Piping Updates in CSA/ANSI/IGSHPA C448 Series:25
Projected Design Life of GHX Piping
ASHRAE 1890-RP

NY-GEO Webinar
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The Plastics Pipe Institute

PPI Represents the Plastic Pipe Industry www.plasticpipe.org

- PPI was formed in 1950 to research and develop test methods for plastic pressure pipes
- Today: Not-for-profit trade association serving North America, based in Irving, TX

PPI Mission

- Improving quality of life today, and for generations to come, by championing the advancement, acceptance, and use of sustainable and resilient plastic pipe systems

PPI Members

- ~200 member firms involved with the North American plastic pipe industry

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The Plastics Pipe Institute

PPI Building & Construction Division (BCD)

- BCD is focused on plastic pressure pipe and tubing systems used within buildings and on building premises for applications such as plumbing, water service, fire protection, hydronic heating & cooling, snow & ice melting, district energy heating & cooling, and **ground source heat pump piping systems**.

BCD Materials: CPVC, HDPE, PEX, PEX/AL/PEX, PE-RT, PE-RT/AL/PE-RT, and PP (PP-R & PP-RCT)

BCD homepage: plasticpipe.org/BuildingConstruction



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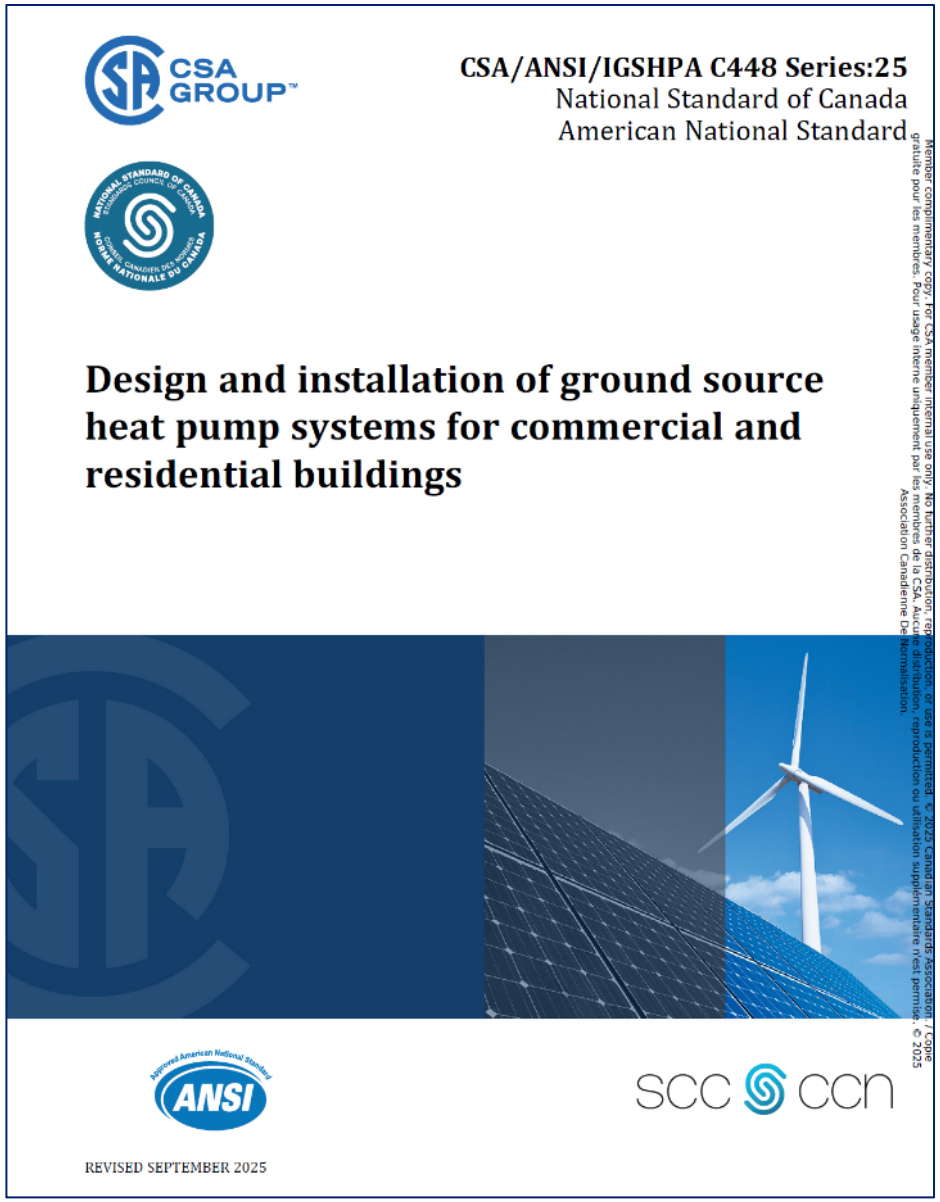
Course Introduction

- The original ANSI/CSA/IGSHPA C448 binational standard published in **2016**

- It was based on the Canada-only CSA C448 first published in 2002, reaffirmed in 2007, and revised in 2013

- **CSA/ANSI/IGSHPA C448 Series:25** published **May 30, 2025** following several years of intensive efforts by dozens of dedicated industry experts

- PPI members collaborated as the “Piping TF”



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Piping Highlights in C448-25

- New Definitions specific to GSHP systems

- Revised Section 5.4 *Underground and Underwater Piping* includes new materials and requirements for ground heat exchanger piping

- Revised Section 5.6 *Interior Piping, Fittings and Accessories* includes new materials and new requirements

- New Section 8.4 *Installation of Ground Heat Exchanger Pipe and Tubing* was added

- New Section 8.6 *Installation of Interior Piping Materials*

- New Section 9.1.2 *Hydrostatic Pressure Tests* for GHX pipes

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Section 5 Equipment, Materials, and Handling

“Pipe” vs. “Tubing”

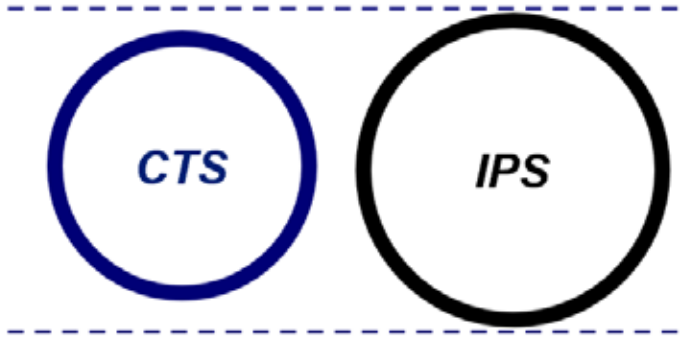
- Many piping materials (e.g., HDPE, PE-RT, and PEX) are available as “pipe” or “tubing”

