Preview of C448 Bi-national Standard: Updated & Expanded

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CSA / ANSI / IGSHPA C448 2024 New Edition – Overview & Highlights

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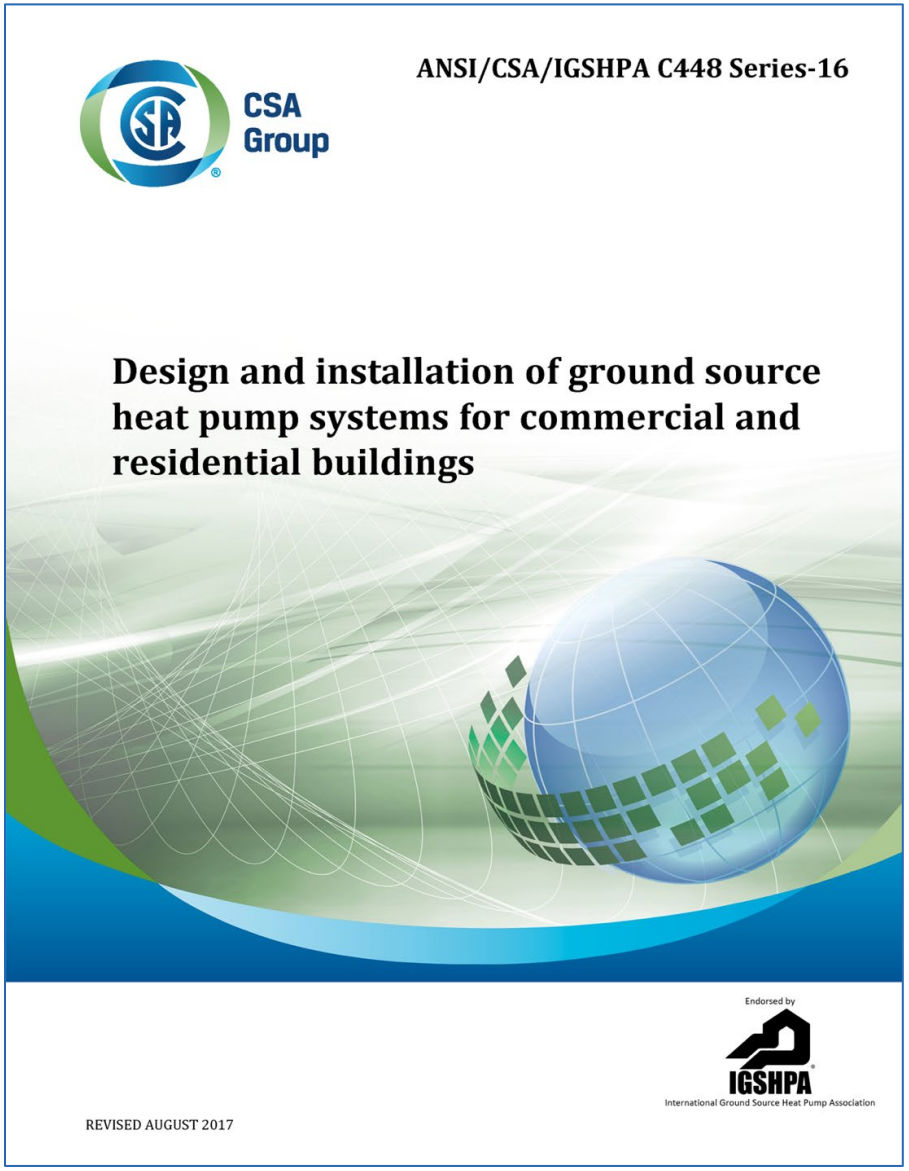
Brief Overview & History



Codes and Standards

What's the Difference?

Code: A code is a set of regulations, rules, and guidelines established by a recognized authority or government agency. Codes define minimum requirements and are legally enforceable and compliance with them is mandatory, and failure to adhere to the code may result in penalties or restrictions.

Standard: A standard is a document or specification developed by a recognized standard-setting organization. Standards are voluntary guidelines that establish a consistent and accepted approach to processes, products, services, or systems. Unlike codes, compliance with standards are not legally mandated, but adherence to standards is often seen as a mark of quality, safety, and best practices.

