

A-D TECHNOLOGIES		Product specification	
Submitted: 12/2008	Title: Cablecon® HDPE Cable in Conduit (CIC)	PS #: PS-101	
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General

The following specification covers the minimum requirements for Cablecon HDPE cable in conduit installed underground suitable for either direct buried or concrete encased. Cablecon is designed to provide protection for 600 volt and medium voltage (up to 35KV) power, fiber optic, coaxial and control type cables.

1.0 Scope

This A-D Technologies Corporation specification addresses the standard conduit types that are commonly selected for use in the power utility, C&I, transportation, irrigation, mining and communications industries.

Standard Wall – Dimensional specifications for this type of HDPE conduit shall be in accordance with ASTM D 3485, and designated type EPEC-A or “Standard Wall” in trade sizes ½” through 3” diameters.

DR13.5 - Dimensional specifications for this type of HDPE conduit shall be in accordance with ASTM F 2160 for SDR 13.5 and shall be designated as type EPEC-B or SDR-13.5 in trade sizes ½” through 4” diameters.

Schedule 40 - Dimensional specifications for this type of HDPE conduit shall be in accordance with ASTM F 2160 for Schedule 40 and designated as type EPEC-40 or Schedule 40 in trade sizes ½” through 4” diameters.

Schedule 80 - Dimensional specifications for this type of HDPE conduit shall be in accordance with ASTM F 2160 for Schedule 80 and shall be designated as type EPEC-80 or Schedule 80 in trade sizes ½” through 4” diameters.

Note:
CIC in sizes ½” through 4” is available with a UL listing (UL 1990) for EPEC B, EPEC 40 or EPEC 80. The finished conduit shall include the UL listed mark and use UL specified dimensions (see Appendix A). The UL requirement must be specified at the time of quotation and on the purchase order.

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2.0 Materials

2.1 Cablecon high-density polyethylene (HDPE) material specifications shall conform to the requirements of ASTM D-3350 and meeting or exceeding the cell classification of 335480 C (minimum 2% carbon black) or E (color with UV stabilizer). The cell specification properties are listed in Table 2.1

TABLE 2-1			
Material Requirements			
Cell	Properties	Requirements	Standards
3	Density	0.941 – 0.947	ASTM D 792 or 1505
3	Melt Flow Index (190/2.160)	0.15 – 0.40 g/10 minutes max	ASTM D 1238
5	Flexural Modulus	110,000 to 160,000 psi	ASTM D 790
4	Tensile Strength at Yield	3000 to 3500 psi	ASTM D 638
8	Environmental Stress Crack Resistance	Condition B, F10 Max, 10% Igepal, for 96 hrs.	ASTM D 1693
0	Pressure Rating	Not Pressure Rated	ASTM D 3350
--	Brittleness Temperature	-75 degrees C	ASTM D 746
--	Elongation, Minimum	400%	ASTM D 638
C	Class C	Minimum 2% carbon black	ASTM D 3350
E	Class E	Colored with UV Stabilizer	ASTM D 3350

- 2.2 If certified test reports are required by the purchaser they shall be requested and agreed to at the time of purchase. Certification shall be provided in accordance with this specification unless changes are previously agreed and authorized in writing by the seller.
- 2.3 A run code shall be printed on each reel length or production lot that is traceable to the resin used in the manufacture of the conduit.
- 2.4 Clean rework material from the manufacturers own production may be used, either alone or blended with virgin compound. The finished conduit made by using a portion of rework material shall meet all of the material and physical requirements of this specification.

3.0 Dimensions and lengths

- 3.1 Cablecon conduit shall meet the dimensional specifications set forth in Table 3-1. Dimensional measurements shall be taken at the beginning and end of each reel or coil and recorded.
- 3.2 Length tolerances shall be +/-10% for the ordered lengths unless otherwise agreed to in writing.
- 3.3 Average outside diameter (OD) shall be as shown in Table 3-1 for each type. Average outside diameter shall be determined using a vernier circumferential wrap tape or other approved measuring device and method done in accordance with ASTM D 2122.
- 3.4 Minimum and Maximum wall thickness shall be as shown in Table 3-1 for each type. Measurements shall be taken using a ball anvil micrometer or other

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approved measuring device on one end of the cut sample, rounded to the nearest 0.001" per ASTM D 2122.