- **Pipe** = same OD as iron or steel pipe of the same nominal designation (e.g., NPS 2, IPS 4)

- **Tubing** = same OD as copper tubing of the same nominal designation (e.g., NTS 3/4, CTS 1)

- **NPS/IPS** pipes are typically larger than **NTS/CTS** tubing

- **Example**: CTS/NTS 1 Tubing OD = 1.125” (28.6 mm)
  IPS/NPS 1 Pipe OD = 1.315” (33.4 mm)
  IPS/NPS 1 Pipe is **15% larger** than CTS 1 tubing



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Section 5 Equipment, Materials, and Handling

“Pipe” vs. “Tubing”

- Specifiers must clearly specify pipe or tubing dimensions using reference to standards

HDPE Pipe standards:

- ASTM D3035: IPS/NPS sizes ½ to 3
- ASTM F714: IPS/NPS sizes 4 to 65
- CSA B137.1: IPS/NPS sizes ½ to 65

HDPE Tubing standards:

- ASTM D2737: NTS sizes ½ to 2
- CSA B137.1: NTS sizes ¾ to 2

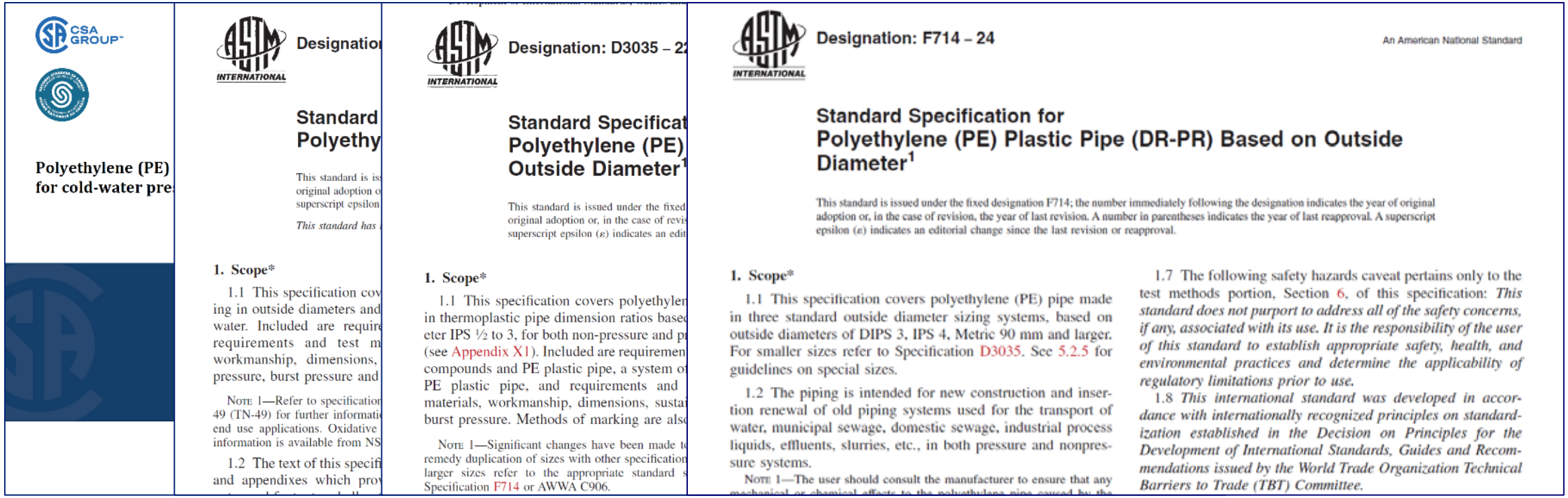


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Section 5 Equipment, Materials, and Handling

Listed Standards in C448-25 for HDPE pipe and tubing

- CSA B137.1, ASTM D2737, ASTM D3035, F714



CSA GROUP

Polyethylene (PE)
for cold-water pre

Designatio

Standard
Polyethy

This standard is iss
original adoption o
superscript epsilon

This standard has

1. Scope*

1.1 This specification cov
ing in outside diameters and
water. Included are require
requirements and test m
workmanship, dimensions,
pressure, burst pressure and

NOTE 1—Refer to specificatio
49 (TN-49) for further informati
end use applications. Oxidative
information is available from NS

1.2 The text of this specifi
and appendixes which prov

Designation: D3035 – 22

Standard Specificat
Polyethylene (PE)
Outside Diameter[1]

This standard is issued under the fixed
original adoption or, in the case of revis
superscript epsilon (ε) indicates an edit

1. Scope*

1.1 This specification covers polyethyler
in thermoplastic pipe dimension ratios based
eter IPS ½ to 3, for both non-pressure and pr
(see Appendix X1). Included are requiremen
compounds and PE plastic pipe, a system o
PE plastic pipe, and requirements and
materials, workmanship, dimensions, sustai
burst pressure. Methods of marking are also

NOTE 1—Significant changes have been made t
remedy duplication of sizes with other specification
larger sizes refer to the appropriate standard s
Specification F714 or AWWA C906.

Designation: F714 – 24

An American National Standard

Standard Specification for
Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside
Diameter[1]

This standard is issued under the fixed designation F714; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope*

1.1 This specification covers polyethylene (PE) pipe made in three standard outside diameter sizing systems, based on outside diameters of DIPS 3, IPS 4, Metric 90 mm and larger. For smaller sizes refer to Specification D3035. See 5.2.5 for guidelines on special sizes.

1.2 The piping is intended for new construction and insertion renewal of old piping systems used for the transport of water, municipal sewage, domestic sewage, industrial process liquids, effluents, slurries, etc., in both pressure and nonpressure systems.

