±2°C (73 ±4°F) for 24 h.

5.4.3 Following conditioning, the weight of the specimen, W_1, shall be determined to within 5 mg of balance, and the specimen shall then be immersed in distilled water for 24 h at a temperature of 23 ±2°C (73 ±4°F). The specimen shall then be removed from the water, dried quickly inside and out with a clean piece of lint-free, absorbent material, and its weight, W_2, shall immediately be determined within 5 mg of balance. W_2/W_1 shall not be larger than 1.0025.

5.4.4 When a specimen is known to contain or is suspected of containing an appreciable amount of water-soluble material, two specimens shall be preconditioned by drying in a full-draft circulating-air oven at a temperature of 50 ±1°C (122 ±2°F) for 24 h and cooling in a desiccator for 24 h; then their weight, W_1, shall be immediately determined. The specimens shall then be immersed in distilled water for 24 h with the water at a temperature of 23 ±2°C (73 ±4°F). Immediately following this immersion, the specimens shall be

reconditioned for 24 h in the oven at 50 ±3°C (122 ±5°F), cooled in a desiccator for 24 h, and their weight, W_2, immediately determined.

5.5 Chemical resistance (optional)

5.5.1 Conduit and any adhesive system used to bond lengths of conduit shall be subjected to the tests described in Clauses 5.5.2 to 5.5.10 if marked in accordance with Clause 6.4. The results of the test on any trade size of conduit shall be considered representative of the performance of the whole size range.

5.5.2 After being exposed to the reagents indicated by the manufacturer at the intended concentration and temperature for 90 days, the crush strength of specimens of the finished conduit shall not be reduced by more than 15 percent, nor shall the specimens experience a change in weight of more than 2.5 percent. Where there is more than 1.0 percent change in weight after 90 days of exposure to the reagent, that change shall not be more than 1.65 times the change in weight measured after 30 days of exposure to the reagent. There shall not be any softening or disintegration of the specimens as a result of exposure to the reagents.

Note: Usually, a reagent is understood to be a substance used to produce a characteristic reaction in chemical analysis. For the purpose of this Standard, however, it is convenient to consider the word in the less restrictive sense of any chemical, oil, or other substance that has a corrosive or degrading influence on conduit or conduit products.

5.5.3 Twelve 51 mm (2 in) long specimens shall be used for each reagent. Each specimen shall be cut from clean lengths of the finished conduit and cleaned of loose particles and ragged edges. The edges of all specimens shall be coated with the same resin used to fabricate the conduit. The weight of each specimen, W_1, shall be determined prior to immersing the specimen in the test solution. Six additional specimens shall be prepared and set aside for comparison purposes during the crush test.

5.5.4 The weighed specimens shall each be immersed in the reagents in separate, covered containers that do not react with the reagent. Each container shall be filled with the reagent at the intended concentration and temperature to the depth necessary to completely cover the specimens that are placed in it. When the liquid comes to rest in each container, the containers shall be closed and kept at the intended temperature for 30 days without agitation of the reagent.

5.5.5 After 30 days, half of the specimens shall be removed from the reagent, rinsed with clean cold water, and carefully wiped dry inside and out with a clean piece of lint-free, absorbent material. The weight of each of the six dried specimens, W_2, shall be determined to within 10 mg of balance and compared to the original weight, W_1, of the specimen. W_2 shall not be greater than 1.0025 times W_1.

5.5.6 The six specimens immersed for 30 days and the specimens set aside for testing unaged shall be in thermal equilibrium with one another, the testing machine, and the surrounding air at a temperature of 23 ± 2°C (73 ± 4°F) throughout the test. The inside diameter of each specimen shall be measured and recorded. The specimens shall then be tested separately between a pair of rigid, flat steel plates that are at least 150 mm (6 in) long and that are horizontal and parallel to one another. The measured inside diameter shall be perpendicular to the platens. One plate shall be moved toward the other at the rate of 12.7 ±3.2 mm/min (0.5 ±0.125 in/min)

a) until the surface of the specimen pulls away from contact with either plate, that is, until the specimen buckles; or

b) until the minor axis measured inside the flattening specimen is 60 percent of the inside diameter measured before the test.

