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THE VOICE OF AN INDUSTRY

HDPE Conduit for Power and Communications

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Presentation Outline

This presentation will:

1. Introduce PPI as a resource of knowledge for HDPE conduit
2. Present HDPE conduit products and explain their benefits
3. Discuss the applications addressed by HDPE conduit solutions
4. Illustrate several installation techniques used with HDPE conduit
5. List industry standards used for HDPE conduit
6. Share knowledge about relevant PPI publications and resources

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1. Introduction to the Plastics Pipe Institute

PPI was formed in 1950 to develop test methods for plastic pressure pipe

- PPI's five divisions focus on solutions for multiple applications:
  - Building & Construction Division
  - Corrugated Plastic pipe Division
  - Energy Piping Systems Division
  - Municipal & Industrial Division
  - **Power & Communications Division (PCD)**

BCD: PEX tubing for radiant heating

EPSD: Gas distribution piping

MID: HDPE water mains

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Introduction to the Plastics Pipe Institute

PPI's Power & Communications Division (PCD) Mission Statement:
"To expand the knowledge of the uses and benefits of HDPE conduit for power and communications applications."

PCD collaborates with standards development organizations (SDOs) that set standards for manufacturing practices, quality control, product-testing and installation methods. PCD also educates designers, installers, users and government officials about HDPE conduit; establishes a forum for problem solving and new ideas; and maintains liaison with industry, educational and government agencies.

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Introduction to the Plastics Pipe Institute

Examples of PCD Member Companies…

- Blue Diamond Industries
- Chevron Phillips
- Dura-Line Corporation
- Dow Chemical
- Endot Industries
- ETCO Specialty Products
- Four Star Industries
- Flying W Plastics
- Formosa Plastics Corp.
- Jain Irrigation
- JM Eagle
- INEOS
- IPEX
- LyondellBassel Industries
- Southwire
- Teel
- Uponor Infra
- United Poly Systems
- Victaulic
- WL Plastics

These are the firms that pioneer, develop and produce HDPE conduit and accessories for power and telecommunications applications across North America.

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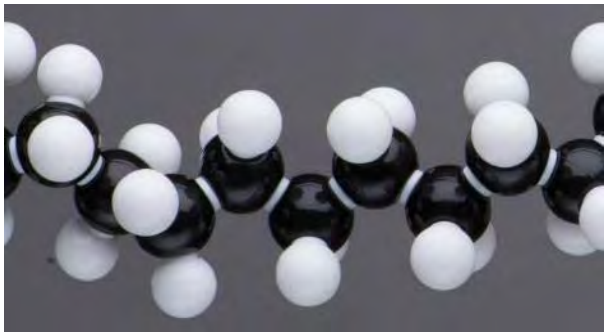
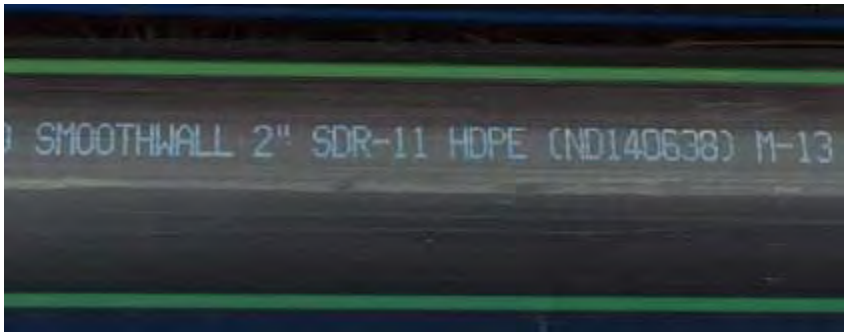
2. HDPE Conduit for Power and Communications

Introduction to High-Density Polyethylene (HDPE)

- "Since its discovery in 1933, PE has grown to become one of the world's most widely used and recognized thermoplastic materials. – *PPI Handbook of Polyethylene Pipe*
- **High-density Polyethylene** is a plastic resin made by the copolymerization of ethylene and a small amount of another hydrocarbon
- The resulting base resin density before additives or pigments is greater than 0.941 g/cm^3





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HDPE Conduit for Power and Communications

HDPE Conduit Types

<u>Outside Plant:</u>

- Smoothwall
- Ribbed
- Innerduct
- Microduct
- Aerial
- Cable-in-Conduit (CIC)

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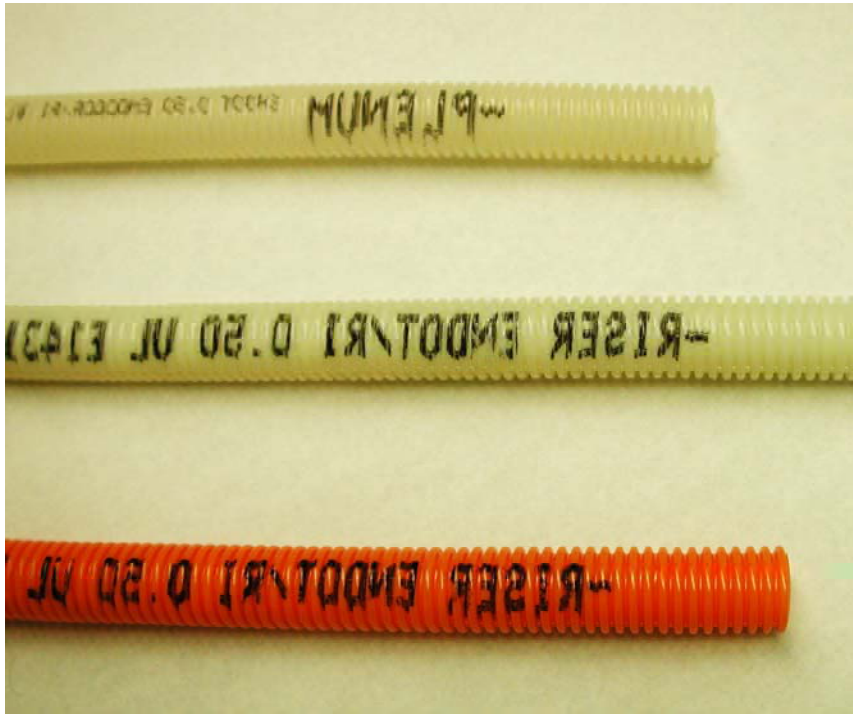
HDPE Conduit for Power and Communications