NOTE 1—The user should consult the manufacturer to ensure that any

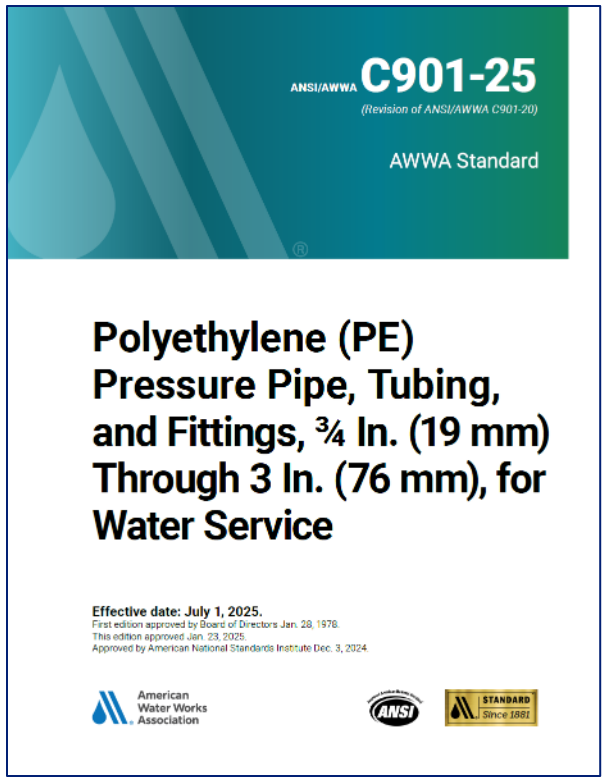
1.7 The following safety hazards caveat pertains only to the test methods portion, Section 6, of this specification: *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.8 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

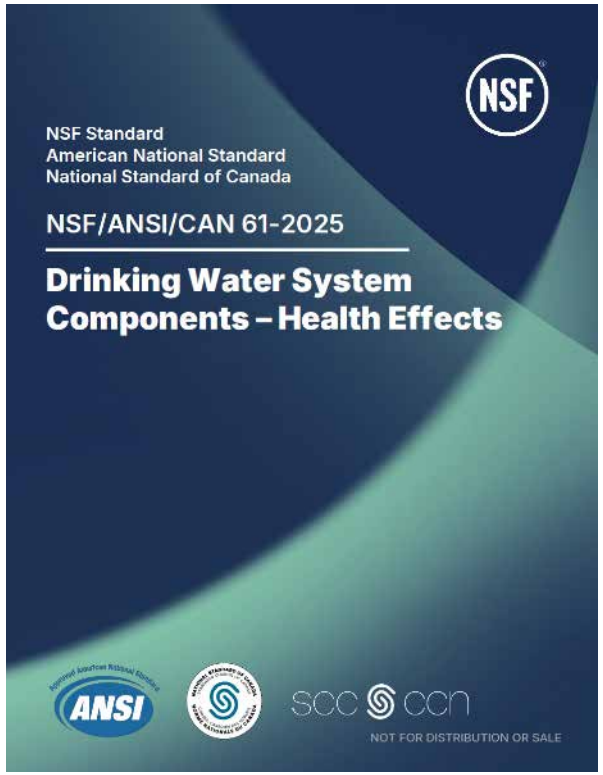
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Section 5 Equipment, Materials, and Handling

Other Standards for piping systems







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Section 5 Equipment, Materials, and Handling

Pipe Material Designation Codes: “PE3608” and “PE4710”

- Thermoplastic pipe material designation codes are defined in **ASTM F412**
- Specific properties make up the *PE Pipe Material Designation Code*
  - First digit: “the cell classification number value for density”
  - Second digit: “the cell classification number value for slow crack growth resistance”
  - Third & Fourth digits: “the hydrostatic design stress at 73°F, in units of 100 psi”

- **PE4710** is the new generation, state-of-the-art, Bimodal PE pressure pipe material with:
  - Much higher slow crack growth resistance (50 to 500+ times better)
  - Higher density/stiffness (compared with PE3408 and PE3608)
  - Higher hydrostatic design stress (1,000 psi vs. 800 psi) = Higher pressure ratings