5.5.7 The crushing loads at the buckling and 60 percent points shall be noted on the dial on the machine and recorded for each specimen. The loads at each of these points for the aged specimens shall each be divided by the average loads at each of these points for the unaged specimens. The resulting ratios shall

not be less than 0.85, and no conditioned specimen shall crack or collapse before buckling or the 60 percent point is reached.

5.5.8 The six remaining specimens shall remain immersed for an additional 60 days at the intended temperature. After the full 90 days, the specimens shall be removed from the reagent, rinsed, and dried as specified in Clause 5.5.5 before being reweighed. The weight of each of the dried specimens, W_3, shall be determined to within 10 mg of balance. The following requirements apply:

a) W_3 shall not be greater than 1.025 times W_1.

b) If W_3 is greater than 1.01 times W_1, the ratio of $(W_3 – W_1)$ to $(W_2 – W_1)$ shall not be greater than 1.65.

5.5.9 The specimens immersed for 90 days shall be in thermal equilibrium with the testing machine and the surrounding air at a temperature of 23 ±2°C (73 ±4°F). The inside diameter of each specimen shall be measured and recorded. The specimens shall be tested separately between a pair of rigid, flat steel plates that are at least 150 mm (6 in) long and that are horizontal and parallel to one another. The measured inside diameter shall be perpendicular to the platens. One plate shall be moved toward the other at the rate of 12.7 ±3.2 mm/min (0.5 ±0.125 in/min)

a) until the surface of the specimen pulls away from contact with either plate, that is, until the specimen buckles; or

b) until the minor axis measured inside the flattening specimen is 60 percent of the inside diameter measured before the test.

5.5.10 The crushing loads at the buckling and the 60 percent points shall be noted from the dial on the machine and recorded for each specimen. The loads at each of these points shall be averaged for the set of six specimens. The average loads at each of these points for the immersed specimens shall be divided by the average loads at each of these points for the unaged specimens. The resulting ratios shall not be less than 0.85, and no conditioned specimen shall crack or collapse before buckling or the 60 percent point is reached.

5.6 Watertightness

5.6.1 Coupled conduit and fittings shall not leak when tested in accordance with Clause 5.6.2.

5.6.2 A 300 ±3 mm (12.0 ±0.125 in) length of conduit shall be inserted into the integral coupling of another length of conduit having a total length of 300 ±3 mm (12.0 ±0.125 in), according to the manufacturer's installation instructions.

5.6.3 In the case of an elbow or fitting, one or two 300 ±3 mm (12.0 ±0.125 in) lengths of conduit, as appropriate, shall be inserted into the coupling according to the manufacturer's instructions. One end of the assembly shall be capped with a suitable enclosure. The assembly shall be placed in the vertical position, with the sealed end at the bottom, and filled with tap water. After a minimum of 4 h, the specimen shall be visually examined to determine any evidence of leakage.

5.7 Joint separation

5.7.1 A joint (conduit and socket) shall not separate when tested in accordance with Clause 5.7.2.

5.7.2 Two joints in each trade size shall be assembled as intended. A gasketed joint shall be subjected to an axial pull of 444 N (100 lbf), applied to the assembly for 5 min, and tending to pull the conduit out of the socket. A mechanical or threaded joint shall be subjected to an axial pull of 4448 N (1000 lbf), applied to the assembly for 1 min, and tending to pull the conduit out of the socket. An adhesively secured joint shall

be subjected to an axial pull of 6670 N (1500 lbf), applied to the assembly for 1 min, and tending to pull the conduit out of the socket.