3.5 Ovality shall be measured as defined in ASTM D 2122 and calculated as follows:

$$\% \text{ Ovality} = \frac{\text{Maximum OD} - \text{Minimum OD}}{\text{Average OD}} \times 100$$

Note:
Maximum allowable ovality of 3" and smaller conduit on reels or as coils shall be less than 10% when measured in accordance with the above formula.

TABLE 3-1 (Dimensions for Cablecon / CIC)										
Trade Size (inch)	Metric Designator	Average Outside Diameter (inches)	Wall Thickness (inches)							
			EPEC A (Standard Wall)		EPEC B (SDR 13.5)		EPEC 40 (Schedule 40)		EPEC 80 (Schedule 80)	
			Min.	Max	Min	Max	Min	Max	Min	Max
1/2	16	0.084 ± 0.008	0.060	0.080	0.062	0.082	0.109	0.129	0.147	0.167
3/4	21	1.050 ± 0.012	0.060	0.080	0.078	0.098	0.113	0.133	0.154	0.174
1	27	1.315 ± 0.012	0.075	0.095	0.097	0.117	0.133	0.153	0.179	0.200
1 1/4	35	1.660 ± 0.012	0.100	0.120	0.123	0.143	0.140	0.160	0.191	0.214
1 1/2	41	1.900 ± 0.012	0.115	0.135	0.141	0.161	0.145	0.165	0.200	0.224
2	53	2.375 ± 0.012	0.145	0.165	0.176	0.197	0.154	0.174	0.218	0.244
2 1/2	63	2.875 ± 0.012	0.203	0.223	0.213	0.239	0.203	0.227	0.276	0.309
3	78	3.500 ± 0.012	0.216	0.236	0.259	0.290	0.216	0.242	0.300	0.336

4.0 Conduit Size and Selection:

- 4.1 This section is provided as a guideline for conduit sizing. Final conduit sizes shall be agreed to between buyer and seller.
 - 4.1.1 *Percent fill* – for power or electrical cables refer to Article 354.100 (D) of the 2002 national electric code for the maximum suggested percentage fill of electrical non-metallic underground conduit with conductors as shown below in Table 4-1.

Table 4-1 Maximum Fill %			
No. of Conductors	1	2	=3
All Conductor Types	53%	31%	40%

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4.1.2 Cross Sectional Area – Table 4-2 provides the nominal cross-sectional area for CIC conduit sizes.

Table 4-2 fill Percentages						
Trade Size	Nom. ID	Cross-Sectional Area Values ⁽¹⁾				ID to OD Ratio ⁽²⁾
		ID Area 100% (sq. in.)	1 Cond. 53% (sq. in.)	2 Cond. 31% (sq. in.)	=3 Cond. 40% (sq. in.)	Comm. Cond. 60% (ratio ID to OD)
½"	0.622"	0.304	0.161	0.094	0.122	0.373"
¾"	0.824"	0.533	0.283	0.165	0.213	0.494"
1"	1.049"	0.864	0.458	0.268	0.346	0.629"
1 ¼"	1.380"	1.496	0.793	0.464	0.598	0.828"
1 ½"	1.610"	2.036	1.079	0.631	0.814	0.966"
2"	2.067"	3.356	1.778	1.040	1.312	1.240"
2 ½"	2.731"	5.858	3.105	1.816	2.243	1.639"
3	3.356"	8.846	4.688	2.742	3.538	2.014"

Notes:
 (1) Values for maximum conduit fill percentages are shown in maximum allowable square inches by conduit size. For example, the maximum amount of fill for 2 conductors (at 31% allowable fill) in a 1" conduit with and cross sectional area of 0.864" is determined by multiplying 0.864 x 0.31 = 0.268" (rounded to the nearest 0.001) for the two conductors.
 (2) Values shown are for communication type cables and are 60% of the conduit ID to the maximum cable or cable bundle OD to be installed.