HDPE Conduit Types

Inside Plant:

- Corrugated (riser / plenum)
- Innerduct
- Microduct



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HDPE Conduit for Power and Communications

HDPE Conduit Sizes

- Various sizing systems exist, including IPS types SDR9, SDR11, SDR 13.5, DR 15.5, Schedule 40 and Schedule 80, "True Sized", and SIDR
- For IPS types, wall thickness is described by the **Dimension Ratio** (DR)* which typically ranges from DR 9 to DR 17 for conduit up to 12 inch in diameter
- HDPE conduit standards such as **ASTM F2160, NEMA TC 7 and UL 651A** specify the exact dimensions for HDPE conduit

**Ratio of outside diameter to wall thickness.*
The lower the DR number, the thicker the wall, relative to other wall types.

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HDPE Conduit for Power and Communications

HDPE Benefits

- High-density polyethylene (HDPE) conduit is the preferred material to house and protect electrical power and telecommunications cables
- It offers unmatched corrosion and chemical resistance, is flexible and durable, and is available in long reel lengths to reduce joints and installation time
- HDPE conduit is available in a variety of sizes, colors, dimensions and lengths

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HDPE Conduit for Power and Communications

HDPE Benefits

- Bendable and flexible without breaking
- Resistant to most ordinary chemicals
- Moisture-proof and water-tight
- Not susceptible to corrosion
- Immune to attack from insects
- Eliminates maintenance common to aerial networks
- Easy installation due to long lengths and high pull strength
- Low coefficient of friction allowing easier long-distance cable pulls
- Better low-temperature impact resistance than other conduit materials

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HDPE Conduit for Power and Communications

HDPE Benefits: Flexibility, Toughness

- HDPE conduit follows trench contours, can be installed around obstacles underground
- Bends and flexes without breakage, even with ground heaves or shifts, over a wide range of temperatures
- High ductility resists damage during transportation, handling, and installation
- Resists brittleness due to aging or cold weather and retains impact resistance

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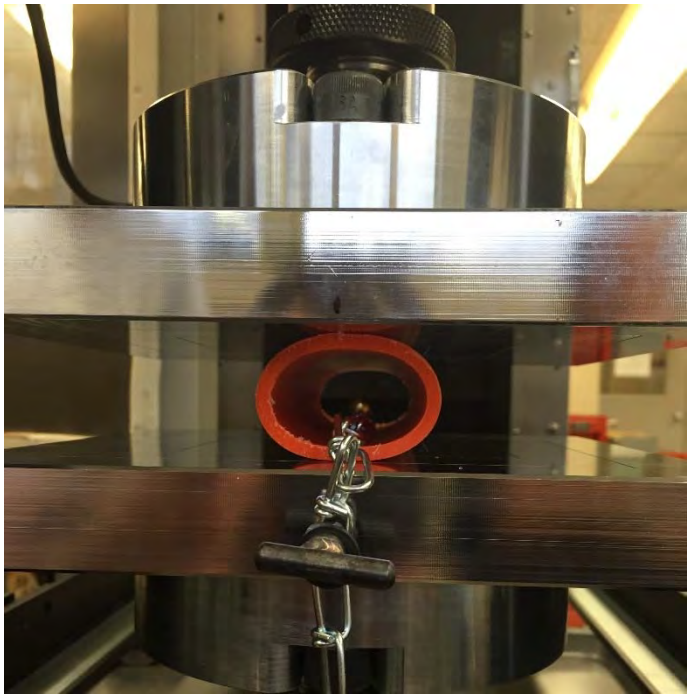
HDPE Conduit for Power and Communications

HDPE Benefits: Flexibility

- Bendable and flexible without breaking
- Example: HDPE conduit undergoing typical Deflection Load test without cracking or breaking



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3. Applications Addressed by HDPE Conduit

Solutions provided by HDPE Conduit

- Power: Low-voltage and medium voltage
- Site Lighting
- Signal and Control
- Fiber Optic and Communications
- Renewable Energies
- ITS (Intelligent Transportation Systems)
- SCADA (Supervisory Control and Data Acquisition)

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Applications Addressed by HDPE Conduit

Power

- HDPE conduit is used for underground power lines
  - Low voltage: 600 V
  - Medium voltage: 15kV to 35kV

Underground installation of power distribution lines using high-density polyethylene (HDPE) conduit is a reliable, sustainable and economical solution.