Codes and Standards

What's the Difference?

However ……

A standard *can* become code if a code body such as the International Association of Plumbing and Mechanical Officials (IAPMO) or International Code Council (ICC) adopts a standard into their codes.

Agenda

- Feedback from Industry on 2016 Standard
- Standard Outline for 2024
- General Applications Section Outline
- Notable Changes
- Additions
- Next Steps

Feedback from Industry on 2016 Standard

- Review of the 2016 Standard was undertaken by the IGSHPA Standards Committee in 2019. Comments were provided to all task force members for consideration at the beginning of the new standard development cycle which began in June 2021.
- Recommendations included moving away from the 2016 format which was meant to be standalone by heat exchanger type to a more concise standard which eliminated a lot of the redundancy by addressing common requirements in the General Applications Section.
- In addition to recommended edits for each section of the standard, there were specific recommendations to review and update:

  - In situ (formation) thermal conductivity test
  - Piping materials
  - Heat transfer fluids for GSHP systems
  - Hydrostatic pressure testing

Standard Outline for 2024

The ANSI/CSA/IGSHPA C448 Series now consists of the following parts:

- ANSI/CSA/IGSHPA C448.0, Design and installation of ground source heat pump systems — General applications for all systems;
- ANSI/CSA/IGSHPA C448.1, Design and installation of ground source heat pump systems for residential and other small buildings;
- ANSI/CSA/IGSHPA C448.2, Design and installation of ground source heat pump systems for commercial and institutional buildings;
- **ANSI/CSA/IGSHPA C448.3, *Planning*, design, installation and commissioning of district energy systems**;
- ANSI/CSA/IGSHPA C448.4, Installation of vertical configured closed-loop ground source heat pump systems;

Standard Outline for 2024 Continued

- ANSI/CSA/IGSHPA C448.5, Installation of horizontal configured closed-loop ground source heat pump systems;
- ANSI/CSA/IGSHPA C448.6, Design and installation of surface water heat pump systems;
- ANSI/CSA/IGSHPA C448.7, Design and installation of groundwater systems;
- ANSI/CSA/IGSHPA C448.8, Installation of standing column well heat pump systems;
- **ANSI/CSA/IGSHPA C448.9, Design and installation of ground source heat pump systems connected to energy foundations; and**
- ANSI/CSA/IGSHPA C448.10, Installation of direct exchange heat pump systems.

Informative Annexes for 2024

A. Electrical, environmental, and other guidelines for ground source heat pumps and underground thermal energy storage (UTES) systems
B. Installation checklist for open- and closed-loop ground source heat pump systems
C. Site Survey/As-built Worksheet
D. Annual energy requirements based on modified ASHRAE bin hour method
E. Wastewater Energy Transfer Systems Design and Installation
F. Bibliography

General Applications Section Outline

The **General Applications** section of this Standard covers minimum requirements for equipment and material selection, site survey, system design, installation, testing and verification, documentation, and commissioning and decommissioning.

- **Clause 1 – Scope**
- **Clause 2 – Reference publications**
- **Clause 3 – Definitions**
- **Clause 4 – General**
- **Clause 5 – Equipment, Materials, and Handling**
- Clause 6 – Site Survey Requirements
- Clause 7 – Design
- Clause 8 – Installation
- Clause 9 – System testing, verification, and delivery
- Clause 10 –Decommissioning and abandonment

Notable Changes:

Definitions

Clarifications and clean-up of **C448.0 Clause 3 Definitions**, for example:

- Designer – the entity legally responsibility for the ground-source heat pump system design.
- Ground heat exchanger - a variety of heat exchangers, external or below a building, that use the ground, groundwater, wastewater, or surface water as a heat source and sink.

  Note: *Ground heat exchangers include vertical loop ground heat exchangers, horizontal loop ground heat exchangers, submerged heat exchangers, and groundwater heat exchangers*
- Ground-source heat pump systems – a variety of systems that use the ground, groundwater, or surfaces of water as a heat source and sink. The general terms include ground-coupled heat pump (GCHP), groundwater heat pump (GWHP), and surface water heater pump (SWHP).