5.8 Flattening resistance

5.8.1 The vertical inside diameter of conduit shall not decrease by more than the value indicated in Table 15 and Table 16 when tested in accordance with Clause 5.8.2.

5.8.2 Two specimens shall be tested. Each specimen shall be 75 ±3 mm (3 ±0.125 in) long. The vertical inside diameter of each specimen shall be measured and the value recorded. The specimens shall be placed horizontally side by side between the 2 steel platens of a static load test as shown in Figure 3. The specimens shall be placed such that the measured vertical inside diameter is in the vertical position. No part of the specimen shall extend beyond either platen. A test mass of 45 kg (100 lb), including the mass of the upper platen, shall be symmetrically applied. This assembly shall be maintained at a temperature of 110 ±1°C (230 ±2°F) for a period of 24 h. The specimens shall be allowed to cool, with the test mass removed, at 23 ±2°C (73 ±4°F) for a minimum of 1 h. The vertical inside diameter shall be re-measured, recorded, and the actual decrease calculated and recorded.

5.9 Halogen content

5.9.1 The halogen content shall not exceed 0.2% by weight, using the calculation method described in Annex A.

5.10 Infrared spectroscopy

5.10.1 General

5.10.1.1 Analysis shall be done with an infrared spectrophotometer and the results shall be recorded as a plot of the transmittance (%) versus the frequency of the infrared radiation. The plot shall be recorded over the entire wavelength range of the infrared instrument, approximately 2.0 to 20.0 µm (wave number 5000 to 500 cm^{-1}). The scan shall be retained as a permanent record of the analysis.

5.10.2 Preparation

5.10.2.1 The general technique for preparing thermoset polymers for infrared analysis shall be to use a fine file to file a sample from the specimen. These filings may be ground in a mechanical vibrating ball mill. The sample shall be ground in short intervals to prevent heating of the sample. Liquid nitrogen may be used to cool the sample during grinding. Care shall be taken to reduce the particles to a size (approximately 2 µm) smaller than that of the shortest wavelength to be scanned, to minimize scattering effects. The ground specimen shall be thoroughly mixed with spectroscopic grade potassium bromide, and an amount of this mixture sufficient to produce a 1 mm (0.04 in) thick diameter disk shall be placed in an evacuable die. The die shall be placed under vacuum and a pressure of 69 to 103 MPa (10,000 to 15,000 lb ft/in^3) shall be applied. The pressed disk shall be removed from the die and mounted in a spectrophotometer and the infrared spectrum of the material recorded.

5.10.3 Report

5.10.3.1 The individual spectra shall be marked with each of the following:

a) the complete identification of the material tested, including type, source, manufacturer's code, and form;

b) specimen preparation procedure; and

c) spectrophotometer operating conditions.

5.11 Tensile strength

5.11.1 The minimum longitudinal tensile strength of the conduit shall not be less than 48.26 MPa (7000 psi) when tested in accordance with ASTM D 638, with no tolerance on relative humidity.

5.12 Durability of printing (all types with surface-applied markings of ink, dyes, etc.)

5.12.1 Specimen preparation

5.12.1.1 Two 300-mm (12-in) specimens of the finished conduit bearing the surface-applied markings shall be used.

5.12.2 Apparatus

5.12.2.2 The apparatus shall consist of a

a) forced-air oven; and

b) 450 ±5 g (1 ±0.01 lb) weight having a layer of craft felt approximately 1.2 mm (0.05 in) thick securely attached to a machined flat surface with dimensions of 25 x 50 mm (1.0 x 2.0 in).

Note: For the purpose of this test, craft felt is defined as having not more than 30% wool content, the remainder being rayon.

5.12.3 Exposure

5.12.3.1 One specimen shall be heated in a forced-air oven at the temperature of 110 ±1°C (230 ±1.8°F) for 24 h. The second specimen shall be maintained at room temperature for a minimum of 24 h.