Courtesy Southwire

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Applications Addressed by HDPE Conduit

Power

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  - Low voltage: 600 V
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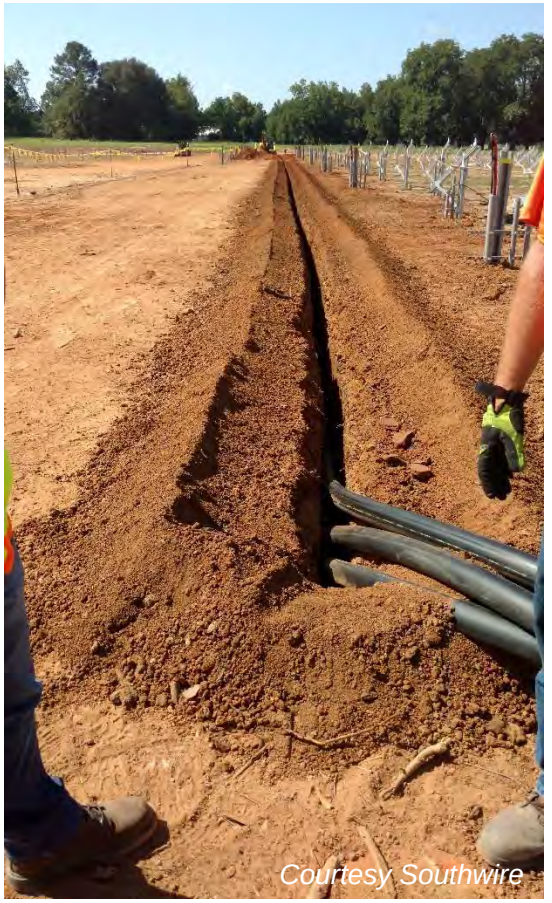
Courtesy Southwire



Courtesy Southwire

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Applications Addressed by HDPE Conduit

Power: Cable-in-Conduit

- HDPE conduit with integrated power lines
  - Reduces installation time, improves productivity

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Applications Addressed by HDPE Conduit

Site Lighting

Courtesy Blue Diamond

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Applications Addressed by HDPE Conduit

Fiber Optic and Communications

- HDPE conduit is used for fiber optic installations connecting data centers to neighborhoods and customers around the world

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Applications Addressed by HDPE Conduit

Fiber Optic and Communications

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Applications Addressed by HDPE Conduit

Fiber Optic and Communications

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Applications Addressed by HDPE Conduit

Fiber Optic and Communications

- When new roads are constructed or rebuilt, HDPE conduit is one of the first utilities to be installed, sometimes for future demands

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Applications Addressed by HDPE Conduit

Renewable Energies

- Solar and wind power projects utilize HDPE conduit for safety and efficiency

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Applications Addressed by HDPE Conduit

ITS - Intelligent Transportation Systems

- ITS uses HDPE conduit for fiber optic communication cables, copper communication cables and power cables

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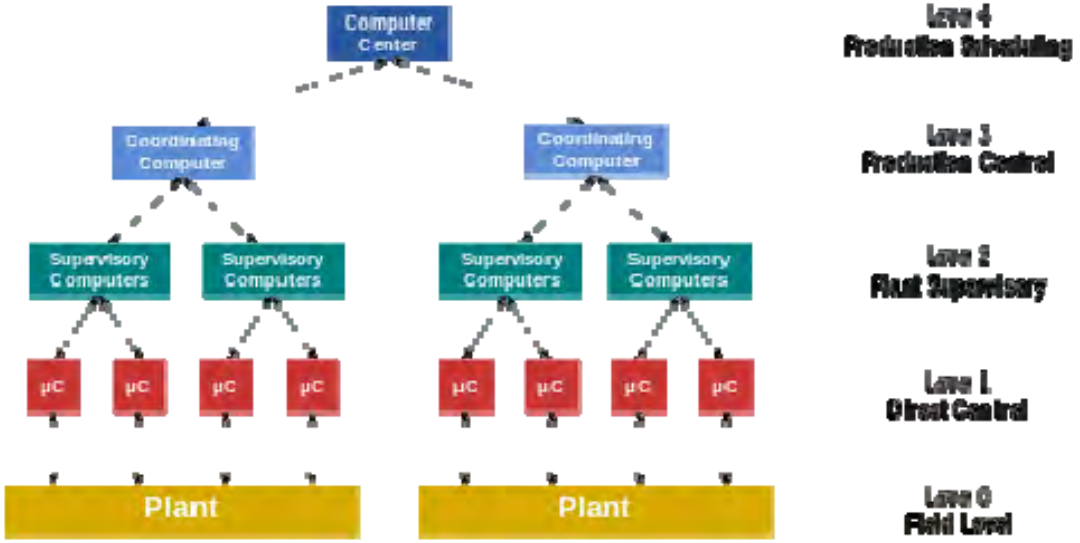
Applications Addressed by HDPE Conduit

SCADA - Supervisory Control and Data Acquisition

- Examples are command/control systems for water treatment plants, oil and gas pipelines, factories, control of solar farm panels, control of wind power propellers, etc.