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Section 8 Installation

2027 ICC International Mechanical Code (IMC) now allows HDPE in mechanical rooms (Table 1202.4)



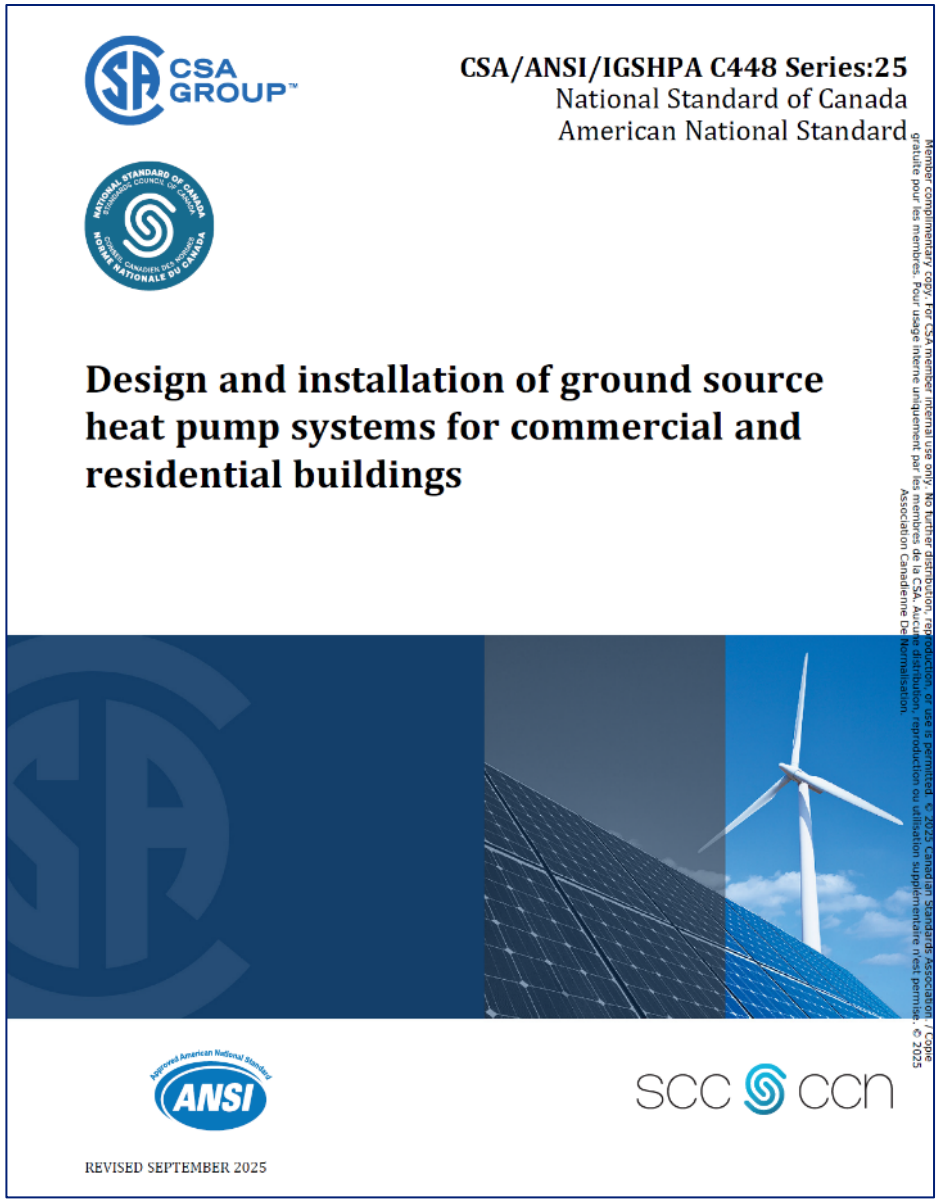
TABLE 1202.4—HYDRONIC PIPE

MATERIAL	STANDARD (see Chapter 15)
Acrylonitrile butadiene styrene (ABS) plastic pipe	ASTM F2806
Chlorinated polyvinyl chloride (CPVC) plastic pipe	ASTM D2846; ASTM F441; ASTM F442
Chlorinated polyvinyl chloride/aluminum/chlorinated polyvinyl chloride (CPVC/AL/CPVC)	ASTM F2855
Copper or copper-alloy pipe	ASTM B42; ASTM B43; ASTM B302
Copper or copper-alloy tube (Type K, L or M)	ASTM B75; ASTM B88; ASTM B135; ASTM B251
Cross-linked polyethylene/aluminum/cross-linked polyethylene (PEX-AL-PEX) pressure pipe	ASTM F1281; CSA B137.10
Cross-linked polyethylene (PEX) tubing	ASTM F876; ASTM F3253; CSA B137.5
Ductile iron pipe	AWWA C115/A21.15; AWWA C151/A21.51
High-density polyethylene (HDPE) pipe	ASTM D2737; ASTM D3035; ASTM F714; ASTM F2165; AWWA C901; CSA B137.1
Polyethylene/aluminum/polyethylene (PE-AL-PE) pressure pipe	ASTM F1282; CSA B137.9

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Summary

- **CSA/ANSI/IGSHPA C448 Series:25** is the state-of-the-art Bi-national code for GSHP system design and installation
- Piping content includes latest materials and specifications
- Installation & testing practices based on years of experience
- Thanks to CSA Group for allowing the use of their content
- Get your own copy at:
- https://www.csagroup.org/store/csa-learning/all-gshp-programs/
- These slides cannot be shared due to copyright rules