5.12.4 Procedure

5.12.4.1 Upon removal from the oven, the specimen shall be allowed to rest at room temperature for a period of 1 h. Following the rest period, the specimen shall be laid on a solid, flat surface with the printing up. The weight having the 51 mm (2 in) dimension with the attached felt shall be slid back and forth over the length of the specimen. This operation shall be repeated two more times. The time to perform the above operation shall be 5 to 10 s. The same procedure shall be performed on the "as-received" specimen conditioned at room temperature.

5.12.5 Result

5.12.5.1 The printing on both specimens shall remain legible.

6 Marking

Advisory Note: *In Canada, there are two official languages, English and French. All markings required by this Standard may be in other languages to conform to the language requirements where the product is to be used.*

6.1 All of the markings mentioned in Clauses 6.2 to 6.4 shall be clearly legible and durable. Additional markings shall be allowed if they do not conflict and cannot be confused with the markings described in Clauses 6.2 to 6.4.

6.2 The outer surface of every straight length of conduit or fitting shall be marked with the following:

a) "Reinforced Thermosetting Resin Conduit", "RTRC", or equivalent wording;

b) the trade size (metric designator) of the conduit, including "HW", as applicable;

c) the name or trademark of the manufacturer or with any other distinctive marking by means of which the organization responsible for the product can readily be identified;

d) "IPS" or "ID" and "EB" or "DB", as applicable;

e) "For Use -40°C to 110°C"; and

f) "Type BG".

6.3 In the United States, where the manufacturer produces conduit, elbows, or fittings at more than one factory, the outer surface of each finished straight length of conduit and each elbow and fitting shall be marked with a distinctive designation (which may be in code) by means of which the conduit, elbow, or fitting is identified as the product of a particular factory.

In Canada, this requirement does not apply.

6.4 The outer surfaces of conduit and elbows that are intended for wetting by reagents in accordance with Clause 5.5 shall be marked, "RESISTANT TO THE FOLLOWING REAGENTS" (name of the specific reagents and temperature limitations).

Table 1
Conduit dimensions – IPS DB

(See Clause 4.2.1)

Trade size	Metric designator	Inside diameter, minimum	Wall thickness		Outside diameter	
			Minimum	Maximum	Nominal	Maximum
		Millimeters				
1/2	16	17.27	1.40	2.16	21.33	21.84
3/4	21	22.61	1.40	2.16	26.67	27.18
1	27	29.34	1.40	2.16	33.40	33.91
1-1/4	35	38.10	1.40	2.16	42.16	42.67
1-1/2	41	44.20	1.40	2.16	48.26	48.77
2	53	56.26	1.40	2.16	60.45	60.96
2-1/2	63	69.60	1.40	2.16	73.66	74.17
3	78	84.84	1.40	2.16	88.90	89.41
4	103	109.72	1.40	2.16	114.30	114.81
4HW	H103	109.72	1.91	2.92	115.32	115.82
5	129	136.14	1.91	2.92	141.22	142.24
5HW	H129	136.14	2.41	3.43	141.73	142.75
6	155	162.05	1.91	2.92	168.40	169.16
6HW	H155	162.05	2.41	3.43	168.91	169.67
Trade size	Metric designator	(Inches)				
1/2	16	0.680	0.055	0.085	0.840	0.860
3/4	21	0.890	0.055	0.085	1.050	1.070
1	27	1.155	0.055	0.085	1.315	1.335
1-1/4	35	1.500	0.055	0.085	1.660	1.680
1-1/2	41	1.740	0.055	0.085	1.900	1.920
2	53	2.215	0.055	0.085	2.380	2.400
2-1/2	63	2.740	0.055	0.085	2.900	2.920
3	78	3.340	0.055	0.085	3.500	3.520
4	103	4.320	0.055	0.085	4.500	4.520
4HW	H103	4.320	0.075	0.115	4.540	4.560
5	129	5.360	0.075	0.115	5.560	5.600
5HW	H129	5.360	0.095	0.135	5.580	5.620
6	155	6.380	0.075	0.115	6.630	6.660
6HW	H155	6.380	0.095	0.135	6.650	6.680