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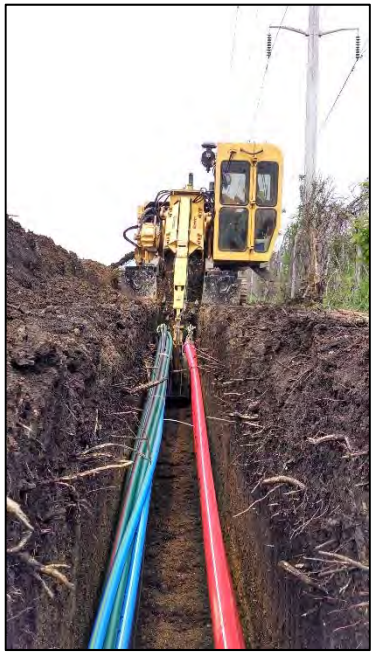
4. HDPE Conduit Installation Techniques

Installation Types

- HDPE conduit is installed via:
  - Trenching
  - Plowing
  - HDD*

**Horizontal Directional Drilling*



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HDPE Conduit Installation Techniques

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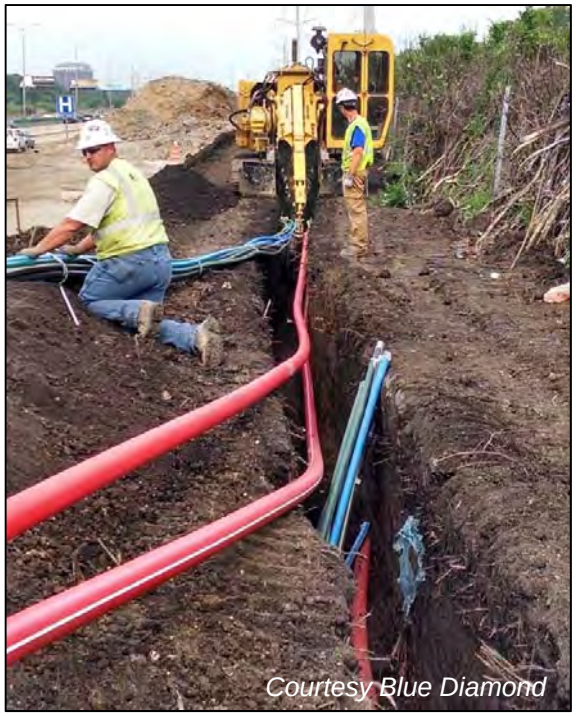

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HDPE Conduit Installation Techniques

Installation Types

- HDPE conduit is installed via:
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HDPE Conduit Installation Techniques

Installation Types

- HDPE conduit is installed via:
  - Plowing

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HDPE Conduit Installation Techniques

Installation Types

- HDPE conduit is installed via:
  - Horizontal Directional Drilling (HDD)
  - Boring under roadways or waterways and pulling the conduit underground

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HDPE Conduit Installation Techniques

Installation Types

- HDPE conduit is installed via:
  - Horizontal Directional Drilling (HDD)
  - Example: Three-in-One HDPE conduit with innerduct

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HDPE Conduit Installation Techniques

Installation Types

- HDPE conduit is installed via:
  - Horizontal Directional Drilling (HDD)
  - Example: Twenty 2 inch ducts being installed under a field, river and golf course

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HDPE Conduit Installation Techniques

Installation Types

- HDPE conduit is installed via:
  - Horizontal Directional Drilling (HDD)
  - Example: Twenty 2 inch ducts being installed under a field, river and golf course

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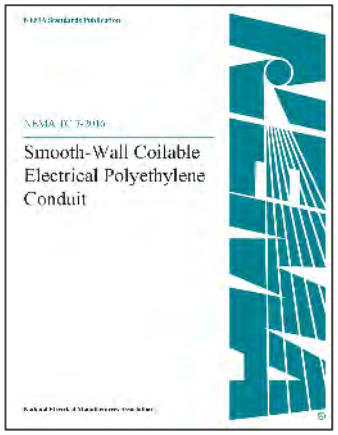
5. Industry Standards for HDPE Conduit

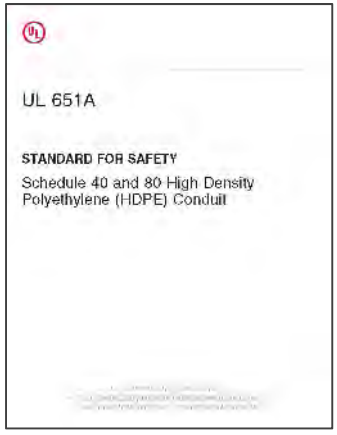
HDPE Conduit Standards

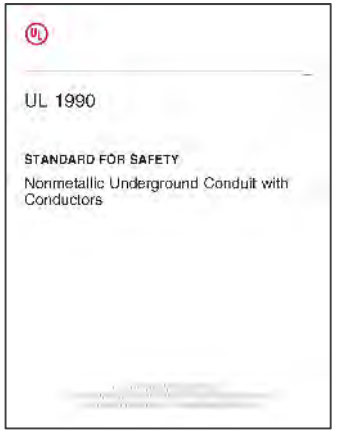
- HDPE conduit standards specify material properties, dimensions, performance requirements and test methods for evaluating HDPE conduit
- The following is a list of five (5) current standard specifications for HDPE conduit and cable in conduit


Standard Specification for
Coilable High Density Polyethylene (HDPE) Cable in Conduit (CIC)


Standard Specification for
Solid Wall High Density Polyethylene (HDPE) Conduit Based on Controlled Outside Diameter (OD)







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Industry Standards for HDPE Conduit

ASTM D3485-15: Standard Specification for Coilable High Density Polyethylene (HDPE) Cable In Conduit

"This specification covers cable in conduit (CIC), which is a smooth-walled, coilable, high-density polyethylene (HDPE) conduit (duct) that contains preassembled wires and cables. The outside diameter of the conduit is controlled and the wire or cable encased within may be comprised of single or multiple configurations consisting of electrical/ power wires or cables, fiber optic, traditional copper communication, coaxial cable, or any combination thereof."