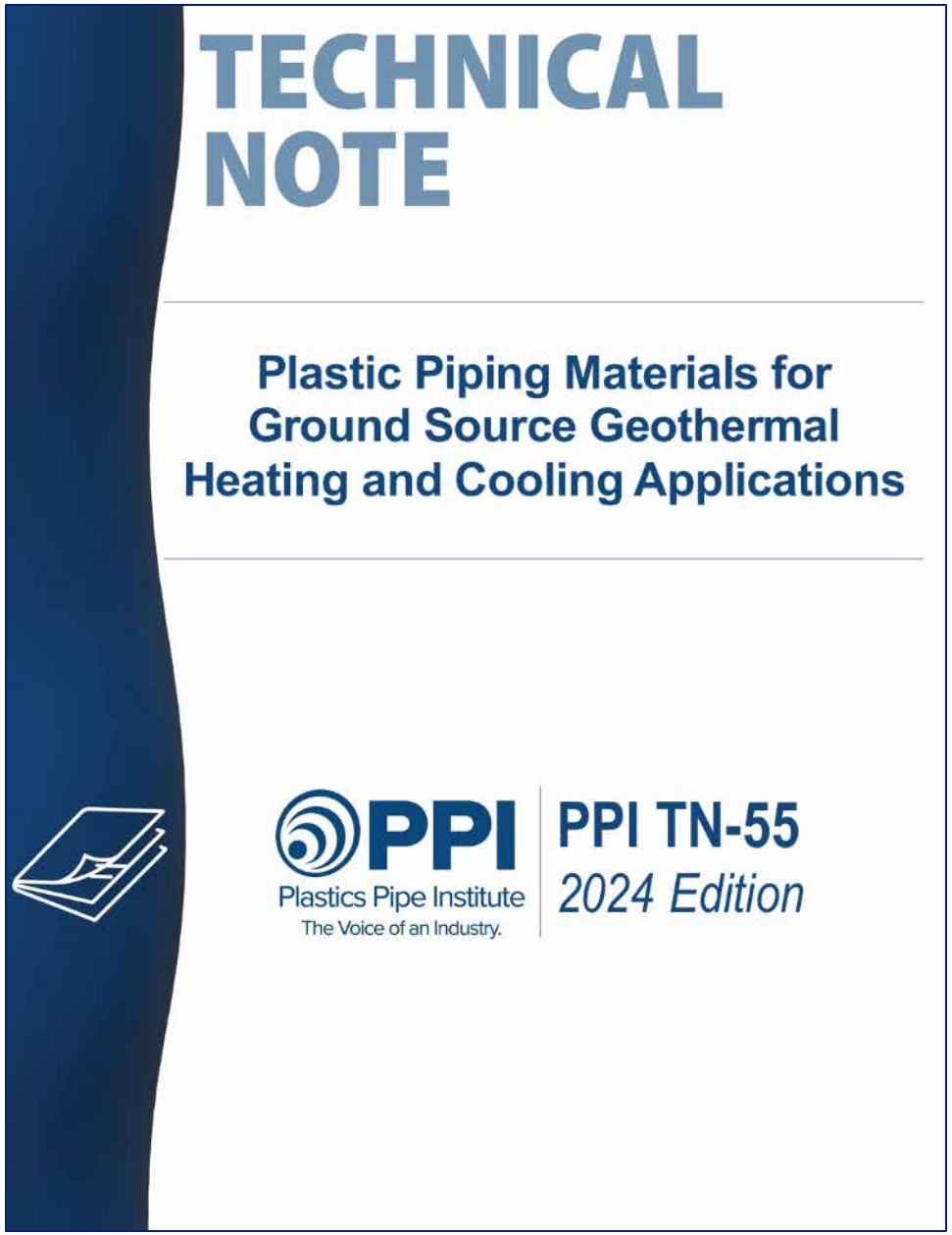


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PPI Resources

PPI Geo Publications – PPI TN-55

- Go to plasticpipe.org/bcd

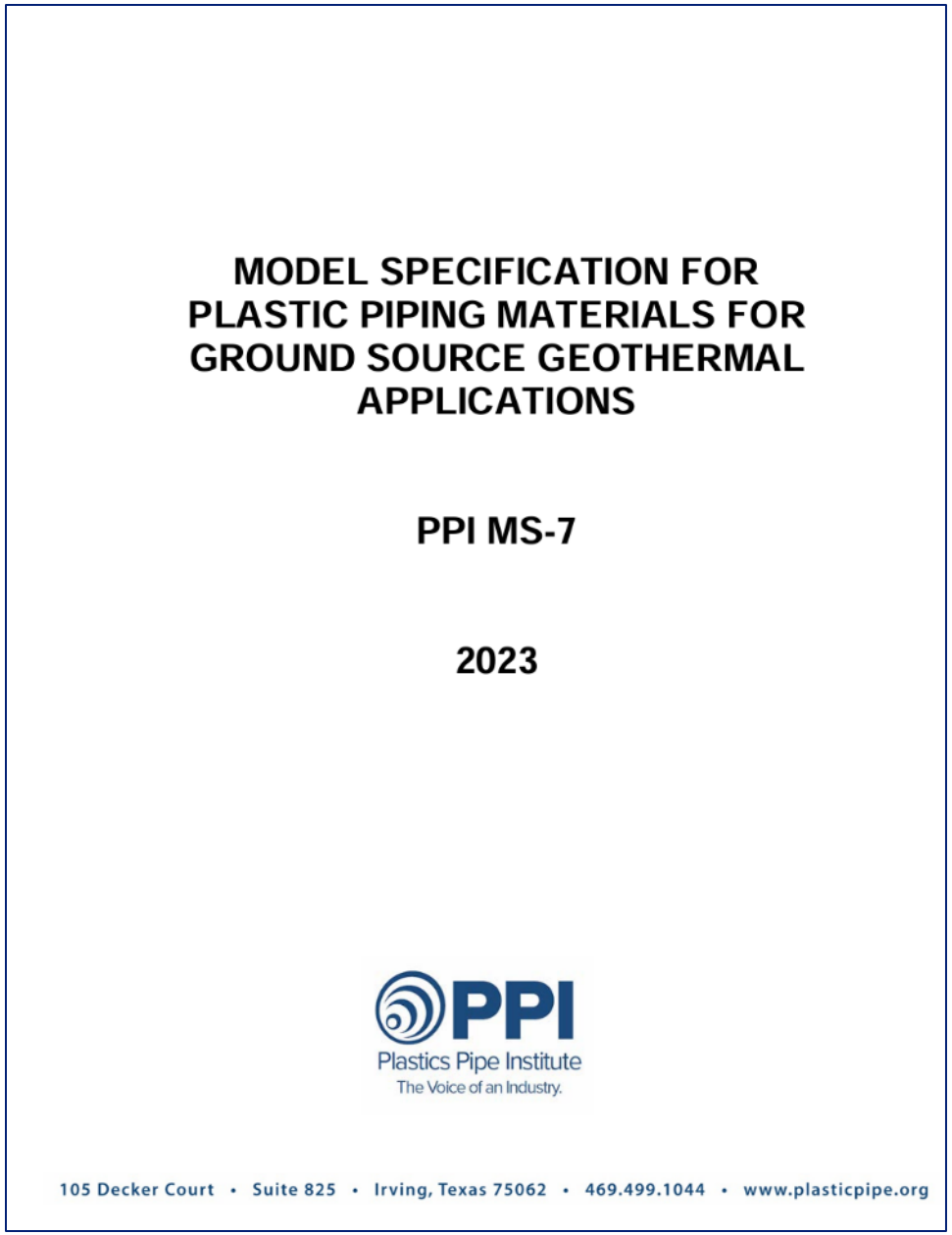


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PPI Resources

PPI Geo Publications – PPI MS-7

- Go to plasticpipe.org/bcd
- New version coming in 2027



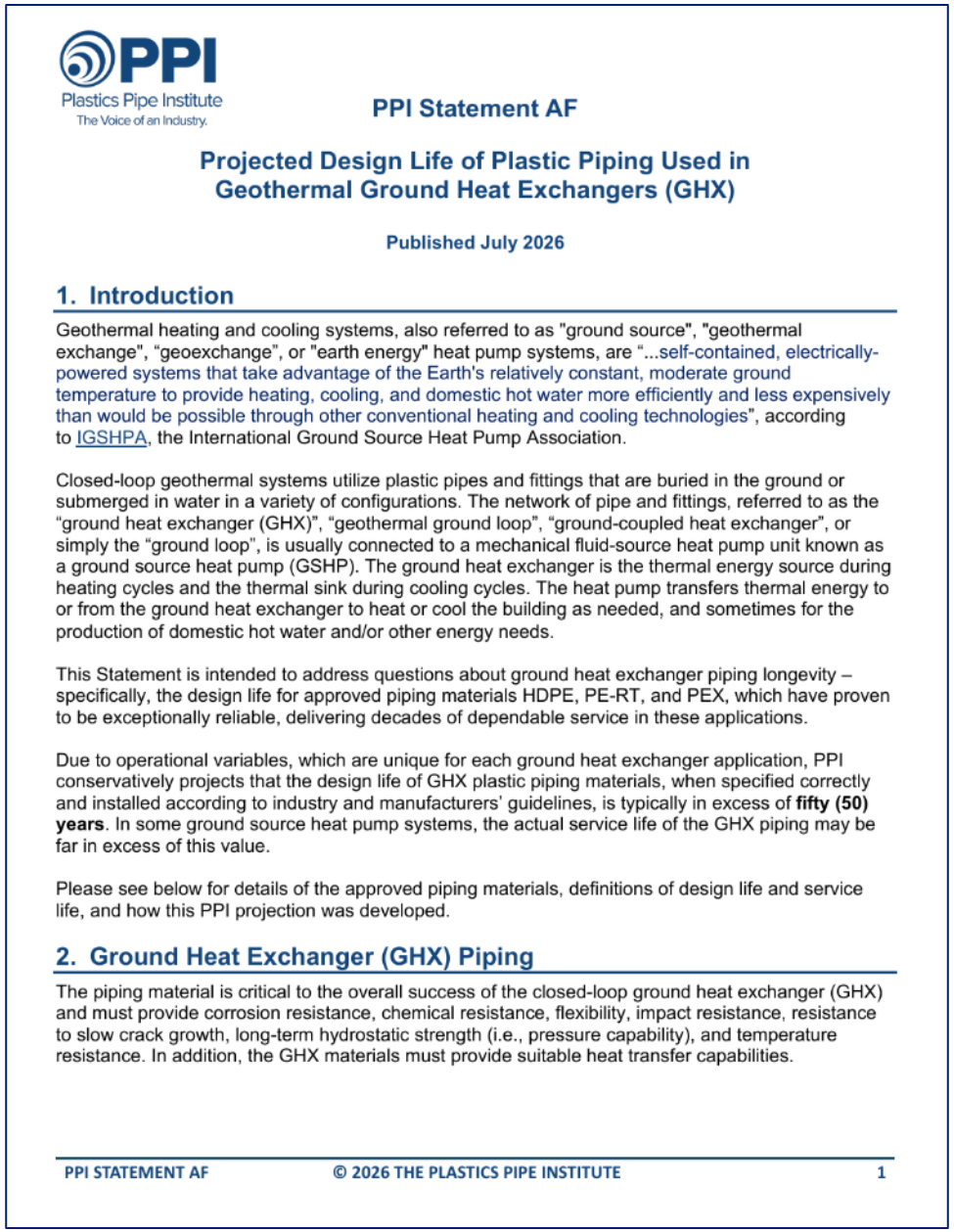
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PPI Resources