Table 2
Conduit dimensions – IPS EB

(See Clause 4.2.1)

Trade size	Metric designator	Inside diameter, minimum	Wall thickness		Outside diameter	
			Minimum	Maximum	Nominal	Maximum
		Millimeters				
4 EB	103	109.72	1.02	1.78	113.28	113.79
5 EB	129	136.14	1.40	2.16	140.72	141.22
6 EB	155	162.05	1.40	2.16	168.15	168.66
Trade size	**Metric designator**	**(Inches)**				
4 EB	103	4.320	0.040	0.070	4.460	4.480
5 EB	129	5.360	0.055	0.085	5.540	5.560
6 EB	155	6.380	0.055	0.085	6.620	6.640

Table 3
Conduit dimensions – ID DB

(See Clause 4.2.1)

Trade size	Metric designator	Inside diameter, minimum	Wall thickness		Outside diameter[a]	
			Minimum	Maximum	Nominal	Maximum
		Millimeters				
1/2	16	11.94	1.40	2.16	15.29	16.05
3/4	21	18.29	1.40	2.16	21.84	22.60
1	27	24.64	1.40	2.16	28.70	29.46
1-1/4	35	30.99	1.40	2.16	35.05	35.81
1-1/2	41	37.34	1.40	2.16	41.40	42.16
2	53	50.29	1.40	2.16	54.36	54.86
2-1/2	63	63.00	1.40	2.16	67.10	67.56
3	78	75.69	1.40	2.16	79.76	80.96
3-1/2	91	88.39	1.40	2.16	92.46	92.96
4	103	101.09	1.40	2.16	105.16	105.66
4HW	H103	101.09	2.03	2.79	106.43	107.19
4-1/2	116	113.79	1.91	2.92	118.62	119.38
4-1/2HW	H116	113.79	2.54	3.18	119.89	120.65
5	129	126.24	1.91	2.92	131.82	132.59
5HW	H129	126.24	2.54	3.18	132.59	134.11
6	155	151.64	1.91	2.92	157.23	157.99
6HW	H155	151.64	2.54	3.18	157.99	159.11
Trade size	Metric designator	(Inches)				
1/2	16	0.470	0.055	0.085	0.602	0.632
3/4	21	0.720	0.055	0.085	0.860	0.890
1	27	0.970	0.055	0.085	1.130	1.160
1-1/4	35	1.220	0.055	0.085	1.380	1.410
1-1/2	41	1.470	0.055	0.085	1.630	1.660
2	53	1.980	0.055	0.085	2.140	2.160
2-1/2	63	2.480	0.055	0.085	2.640	2.660
3	78	2.980	0.055	0.085	3.140	3.160
3-1/2	91	3.480	0.055	0.085	3.640	3.660
4	103	3.980	0.055	0.085	4.140	4.160
4HW	H103	3.980	0.080	0.110	4.190	4.220
4-1/2	116	4.480	0.075	0.115	4.670	4.700
4-1/2HW	H116	4.480	0.100	0.125	4.720	4.750
5	129	4.970	0.075	0.115	5.200	5.230
5HW	H129	4.970	0.100	0.125	5.220	5.240
6	155	5.970	0.075	0.115	6.190	6.220
6HW	H155	5.970	0.100	0.125	6.220	6.240

[a] Measured circumferentially.