- Originally approved 1976
- Current edition approved in 2015

Industry Standards for HDPE Conduit

ASTM F2160-16: Standard Specification for Solid Wall High Density Polyethylene (HDPE) Conduit Based on Controlled Outside Diameter (OD)

"*This specification covers material, dimensional, workmanship and performance requirements for polyethylene conduit, duct and innerduct manufactured for use in a nonpressure applications for the protection of fiber optic and power cables. Applications include telecom, SCADA command and control, highway lighting, ITS (Intelligent Transportation Systems) and Underground Utilities with PE conduit installed using methods such as Horizontal Directional Drilling (HDD),plowing and open trench.*"

- Originally approved 2001
- Current edition approved in 2016

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Industry Standards for HDPE Conduit

NEMA TC 7-16: Smooth Wall Coilable Electrical Polyethylene Conduit

"*This standard covers several wall types of high-density polyethylene (HDPE) conduit for use in providing a protective raceway for electrical cables or communication cables buried underground or concrete encased."*
"Note: Typical applications for HDPE conduit include power distribution, site lighting, signal and control, and Supervisory Control and Data Acquisition (SCADA)."

Includes wall types EPEC-40, EPEC-80, EPEC-11, EPEC-13.5, EPEC-15.5, EPEC 17

- Originally published in 1983
- Current edition approved in 2016

NEMA®

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Industry Standards for HDPE Conduit

UL 651A: Schedule 40 and 80 High Density Polyethylene (HDPE) Conduit

"These requirements cover straight conduit and coilable, smooth-wall, continuous length conduit with a circular cross section:

a) Extruded straight rigid Schedule 40 high density PE (polyethylene) electrical conduit and the following fittings for use with this conduit type:

1) Elbows, and

2) Rigid high density PE couplings;

b) Schedule 40, Schedule 80, EPEC-A, and EPEC-B coilable, smooth-wall continuous length high density PE electrical conduit."

- Originally published in 1981
- Current edition shows as "Fifth Edition – Oct. 26, 2011" but includes 2016 updates

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Industry Standards for HDPE Conduit

UL 1990: Standard for Nonmetallic Underground Conduit with Conductors

"These requirements cover nonmetallic underground conduit with conductors. These products consist of a factory assembly of conductors or cables inside a coilable, smooth-wall, continuous length conduit with a circular cross section. The conduit is Schedule-40, Schedule-80, EPEC-A or EPEC-B High Density Polyethylene (HDPE) in trade sizes 1/2 (16) - 4 (103). This product is intended for installation in accordance with the National Electrical Code, NFPA 70."

- Originally published in 1998
- Current edition shows as "Third Edition – Nov. 22, 2013" but includes 2017 updates

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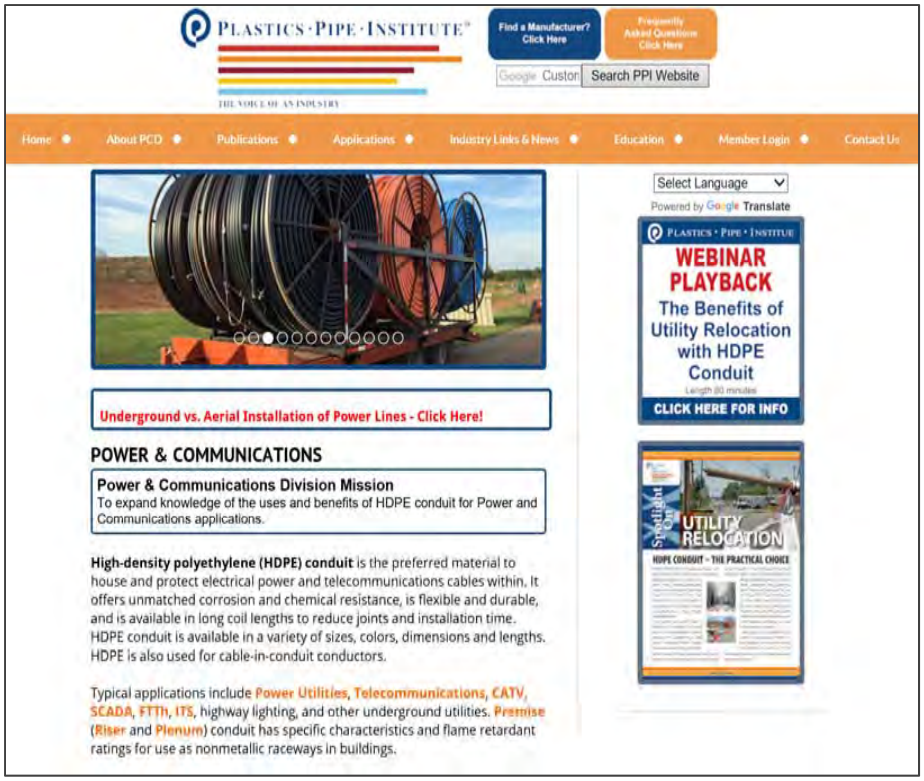
6. PPI Publications

Please visit our website for:

- Product information
- Technical Reports
- Technical Notes
- Case studies
- Position Papers
- Design information
- Educational videos
- Finding a Manufacturer
- Frequently Asked Questions
- Connecting with other organizations
- www.plasticpipe.org/power-comm