PPI Geo Publications – PPI Statement AF

- Go to plasticpipe.org/bcd

“Due to operational variables, which are unique for each ground heat exchanger application, PPI conservatively projects that the design life of GHX plastic piping materials, when specified correctly and installed according to industry and manufacturers’ guidelines, is typically **in excess of fifty (50) years**. In some ground source heat pump systems, the actual service life of the GHX piping may be far in excess of this value.”



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The Voice of an Industry.

PPI Statement AF

Projected Design Life of Plastic Piping Used in Geothermal Ground Heat Exchangers (GHX)

Published July 2026

1. Introduction

Geothermal heating and cooling systems, also referred to as "ground source", "geothermal exchange", “geoexchange”, or "earth energy" heat pump systems, are “...self-contained, electrically-powered systems that take advantage of the Earth's relatively constant, moderate ground temperature to provide heating, cooling, and domestic hot water more efficiently and less expensively than would be possible through other conventional heating and cooling technologies”, according to IGSHPA, the International Ground Source Heat Pump Association.

Closed-loop geothermal systems utilize plastic pipes and fittings that are buried in the ground or submerged in water in a variety of configurations. The network of pipe and fittings, referred to as the “ground heat exchanger (GHX)”, “geothermal ground loop”, “ground-coupled heat exchanger”, or simply the “ground loop”, is usually connected to a mechanical fluid-source heat pump unit known as a ground source heat pump (GSHP). The ground heat exchanger is the thermal energy source during heating cycles and the thermal sink during cooling cycles. The heat pump transfers thermal energy to or from the ground heat exchanger to heat or cool the building as needed, and sometimes for the production of domestic hot water and/or other energy needs.

This Statement is intended to address questions about ground heat exchanger piping longevity – specifically, the design life for approved piping materials HDPE, PE-RT, and PEX, which have proven to be exceptionally reliable, delivering decades of dependable service in these applications.

Due to operational variables, which are unique for each ground heat exchanger application, PPI conservatively projects that the design life of GHX plastic piping materials, when specified correctly and installed according to industry and manufacturers' guidelines, is typically in excess of **fifty (50) years**. In some ground source heat pump systems, the actual service life of the GHX piping may be far in excess of this value.

Please see below for details of the approved piping materials, definitions of design life and service life, and how this PPI projection was developed.

2. Ground Heat Exchanger (GHX) Piping

The piping material is critical to the overall success of the closed-loop ground heat exchanger (GHX) and must provide corrosion resistance, chemical resistance, flexibility, impact resistance, resistance to slow crack growth, long-term hydrostatic strength (i.e., pressure capability), and temperature resistance. In addition, the GHX materials must provide suitable heat transfer capabilities.

PPI STATEMENT AF © 2026 THE PLASTICS PIPE INSTITUTE 1

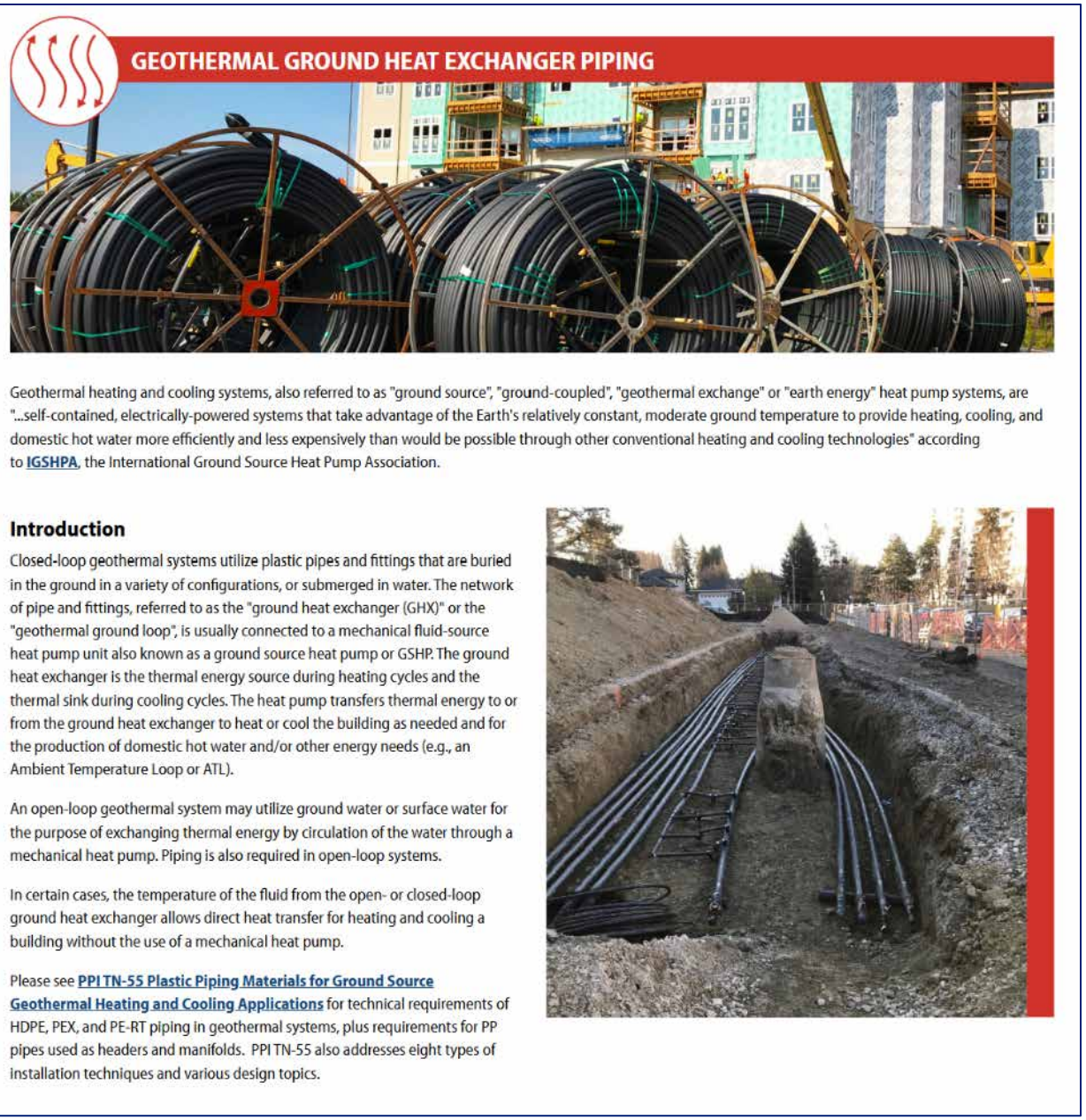
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PPI Resources