Table 4
Conduit dimensions – ID EB

(See Clause 4.2.1)

Trade size	Metric designator	Inside diameter, minimum	Wall thickness		Outside diameter[a]	
			Minimum	Maximum	Nominal	Maximum
		Millimeters				
4EB	103	101.09	1.02	1.78	104.65	105.16
4-1/2EB	116	113.54	1.40	2.16	117.60	118.11
5EB	129	126.24	1.40	2.16	130.56	131.06
6EB	155	151.64	1.40	2.16	155.96	156.46
Trade size	**Metric designator**	**(Inches)**				
4EB	103	3.980	0.040	0.070	4.120	4.140
4-1/2EB	116	4.470	0.055	0.085	4.630	4.650
5EB	129	4.970	0.055	0.085	5.140	5.160
6EB	155	5.970	0.055	0.085	6.140	6.160

[a] Measured circumferentially.

Table 5
Dimensions for couplings – IPS DB

(See Clause 4.3.1)

Trade size	Metric designator	Socket depth				Inside diameter of socket at entrance, minimum		Socket wall thickness, minimum	
		Minimum		Maximum					
		mm	(in)	mm	(in)	mm	(in)	mm	(in)
1/2	16	50.80	2.00	101.6	4	22.10	0.870	1.40	0.055
3/4	21	50.80	2.00	101.6	4	27.43	1.080	1.40	0.055
1	27	50.80	2.00	101.6	4	34.16	1.345	1.40	0.055
1-1/4	35	50.80	2.00	101.6	4	42.93	1.690	1.40	0.055
1-1/2	41	50.80	2.00	101.6	4	49.02	1.930	1.40	0.055
2	53	50.80	2.00	127	5	60.96	2.400	1.40	0.055
2-1/2	63	50.80	2.00	127	5	74.42	2.930	1.40	0.055
3	78	50.80	2.00	127	5	89.66	3.530	1.40	0.055
4	103	76.20	3.00	127	5	115.06	4.530	1.40	0.055
4HW	H103	76.20	3.00	127	5	115.06	4.530	1.91	0.075
5	129	76.20	3.00	127	5	142.49	5.610	2.03	0.080
5HW	H129	76.20	3.00	127	5	142.49	5.610	2.41	0.095
6	155	76.20	3.00	127	5	169.04	6.655	2.03	0.080
6HW	H155	76.20	3.00	127	5	169.16	6.660	2.41	0.095

Table 6
Dimensions for couplings – IPS EB

(See Clause 4.3.1)

Trade size	Metric designator	Socket depth				Inside diameter of socket at entrance, minimum		Socket wall thickness, minimum	
		Minimum		Maximum					
		mm	(in)	mm	(in)	mm	(in)	mm	(in)
4EB	103	76.20	3.00	127	5	114.05	4.490	1.02	0.040
5EB	129	76.20	3.00	127	5	141.48	5.570	1.40	0.055
6EB	155	76.20	3.00	127	5	168.91	6.650	1.40	0.055

Table 7
Dimensions for couplings – ID DB

(See Clause 4.3.1)

Trade size	Metric designator	Socket depth				Inside diameter of socket at entrance, minimum		Socket wall thickness, minimum	
		Minimum		Maximum					
		mm	(in)	mm	(in)	mm	(in)	mm	(in)
1/2	16	50.80	2.00	101.6	4	16.05	0.632	1.40	0.055
3/4	21	50.80	2.00	101.6	4	22.40	0.890	1.40	0.055
1	27	50.80	2.00	101.6	4	29.46	1.170	1.40	0.055
1-1/4	35	50.80	2.00	101.6	4	35.81	1.420	1.40	0.055
1-1/2	41	50.80	2.00	101.6	4	42.16	1.670	1.40	0.055
2	53	50.80	2.00	127	5	55.12	2.170	1.40	0.055
2-1/2	63	50.80	2.00	127	5	66.29	2.670	1.40	0.055
3	78	50.80	2.00	127	5	80.52	3.170	1.40	0.055
3-1/2	91	50.80	2.00	127	5	93.22	3.670	1.40	0.055
4	103	76.20	3.00	127	5	105.92	4.170	1.40	0.055
4HW	H103	76.20	3.00	127	5	107.44	4.230	1.91	0.075
4-1/2	116	101.60	4.00	127	5	119.63	4.710	2.03	0.080
4-1/2HW	H116	101.60	4.00	127	5	120.90	4.760	2.29	0.090
5	129	101.60	4.00	127	5	132.84	5.230	2.03	0.080
5HW	H129	101.60	4.00	127	5	133.10	5.240	2.29	0.090
6	155	101.60	4.00	127	5	158.24	6.230	2.03	0.080
6HW	H155	101.60	4.00	127	5	158.24	6.230	2.29	0.090