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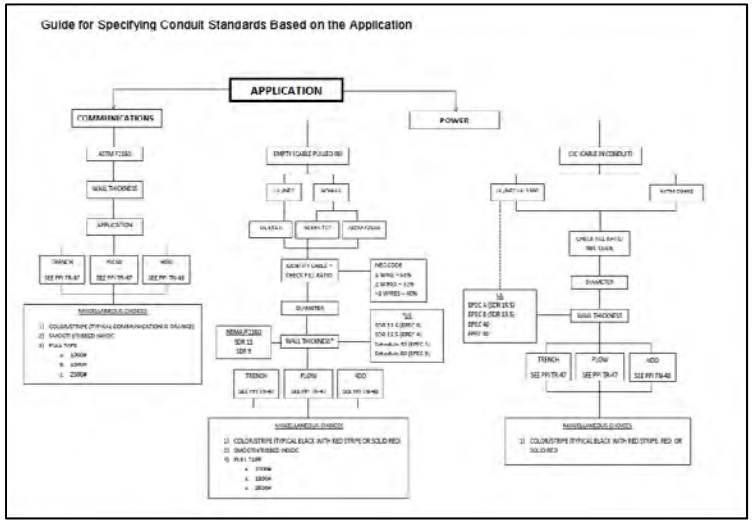
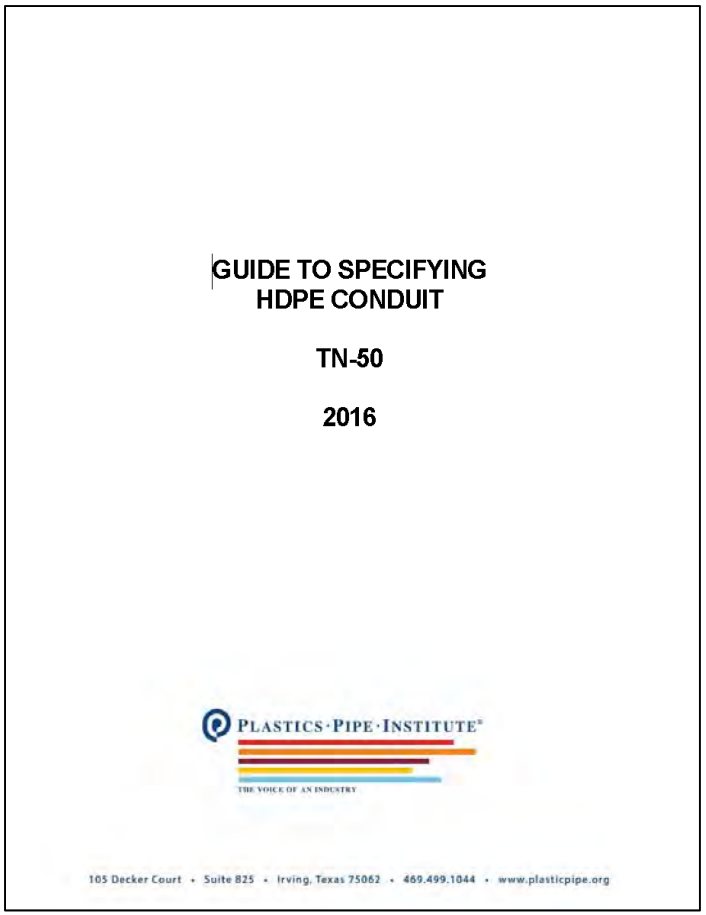
PPI Publications

PPI Technical Notes and Reports

Example:

- Technical Note 50: *Guide to Specifying HDPE Conduit*





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PPI Publications

PPI Technical Notes and Reports

Example:

- Technical Note 50: *Guide to Specifying HDPE Conduit*

Table 1: HDPE Conduit Diameters Available per Wall Type and Standard Specification

Wall Type	HDPE Conduit Standards with Available Diameters				
	ASTM D3485	ASTM F2160	NEMA TC 7	UL 651A	UL 1990
Schedule 40	1/2" to 3"	1/2" to 12"	1/2" to 8"	1/2" to 6"	1/2" to 6"
Schedule 80	1/2" to 3"	1/2" to 6"	1/2" to 6"	1/2" to 6"	1/2" to 6"
SDR 17	N/A	N/A	1/2" to 2"	1/2" to 6"	1/2" to 6"
DR 15.5	1/2" to 3"	1/2" to 12"	1/2" to 6"	N/A	N/A
SDR 13.5	1/2" to 3"	1/2" to 12"	1/2" to 8"	1/2" to 6"	1/2" to 6"
SDR 11	1/2" to 3"	1/2" to 12"	1/2" to 8"	N/A	N/A
SDR 9	N/A	1/2" to 12"	N/A	N/A	N/A
True-size 9	N/A	13 mm to 2"	N/A	N/A	N/A
True-size 11	N/A	13 mm to 2"	N/A	N/A	N/A