PPI Geo Webpage

- Go to plasticpipe.org/bcd

- Info on piping materials
- Links to PPI documents
- Case studies
- Industry associations
- Codes and standards
- Training resources (e.g., CSA/IGSHPA)
- Research reports
- Geo in the Media
- Energy calculation tools



GEOTHERMAL GROUND HEAT EXCHANGER PIPING

Geothermal heating and cooling systems, also referred to as "ground source", "ground-coupled", "geothermal exchange" or "earth energy" heat pump systems, are "...self-contained, electrically-powered systems that take advantage of the Earth's relatively constant, moderate ground temperature to provide heating, cooling, and domestic hot water more efficiently and less expensively than would be possible through other conventional heating and cooling technologies" according to IGSHPA, the International Ground Source Heat Pump Association.

Introduction

Closed-loop geothermal systems utilize plastic pipes and fittings that are buried in the ground in a variety of configurations, or submerged in water. The network of pipe and fittings, referred to as the "ground heat exchanger (GHX)" or the "geothermal ground loop", is usually connected to a mechanical fluid-source heat pump unit also known as a ground source heat pump or GSHP. The ground heat exchanger is the thermal energy source during heating cycles and the thermal sink during cooling cycles. The heat pump transfers thermal energy to or from the ground heat exchanger to heat or cool the building as needed and for the production of domestic hot water and/or other energy needs (e.g., an Ambient Temperature Loop or ATL).

An open-loop geothermal system may utilize ground water or surface water for the purpose of exchanging thermal energy by circulation of the water through a mechanical heat pump. Piping is also required in open-loop systems.

In certain cases, the temperature of the fluid from the open- or closed-loop ground heat exchanger allows direct heat transfer for heating and cooling a building without the use of a mechanical heat pump.

Please see PPI TN-55 Plastic Piping Materials for Ground Source Geothermal Heating and Cooling Applications for technical requirements of HDPE, PEX, and PE-RT piping in geothermal systems, plus requirements for PP pipes used as headers and manifolds. PPI TN-55 also addresses eight types of installation techniques and various design topics.

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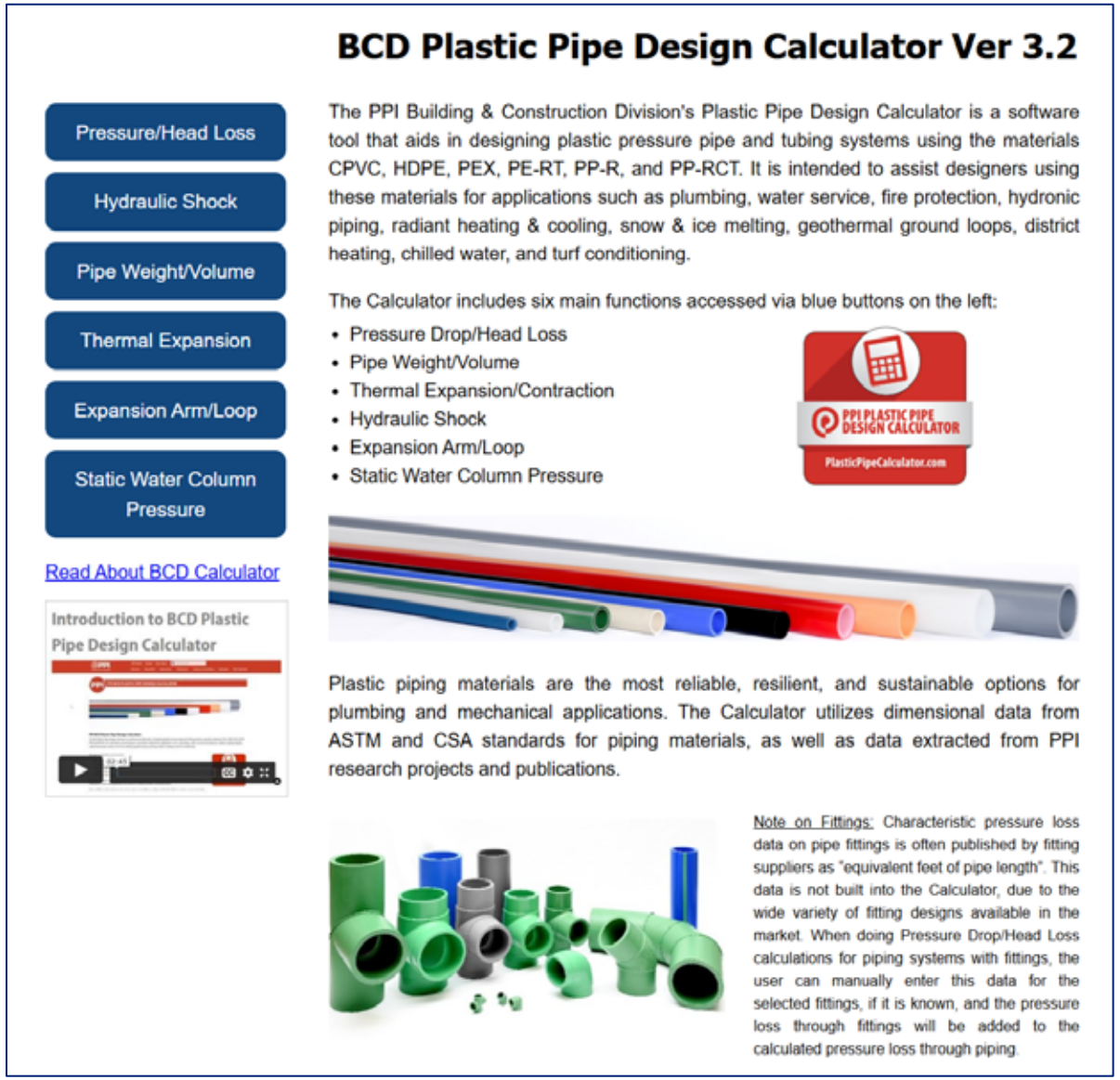
PPI Resources