4.1.3 Percent fill for communication cables i.e. fiber optic, coaxial or twisted pair is determined by dividing the cable or cable bundle OD by the conduit ID and multiplying by 100. Fill percentages for communication types of cables may be as high as 60% provided manufacturing capabilities are not exceeded, values shall be agreed to between buyer and seller.

Note in consideration of future cable replacement:

- Length of installation, number of bends should be taken into consideration in determining conduit diameter selection. Under certain conditions it may be advisable to use a larger conduit size or lesser fill in consideration of allowable replacement pulling loads.
- Cable jamming ratios should be considered when installing three cables into conduit. The ratio comparing the inside diameter of the conduit to the conductor outside diameter should not fall between 2.8 to 3.2 to avoid potential jamming issues in future cable replacement.

5.0 Surface Appearance and Workmanship

- 5.1 There shall not be any foreign particles embedded in the plastic surface.
- 5.2 There shall not be any surface distortion which penetrates either into the internal or external wall greater than 10% of the minimum wall thickness.
- 5.3 There shall not be any holes, visible cracks or defects which could cause damage or compromise the physical strength of the conduit

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- 5.4 There shall be no bonding of the factory-installed cable to the inner conduit wall. This shall be verified during the production of the conduit by free movement of the cable inside the conduit.
- 5.5 All cable factory installed into duct shall be lubricated with a compatible permanent lubrication.
 - 5.5.1 Lubricant shall not cause stress cracking on LDPE cable jackets when tested per IEEE/ICC lubricant standard 1210, standard tests for determining compatibility of pulling lubricants with wire and cable. Cable jacket/insulation materials tensile and elongation properties after heat aging shall meet the requirements of IEEE/ICC lubricant standard 1210.
 - 5.5.2 When used on medium voltage (15-35KV) cables, shall not affect the volume resistivity of the semi-conducting jacket or insulation shields. The volume resistivity of the semi-conducting material shall not increase more than 100% when tested per ICEA T-25-425 method, 90°C exposure, 168 hours, and recorded once every 24 hours after cooled to 23°C.
- 5.6 Cable shall be installed during the extrusion of the conduit.
- 5.7 Medium and 600 Volt Power Cables.
 - 5.7.1 HDPE conduit shall be suitable for use with electrical 600 volt and medium voltage rated cables not to exceed 90° C for normal operating temperature.
 - 5.7.2 HDPE conduit shall be compatible with common types of insulating and jacketing materials used for power cables.

6.0 Test Requirements for Finished Conduit:

- 6.1 All samples shall be conditioned per ASTM 618 at 73.4°F ±3.6°F, procedure A, but samples can be conditioned for shorter time provided equilibrium has been reached.
- 6.2 Samples shall be tested at the beginning and end of each reel or coil unless otherwise specified.
- 6.3 Compression Recovery – Three specimens shall be tested every lot or every 24 hours from a production lot whichever is more frequent.
 - 6.3.1 Samples are to be cut to 6” in length, temperature conditioned as stated above, placed between two parallel plates and compressed at the rate of 0.5 in/min until the ID is compressed to 50% of its original diameter.
 - 6.3.2 The method for determining 50% of the inside diameter shall be by 2 * the average wall thickness (t) and subtracting it from the average OD measured in accordance with section 3.3 for OD and 3.4 for wall thickness.

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6.3.3 The minimum force required to compress the specimens to 50% deflection shall exceed the values provided in Table 6-1 below.