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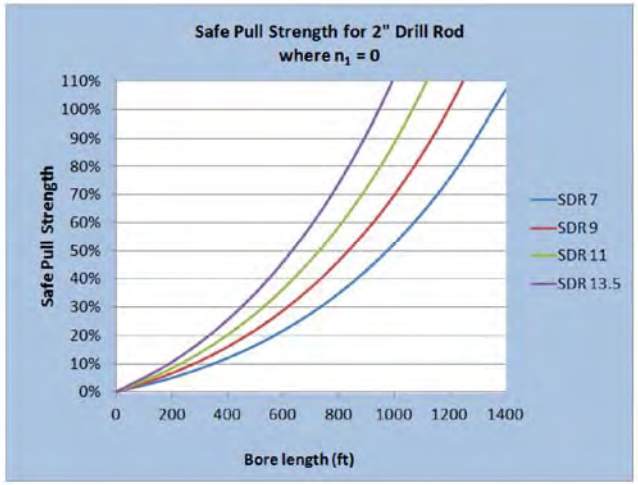
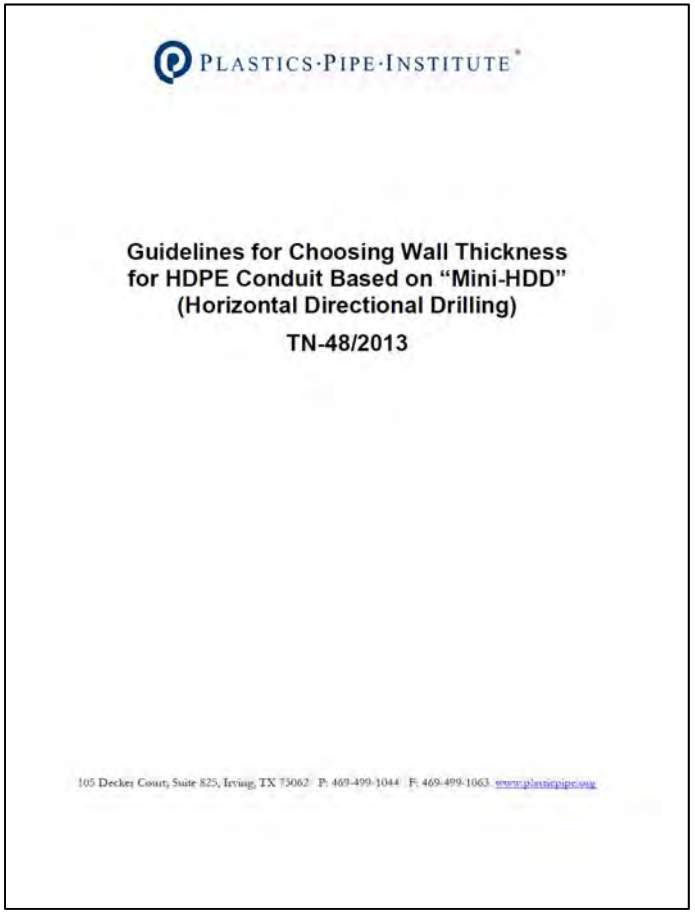
PPI Publications

PPI Technical Notes and Reports

Example:

- Technical Note 48: *Guidelines for Choosing Wall Thickness for HDPE Conduit Based on "Mini-HDD" (Horizontal Directional Drilling)*

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Guidelines for Choosing Wall Thickness for HDPE Conduit Based on "Mini-HDD" (Horizontal Directional Drilling)

TN-48/2013

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PPI Publications

PPI Position Papers

Example:

- *Underground vs. Aerial Installation of Power Lines*

"When utilities have a choice between burying power lines underground and installing aerial power lines in vulnerable or unsightly locations, the Plastics Pipe Institute (PPI) encourages them to analyze lifetime costs of underground vs. aerial installations on a case-by-case basis, considering technical, economic and environmental factors."

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Position Paper

Underground vs. Aerial Installation of Power Lines

February 19, 2016

Position

North America's electrical distribution grid is an aging infrastructure which requires extensive upgrades to effectively meet 21st century energy demands and expectations for grid reliability and resiliency. Severe weather is the number one cause of power outages in the United States, costing the economy between $18 and $33 billion every year in lost output and wages, spoiled inventory, delayed production and damage to grid infrastructure[1]. Climate change is expected to increase the frequency and intensity of severe weather events. Also, threats to aerial installations from traffic and wildlife are ubiquitous.

Underground installation of power distribution lines using high density polyethylene (HDPE) conduit is a reliable, sustainable and economical solution. When utilities have a choice between burying power lines underground and installing aerial power lines in vulnerable or unsightly locations, the Plastic Pipe Institute (PPI) encourages them to analyze lifetime costs of underground vs. aerial installations on a case by case basis, considering technical, economic and environmental factors.

Background

Although *initial installation costs* of underground power distribution lines are sometimes higher, installation by plowing HDPE conduit and pulling cable can be close to the cost of aerial construction. By utilizing modern horizontal directional drilling (HDD) technologies, underground power installations can be far less disruptive than installing aerial power lines.

The long-term savings inherent through underground installation in conduit may be realized through:

1. Reduced Maintenance Repair & Operation (MRO) costs for tree trimming and ground clearing
2. Reduced risk of damage to assets caused by external factors such as vehicles and wildlife
3. Eliminated aging of poles, exposed switches, supports and insulators
4. Improved service reliability by eliminating disruptions caused by weather, vehicles and wildlife
5. Reduced costs of Right of Way (ROW) acquisition and maintenance
6. Improved appearance of streets and roads with underground buried utilities and resulting higher residential property values

[1] http://energy.gov/articles/top-9-things-you-didnt-know-about-america-s-power-grid

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PPI Publications

Frequently Asked Questions

FREQUENTLY ASKED QUESTIONS

- CABLES
- COLORS
- INNERDUCT
- INSTALLATION
- MANUFACTURING
- MATERIALS
- SIZES
- STANDARDS

FREQUENTLY ASKED QUESTIONS

Return to FAQ's Index

CABLES

1. What is the voltage of mainline power distribution and can HDPE conduit handle that voltage?
2. How many cables can I fit into an innerduct or conduit?

What is the voltage of mainline power distribution and can HDPE conduit handle that voltage?

HDPE conduits up to 8" in diameter have had solid dielectric, high voltage cables, rated at 345kV installed inside them. Further, conduit pipes through 6" are commonly used to protect underground distribution cables having voltage ratings from 600V to 35kV. Cable voltage ratings have not been a deterrent for utilities choosing to use conduit made from HDPE for underground power cables.