PPI BCD Plastic Pipe Design Calculator

- Go to www.plasticpipecalculator.com

- Six types of design calculations/functions (blue buttons)

- Includes all GHX piping materials and fluid types used in GSHP systems



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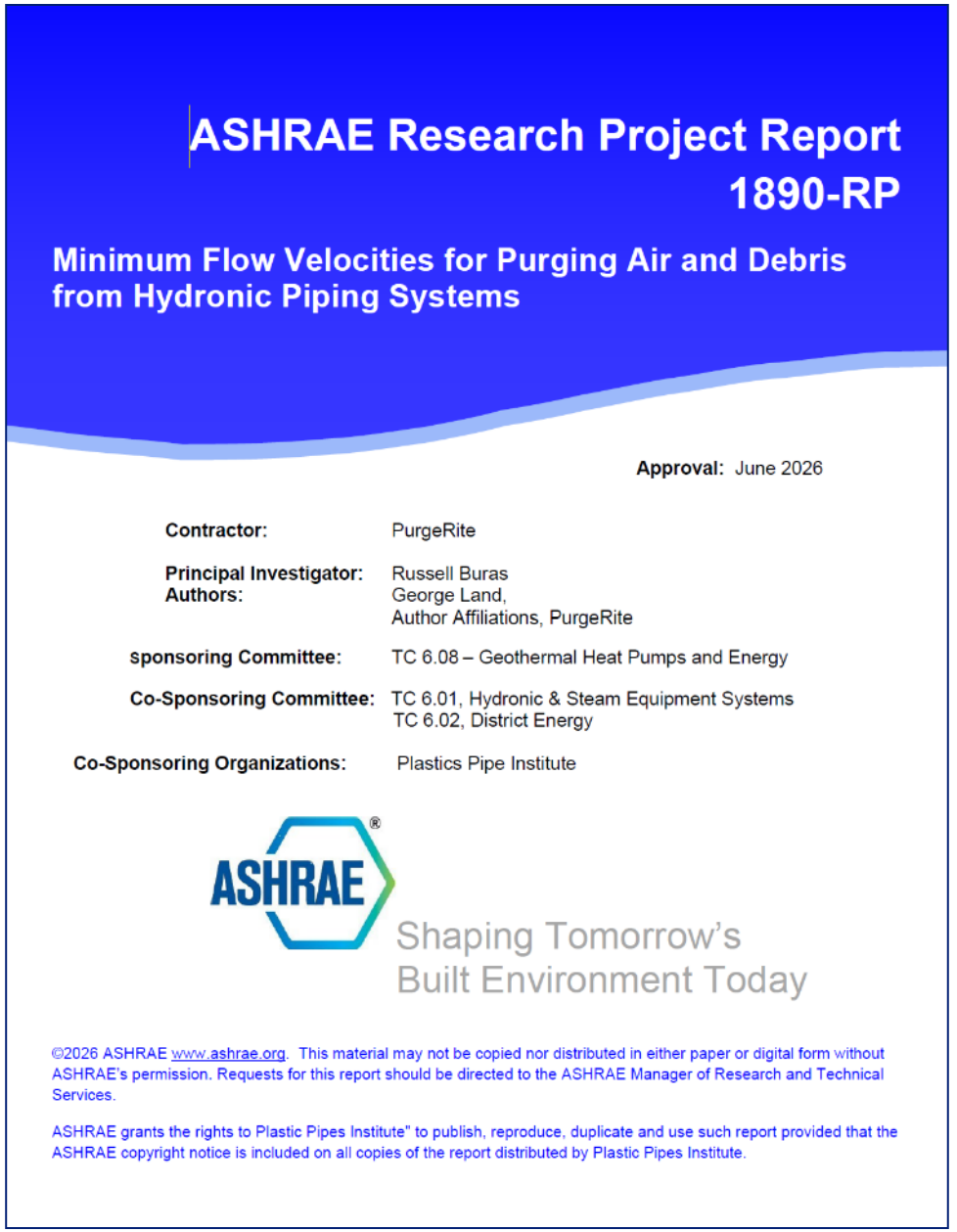
Other Resources

ASHRAE 1890-RP

- This ASHRAE-sponsored study quantifies the flow velocity required to remove air and representative debris from commercial hydronic piping systems, including common piping materials, fittings, and configurations seen in the industry

- PPI was a sponsor of this research

- **Final Report** is available to the public for **$30**
- https://technologyportal.ashrae.org/Report



ASHRAE Research Project Report 1890-RP

Minimum Flow Velocities for Purging Air and Debris from Hydronic Piping Systems

Approval: June 2026

Contractor: PurgeRite

Principal Investigator: Russell Buras
Authors: George Land,
Author Affiliations, PurgeRite

sponsoring Committee: TC 6.08 – Geothermal Heat Pumps and Energy

Co-Sponsoring Committee: TC 6.01, Hydronic & Steam Equipment Systems
TC 6.02, District Energy

Co-Sponsoring Organizations: Plastics Pipe Institute

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Closing

Thank you for opportunity to share info on:

- CSA/ANSI/IGSHPA C448 Series:25

- PPI publications and resources, including the new **PPI Statement AF**

- **ASHRAE 1890-RP** research report



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