Table 8
Dimensions for couplings – ID EB

(See Clause 4.3.1)

Trade size	Metric designator	Socket depth				Inside diameter of socket at entrance, minimum		Socket wall thickness, minimum	
		Minimum		Maximum					
		mm	(in)	mm	(in)	mm	(in)	mm	(in)
4EB	103	76.20	3.00	127	5	105.41	4.150	1.02	0.040
4-1/2EB	116	76.20	3.00	127	5	118.36	4.660	1.40	0.055
5EB	129	76.20	3.00	127	5	131.32	5.170	1.40	0.055
6EB	155	76.20	3.00	127	5	156.72	6.170	1.40	0.055

Table 9
Radius of elbows

(See Clause 4.4.2)

Conduit		Minimum radius R of elbow to centerline of conduit	
Trade size	Metric designator	mm	(in)
1/2	16	102	4
3/4	21	114	4-1/2
1	27	146	5-3/4
1-1/4	35	184	7-1/4
1-1/2	41	210	8-1/4
2	53	241	9-1/2
2-1/2	63	267	10-1/2
3	78	330	13
3-1/2	91	381	15
4	103	406	16
4-1/2	116	610	24
5	129	610	24
6	155	762	30

Table 10
Threaded adapter

(See Clause 4.5.1.1 and Annex B)

Trade size	Metric designator	Socket depth				Minimum inside diameter	
		Minimum		Maximum			
		mm	(in)	mm	(in)	mm	(in)
1/2	16	50.8	2	101.6	4	12.2	0.42
3/4	21	50.8	2	101.6	4	18.5	0.73
1	27	50.8	2	101.6	4	24.9	0.98
1-1/4	35	50.8	2	101.6	4	31.2	1.23
1-1/2	41	50.8	2	101.6	4	36.8	1.48
2	53	50.8	2	127	5	50.3	1.98
2-1/2	63	50.8	2	127	5	63.0	2.48
3	78	50.8	2	127	5	75.7	2.98
3-1/2	91	50.8	2	127	5	88.4	3.48
4	103	76.2	3	127	5	101.1	3.98
4-1/2*	116	76.2	3	127	5	113.8	4.48
5	129	76.2	3	127	5	126.5	4.98
6	155	76.2	3	127	5	151.9	5.98

*See Annex B

Note: Threaded adapter includes both tapered theads (national pipe taper, NPT) and straight threads (national pipe straight, NPS).

Table 11
Force for compression test – DB

(See Clauses 5.2.1.1 and 5.2.4.1)

Trade size	Metric designator	Force	
		N	(lbf)
1/2	16	4450	1000
3/4	21	4450	1000
1	27	4450	1000
1-1/4	35	4450	1000
1-1/2	41	4450	1000
2	53	2670	600
2-1/2	63	2200	500
3	78	1555	350
3-1/2	91	1335	300
4	103	800	180
4 HW	H103	2000	450
4-1/2	116	1780	400
4-1/2 HW	H116	1850	415
5	129	1335	300
5 HW	H129	3100	695
6	155	1160	260
6 HW	H155	2670	600

Table 12
Force for compression test – EB

(See Clauses 5.2.1.1 and 5.2.4.1)

Trade size	Metric designator	Force	
		N	(lbf)
4EB	103	600	135
4-1/2EB	116	645	145
5EB	129	690	155
6EB	155	780	175