Trade Size	EPEC A Lb/ft	EPEC B Lb/ft	EPEC 40 Lb/ft	EPEC 80 Lb/ft
1/2"	150	275	950	1600
3/4"	150	250	750	1500
1"	175	250	650	1300
1 1/4"	188	350	500	1000
1 1/2"	238	450	400	900
2"	300	450	400	900
2 1/2"	350	500	400	800
3"	350	500	400	800

6.3.4 Within 10 minute after removal of the force the specimens shall recover to 85% or greater of the original ID.

6.4 Impact testing – Five each 6” specimens will be cut per production lot or every 24 hours from a production lot whichever is more frequent.

6.4.1 *Low temperature test* – the samples are to be conditioned to a temperature of -4°F ±4°F for 5 h.

6.4.2 The impact test shall be conducted as set forth in Test Method D of 2444 using a 20-lb Type B tup, dropped via a vertical guide from height for each diameter as indicated in Table 6-2 below.

Trade Size	Height (ft)
1/2"	2.5
3/4"	4
1"	5
1 1/4"	6
1 1/2"	7.5
2"	9.5
2 1/2"	10.5
3"	11

6.4.3 A crack or tear longer than 0.031” is considered a failure.

7.0 Markings

7.1 Conduit print marking requirements

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The standard markings on the conduit shall be legible in a standard distinguishable color and spaced at intervals not to exceed 5 ft. and include:

- Manufacturer's name or trademark (i.e., A-D Technologies or Cablecon)
- Standard (i.e., ASTM D3485)
- Wall type and Material type (i.e., EPEC-40-HDPE or Schedule 40 HDPE)
- Trade size, in inches or mm (i.e., 2")
- Month & year of manufacture (i.e., Jan 2008)
- Manufacturing or lot code.
- Sequential length numbering with an accuracy of -0/+5%. Start and finish footage markings shall be noted on the product identification tags
- Industry standard markings such as lightning bolt symbol can be used to indicate conduit is a carrier of electrical conductor(s).

7.2 Optional surface printing and coloring options

7.2.1 Special markings as agreed to between the manufacturer and buyer.

7.2.2 Color designators for the conduit shall include complete wall coloring, a minimum of three longitudinally extruded color stripes or coextruded color jacket.

8.0 Packaging

8.1 Coilable conduit shall be available on plastic, steel or wooden reels. The minimum drum diameter shall be consistent with the following recommendation: Drum Diameter equals [Duct Diameter / .0555].

8.2 Reels shall have sufficient clearance between outer wrap of Cablecon and the overall flange diameter to protect outside wraps from incidental damage during storage and transport.

8.3 All power cable installed in conduit shall be packaged on reels of sufficient duty to facilitate storage, transportation & handling requirements.

8.3.1 Wooden reels shall be designed with start slots in the flange for securing the CIC start end and also to provide access for cable testing.

8.3.2 Power cable ends shall be capped with heat shrink caps prior to capping conduit. The conduit shall be capped using a re-enterable rubber cap.

9.0 Tagging and Shipping

9.1 The following information is to be included with any reels of CIC that are completed and to be shipped from any A-D Technologies manufacturing facility. All tags and shipping documents shall be typed or printed. Both the Shipping and Product Identification tags shall be printed using indelible ink. Required documentation includes the following items.

- Shipping Tag – Each reel shall have a tag with complete shipping information that shows both a return address and ship to address.
- Product Identification Tag – Each reel shall have a tag that has complete product identification information.
- Packing List – That includes return and destination addresses along with a detailed breakdown of the reels that are shipping.