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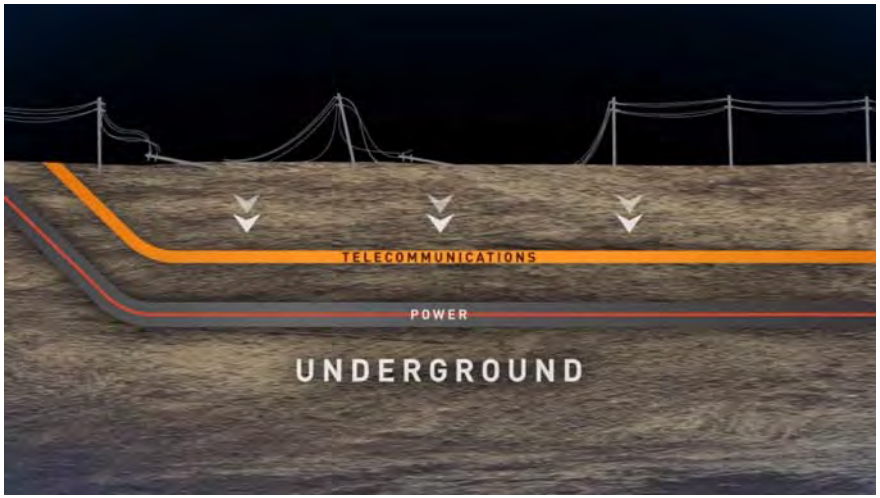
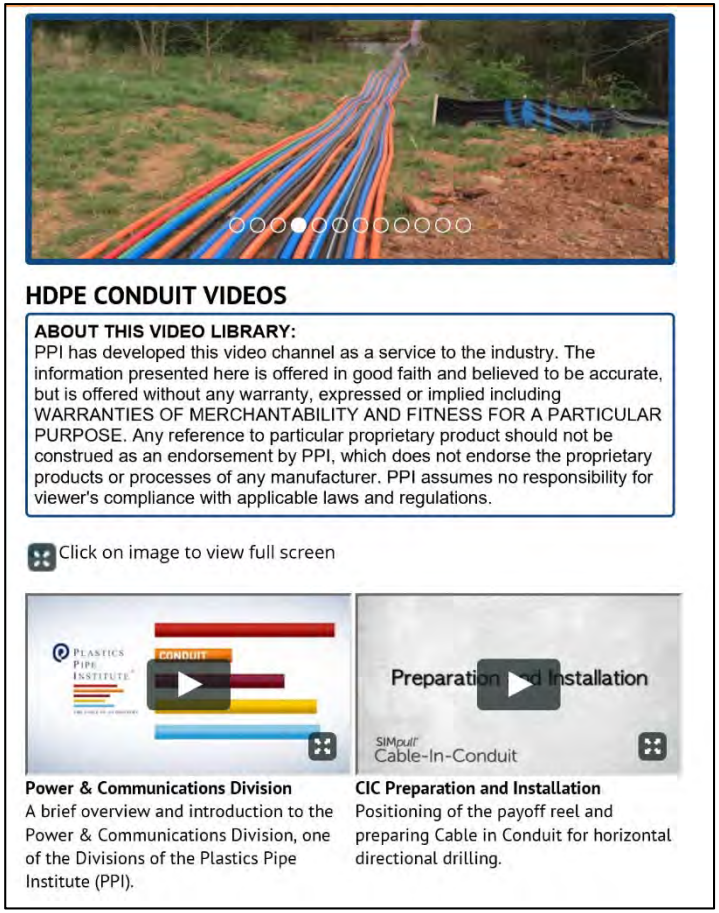
PPI Publications

Educational Videos

- PCD Division video introduces HDPE Conduit
- Instructional videos explain how to work with HDPE conduit for buried applications





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PPI Publications

Industry Links

- Get direct access to standards development organizations (SDOs), product certification agencies, code bodies and other associations through this PCD webpage

INDUSTRY LINKS

AASHTO - American Association of State Highway & Transportation Officials
ANSI - American National Standards Institute
ASME - American Society of Mechanical Engineers
ASTM - American Society for Testing and Materials
AWEA - American Wind and Energy Association
BICSI - Building Industry Consulting Service International, Inc.
CSA Group - Canadian Standards Association
CATT - Canadian Association for Trenchless Technology
CTIA - The Wireless Association
NASTT - North American Society for Trenchless Technology
NCTA - National Cable & Telecommunications Association
NEMA - National Electrical Manufacturers Association
NSF - NSF International
NTIA - Broadband USA
PCCA - Power and Communication Contractors Association
SCTE - Society of Cable Telecommunications Engineers
TIA - Telecommunications Industry Association
TIC - Trenchless Information Center
UL - Underwriters Laboratories
ULC - Underwriters Laboratories of Canada
USTELCOM United States Telecom Association

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- Publications and industry news shared on LinkedIn

- Events are promoted through

- Educational videos or YouTube

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Summary

This presentation did:

1. Introduce PPI as a resource of knowledge for HDPE conduit
2. Present HDPE conduit products and explain their benefits
3. Discuss the applications addressed by HDPE conduit solutions
4. Illustrate several installation techniques used with HDPE conduit
5. List industry standards used for HDPE conduit
6. Share knowledge about relevant PPI publications and resources

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Path Forward

Contact PPI's Power & Communications Division at:

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Thank you!

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HDPE Conduit for Power and Communications