Table 13
Impact resistance – DB

(See Clause 5.3.4)

Trade size	Metric designator	Force	
		J	(ft-lbf)
1/2	16	20	15
3/4	21	20	15
1	27	20	15
1-1/4	35	20	15
1-1/2	41	27	20
2	53	47	35
2-1/2	63	61	45
3	78	80	60
3-1/2	91	80	60
4	103	80	60
4 HW	H103	110	80
4-1/2	116	110	80
4-1/2 HW	H116	140	100
5	129	140	100
5 HW	H129	240	180
6	155	140	100
6 HW	H155	270	200

Table 14
Impact resistance – EB

(See Clause 5.3.4)

Trade size	Metric designator	Force	
		J	(ft-lbf)
4EB	103	65	50
4-1/2EB	116	80	60
5EB	129	120	90
6EB	155	135	95

Table 15
Maximum vertical deflection of the diameter on the resistance to flattening test – DB

(See Clause 5.8.1)

Trade size	Metric designator	Maximum vertical deflection of diameter	
		mm	(in)
1/2	16	1.28	0.050
3/4	21	1.53	0.060
1	27	1.78	0.070
1-1/4	35	2.16	0.085
1-1/2	41	2.55	0.100
2	53	2.93	0.115
2-1/2	63	6.61	0.260
3	78	9.83	0.387
3-1/2	91	15.62	0.615
4	103	25.63	1.010
4HW	H103	15.24	0.600
4-1/2	116	11.43	0.450
4-1/2HW	H116	9.14	0.360
5	129	15.24	0.600
5HW	H129	9.14	0.360
6	155	24.38	0.960
6HW	H155	14.48	0.570

Table 16
Maximum vertical deflection of the diameter on the resistance to flattening test – EB

(See Clause 5.8.1)

Trade size	Metric designator	Maximum vertical deflection of diameter	
		mm	(in)
4EB	103	63.50	2.500
4-1/2EB	116	38.10	1.500
5EB	129	38.10	1.500
6EB	155	60.96	2.400

Figure 1

Elbows

(See Clauses 4.4.2 and 4.4.3)

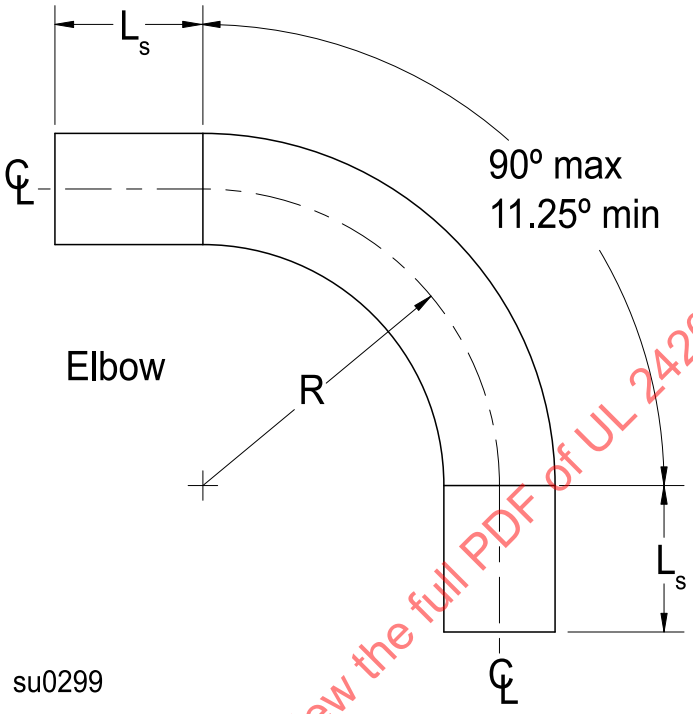

Figure 2

Impact – tup geometry

(See Clause 5.3.4)