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- Bill of Lading – A standard commercially acceptable bill of lading shall be prepared for each shipment.
- 9.2 All tags shall have an adhesive backing and be affixed to reels below the A-D Technologies stenciled logo on the plastic placard for steel reels and stapled in each of the four corners with commercial grade staples on wooden reels.
- 9.3 Shipping Tags shall include the following standard information.
- 9.3.1 Complete return and ship to addresses
 - 9.3.2 Customer purchase order (PO) number
 - 9.3.3 A-D Technologies Part Number
 - 9.3.4 Product description
 - 9.3.5 A-D Technologies customer order (CO) number
- 9.4 Product Identification Tags shall include the following standard information.
- 9.4.1 Catalog or Part # and complete description.
 - 9.4.2 Customer stock/product identification number, when required.
 - 9.4.3 CIC total conduit length including start and ending footage markings.
 - 9.4.4 Gross, Tare and Net weights where; gross weight is the total weight of the CIC and reel; tare weight is the weight of the reel; the net weight is determined by subtracting the tare weight from the gross weight.
 - 9.4.5 Other optional identification markings as agreed to at the time of order.
- 9.5 Tag shall be affixed to the reels using the following procedure
- 9.5.1 For wooden reels a shipping and product identification tag shall be attached to one flange on each reel below of the stenciled A-D Technologies logo of the wooden reel.
 - 9.5.2 For Steel reels a shipping and product identification tag shall be attached to one flange on each reel on the A-D Technologies plastic placard.
 - 9.5.3 Optional tags identifying the cable, when provided by the cable manufacturer shall be placed immediately to the right on wooden reels or immediately above on steel reels to the A-D Technologies product identification tag.

10.0 End of Main Specification

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Appendix-A – UL Standard 1990, Dimensional and Special Requirements

General: This section highlights added or modified requirements for Cablecon listed in accordance with UL 1990. UL listed conduit shall be requested at the time of quotation and noted on the purchase order. Order notification is necessary to assure the UL listed marking is printed on the conduit and all special UL required testing is completed at the time of manufacture. Certified test reports, if required, must be specified on the purchase order along with complete contact and transmittal information for delivering the test reports.

- 1.0 Scope:** Cablecon/UL is for use in applications requiring a UL listed conduit. Types available are EPEC B (SDR 13.5), EPEC 40 (Schedule 40) and EPEC 80 (Schedule 80), note some diameters may not be available, contact you're A-D Technologies for a current list of approved products. Cablecon/UL is suitable for direct burial, concrete encasement or above ground with a minimum of 2" of concrete cover. Cablecon / UL shall have an approved 3rd party testing, listing and periodic verification program demonstrating compliance with the requirements of UL 1990.
- 2.0 Material Properties:** Shall be the same as those found in the main body of this specification.
- 3.0 Dimensions and lengths:** The dimensional changes from the main body are those listed in the table below for the outside diameter tolerance.

Table A1

Outside Dimensions for UL Listed			
Trade Size (in)	Metric Designator (mm)	Outside Diameter (in)	Tolerance (in)
1/2	16	0.084	±.004
3/4	21	1.050	±.004
1	27	1.315	±.005
1 1/4	35	1.660	±.005
1 1/2	41	1.900	±.006
2	53	2.375	±.006
2 1/2	63	2.875	±.007
3	78	3.500	±.008
4	103	4.500	±.009

- 4.0 Conduit Size and Selection:** UL 1990 single and multiple cable requirements:
 - 4.1 Cable or conductors shall be rated for wet locations.
 - 4.2 All conductors shall have an insulation rating at least equal to the maximum circuit voltage of any of the cables or conductors housed in the same conduit.
 - 4.3 Conductors rated 600V or less shall not occupy that same conduit as conductors rated greater than 600V.
- 5.0 Surface Appearance and Workmanship:** Same as main body of specification.

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6.0 Test Requirements for Completed Cablecon / UL

- 6.1 Testing conducted by an ANSI accredited 3rd party testing laboratory indicating compliance with qualification tests per UL 1990.
- 6.2 Maintain 3rd party periodic compliance inspection program for Cablecon approved manufacturing facilities.
- 6.3 Be able to provide listing verification via access to active 3rd party listings.

7.0 Markings:

- 7.1 The UL listed logo shall be incorporated into the print line.
- 7.2 Standard for print line shall include the designation - UL 1990.

8.0 Packaging: Same as main body of specification.

9.0 Tagging and Shipping: Same as main body of specification.

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