

SECTION 1091
ELECTRICAL MATERIALS

1091-1 GENERAL REQUIREMENTS

(A) New Materials

Furnish new equipment, materials and hardware unless otherwise specified.

(B) Electrical Industry Standards

Provide electrical materials labeled and listed by UL when available or an electrical industry standards organization acceptable to the Engineer. The listing organization shall maintain periodic inspection of the production of materials and shall, by the labeling or listing procedure, verify that the materials comply with appropriate standards of performance or are suitable for use in a specified manner.

(C) Certification

Furnish a Type 3 material certification in accordance with Article 106-3.

1091-2 Wire and Cable

Use only stranded copper conductors, unless otherwise shown in the contract or *Standard Specifications*. Provide wire and cable with identification labels or tags on either the wire or cable itself or on the coil, reel or smallest container in which the product is packaged when delivered to the project. Show the manufacturer's name, gauge, UL symbol and type of wire or cable on the identification label or tag. When requested by the Department, furnish samples of wire and cable to the Department at no additional cost.

Use wire and cable of the type and size shown in the contract meeting the following applicable UL standards: 44, 83, 493, 719, 854, 1063 and 1581.

Where required by the plans, use soft or annealed solid bare copper wire conforming to ASTM B3.

1091-3 CONDUIT

(A) Conduit Bodies, Boxes and Fittings

Use conduit bodies, boxes, and fittings that meet UL Standard 514A or 514B for electrical and communications installations.

(B) Rigid Metallic Conduit

Provide rigid hot dipped galvanized steel conduit that meets UL Standard 6 with rigid full weight sherardized or galvanized threaded fittings.

(C) PVC Conduit

Provide non-metallic conduit and duct including associated couplings, approved for above and below ground use with or without concrete encasement in accordance with UL Standard 651A. Provide Schedule 40 conduit unless otherwise specified.

(D) Liquid-Tight Flexible Metal Conduit

Provide conduit that meets UL Standard 360 that is acceptable for equipment grounding in accordance with the NEC. Ensure conduit has insulated throat and malleable iron watertight fittings.

(E) Liquid-Tight Flexible Nonmetallic Conduit

Provide conduit that meets UL Standard 1660.

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1 (F) Solid Wall HDPE Conduit

2 Use HDPE conduit that conforms to UL Standard 651B. Provide conduit meeting
 3 Table 1091-1 with minimum wall thickness ratios corresponding to
 4 EPEC-40 (Schedule 40), EPEC-80 (Schedule 80) or EPEC-B (SDR 13.5) as listed in
 5 UL Standard 651B, Table 5.1, 5.2 and 5.3.

TABLE 1091-1 HDPE CONDUIT SIZE	
Conduit Trade Size	Furnish
1"	EPEC-40
1 1/4"	EPEC-40
1 1/2"	EPEC-B (SDR 13.5)
2"	EPEC-B (SDR 13.5)
2 1/2"	EPEC-B (SDR 13.5)
3"	EPEC-B (SDR 13.5)
4"	EPEC-B (SDR 13.5)
5"	EPEC-80
6"	EPEC-80

6 Ensure the PE resin compounds used in manufacturing the conduit meet or exceed the
 7 cell classification PE 334420C (black with 2% minimum carbon black) or
 8 PE 334420E (colored conduit with UV inhibitors) in ASTM D3350 and Table 1091-2.

TABLE 1091-2 RESIN PROPERTIES		
Property	Requirement	Test Method
Density	0.940 - 0.947g/cm ³	ASTM D1505 ASTM D792 ASTM D4883
Melt Index (condition 190/2.16 is acceptable)	< 0.4 grams/10 minutes	ASTM D1238
Flexural Modulus	80,000 psi, min.	ASTM D790
Tensile Strength	Tensile Strength 3,000 psi, min.	ASTM D638
Elongation	Elongation 400%, min.	ASTM D638
Slow Crack Growth Resistance	An ESCR as per condition B, 10% IGEPAL requirement of F50>24 hrs is allowable	ASTM D1693
Hydrostatic Design Basis	"0" for Non-Pressure Rated Pipe	ASTM D2837
UV Resistance (Outdoor Conduit Only)	Stabilize with at least 2% by weight carbon black or colored with UV Inhibitor	ASTM D4218

9 Furnish conduits in the colors for the applications shown in Table 1091-3. For conduits
 10 manufactured with stripes, ensure the stripes are uniformly located around the conduit
 11 with 120 degrees of separation. Do not use "Solid Yellow" or "Black with Yellow
 12 Stripes" conduit.

**TABLE 1091-3
CONDUIT COLORS**

Conduit Contents	Preferred Solid Color	Alternate
Signal Cable	Black	None
Loop Lead-in Cable	White	Black with White Stripes
Communication Cable (Copper, Fiber Optic, Coaxial)	Orange	Black with Orange Stripes
Electrical Power Cable	Red	Black with Red Stripes

1 Ensure the HDPE conduit is resistant to benzene, calcium chloride, ethyl alcohol, fuel oil,
2 gasoline, lubricating oil, potassium chloride, sodium chloride, sodium nitrate and
3 transformer oil and is protected against degradation due to oxidation and general
4 corrosion.

5 Furnish factory lubricated, low friction, conduit with a coefficient of friction of 0.10 or
6 less in accordance with Telcordia GR-356.

7 Ensure the supplied conduit is identified and certified as meeting, UL Standard 651B.
8 Ensure the conduit is marked at least with the following information on 10 ft or less
9 intervals:

10 (1) Material: HDPE

11 (2) Trade Size: i.e., 2"

12 (3) Conduit Type: SDR 13.5 or EPEC-B

13 (4) Manufacturer's name or trademark

14 (5) Manufacturer's identity code to identify manufacturing date, facility, etc.

15 (6) UL symbol or UL listing number

16 Furnish coilable conduit that is supplied on reels in continuous lengths for transportation
17 and storage outside. Ensure that the process of installing the coilable conduit on the reel
18 does not alter the properties or performance of the conduit for its intended purpose.

19 **(G) Conduit Plugs, Pull Line and Tracer Wire**

20 Furnish conduit plugs that provide a watertight barrier when installed in conduit. Furnish
21 conduit plugs sized in accordance with conduit. Ensure conduit plug provides a means to
22 secure a pull line to the end of the plug. Provide removable and re-usable conduit plugs.
23 Conduit plugs are not required to be listed electrical devices.

24 For all spare conduits, furnish 3/4", pre-lubricated, woven polyester tape, pull line with
25 minimum rated tensile strength of 2,500 lb. Pull lines are not required to be listed
26 electrical devices.

27 Provide green insulated number 14 AWG, THWN, stranded copper wire to serve as
28 tracer wire.

29 **1091-4 DUCT AND CONDUIT SEALER**

30 Use duct and conduit sealer or mastic which is a putty-like compound and:

31 **(A)** Is permanently non-hardening, non-oxidizing, and non-corrosive to metals, rubber,
32 plastic, lacquer and paints;

33 **(B)** Is readily workable for thumbing into openings and forming into seals around wires
34 inside conduits and openings around conduits;

35 **(C)** Has a service temperature range of minus 30°F to 200°F;

36 **(D)** Is clean, non-poisonous and non-injurious to human skin;

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1 (E) Seals against water, dust and air and shall adhere to wood, glass, plastics, metal, rubber
2 and painted surfaces; and

3 (F) Is non-conductive.

4 **1091-5 ELECTRICAL JUNCTION BOXES**

5 **(A) General**

6 Provide electrical junction boxes with covers of the type and size indicated by the
7 contract or plans for the termination of conduits.

8 **(B) Polymer Concrete (PC) Junction Boxes**

9 Provide polymer concrete (PC) boxes which are stackable, have bolted covers and have
10 open bottoms. Ensure vertical extensions of 6" to 12" are available from the junction box
11 manufacturer.

12 Use polymer concrete material made of an aggregate consisting of sand and gravel bound
13 together with a polymer and reinforced with glass strands to fabricate box and cover
14 components which are exposed to sunlight. Other thermosetting glass-reinforced
15 materials may be used for components which are not normally exposed to sunlight.

16 Provide certification that the polymer concrete boxes and covers meet
17 Tier 15 requirements of ANSI/SCTE 77. Provide certification that testing methods are
18 compliant with ANSI/SCTE 77.

19 Provide the required logo on the cover. Provide at least 2 size 3/8" diameter hex head
20 stainless steel cover bolts to match inserts in the box. Provide pull slot(s) with stainless
21 steel pin(s). Polymer concrete junction boxes are not required to be listed electrical
22 devices.

23 **(C) Cast Metal (BR) Junction Boxes**

24 Provide cast-metal (BR) box, replaceable frame and cover that are hot dipped galvanized
25 with factory or field drilled conduit entrances. Provide a cover with checkered imprint,
26 pry bar slots, and reinforcing ribs for heavy loading, neoprene gasket, and brass or
27 stainless steel bolts. Provide a blind tapped (1/4" NC thread minimum) boss on interior
28 of box for grounding.

29 **1091-6 GROUNDING ELECTRODES**

30 Provide grounding electrodes of the following types as indicated in the specifications and
31 plans.

32 **(A) Ground Rods**

33 Provide 5/8" diameter, 10 ft long, copper-clad steel ground rods with 10 mil thick copper
34 cladding.

35 **(B) Sectional Ground Rods**

36 Provide sectional ground rods comprised of 5/8" diameter, 10 ft long, steel ground rods
37 with 10 mil thick copper cladding, welded together in a butt configuration with
38 an exothermic weld. As an alternative, provide UL listed bronze couplers designed to
39 connect 5/8" diameter copper-clad steel rods. Do not use threaded ground rods or
40 threaded couplers. Provide minimum lengths required by plans.