Notable Changes:

Setbacks

4.5 Setbacks

4.5.1 General

The placement of infrastructure on any project site supporting a ground heat exchanger shall be the responsibility of the designer. The designer shall review and assess impacts of the ground heat exchanger with respect to

a) property lines and easements;

b) encroachment to adjacent properties;

c) foreshore requirements of the local authority having jurisdiction for ocean, lake, pond, or river/ stream applications;

d) lateral and vertical location in proximity to any unpressurized (gravity flow) sewer lines into or from a building;

e) lateral and vertical location in proximity to any pressurized (pumped) sewer lines into or from a building;

f) distance from septic tanks and/or subsurface sewage leaching fields;

g) lateral and vertical location from any other buried utilities such as electrical, gas, or water;

h) lateral and vertical location from any building and infrastructure, including deep infrastructure such as tunnels, mines, subways, and adjacent ground source heat exchangers;

i) distance from a water well;

j) lateral distance from a fresh water spring;

k) for vertical ground heat exchangers beneath a building or parking garage clearances shall be defined by the local authority having jurisdiction and the structural engineer providing foundation calculations for the building permit; and

l) other environmental setbacks including dripline of trees.

Notable Changes:

Piping materials

5.4 Underground and underwater piping systems requirements

5.4.1 General requirements

5.4.1.1 Piping materials

Acceptable plastic pipe and fitting materials for the underground or underwater portion of a ground heat exchanger (i.e., the ground loop) include PE, PE-RT, and PEX, as specified in this Standard.

Note: *This Clause includes minimum performance requirements for flexible polyolefin piping systems, such as high-density PE, PE-RT, and PEX, and also for DX piping systems. The requirements specified in Clauses 5.4.2, a) or 5.4.4 are provided to ensure the necessary performance criteria for underground and underwater piping systems (such as corrosion resistance, chemical resistance, flexibility, impact resistance, hydrostatic pressure capability, and temperature resistance) are met.*

Note: CPVC/PVC is no longer listed as an acceptable piping material for field headers, manifolds, and indoor piping associated with GSHP systems.

Notable Changes:

Horizontal piping locations

Updated **C448.0 Clauses 7.4.3 Horizontal piping location** and **8.5.2.3** Locating and marking buried pipes.

7.4.3.1 General locating and marking requirements

All buried horizontal piping shall include a non-destructive system for location purposes and permanent, conspicuous, and non-biodegradable warning marking. The system shall meet the requirements of the authority having jurisdiction. See Clause 8.5.2.3 for installation requirements.

Note: *Non-destructive systems for location purposes can include tracer wire, detectable tape, or radio frequency or other detectable markers.*

Notable Changes:

Heat Transfer Fluids

C448.0 Clause 5.7

5.7.1 System preparation

5.7.1.1 General

5.7.1.2 System cleaning process

5.7.1.3 System disinfection process

5.7.2 Water quality requirements

5.7.2.1 Water analysis

5.7.2.1.2 Water quality specification

5.7.2.2 Corrosion inhibitors

5.7.2.3 Scale inhibitors

5.7.3 Heat transfer fluids with anti-freeze

5.7.3.1 General

5.7.3.2 Acceptable fluids

5.7.3.3 Flammable heat transfer fluids

5.7.3.4 Chemical inhibitors

5.7.3.5 Properties of anti-freeze fluids

Notable Changes:

Heat Transfer Fluids

Properties of common commercial heat transfer fluids

(See Clause 5.7.3.5.)

Property	Water	Propylene glycol	Ethylene glycol	Methanol	Ethanol	Glycerin
Efficiency	Very good	Fair	Very good	Very good	Good	Good
Corrosion protection	None	Very good	Very good	Fair	Fair	Very good
Freeze Protection	None	Very good	Very good	Very good	Very good	Very good
BOD/COD	None	Fair	Good	Good	Good	Good
Flammable	No	No	No	Yes	Yes	No
Toxic	No	No	Yes	Yes	No	No

Notable Changes:

Pressure Testing

C448.0 Clause 9.1.1 Flushing and purging of complete systems.

C448.0 Clause 9.1.2 Hydrostatic pressure tests.

- Individual borehole u-bend assembly short term test (optional)
- Ground heat exchanger hydrostatic pressure testing

<u>Changes to note</u>:

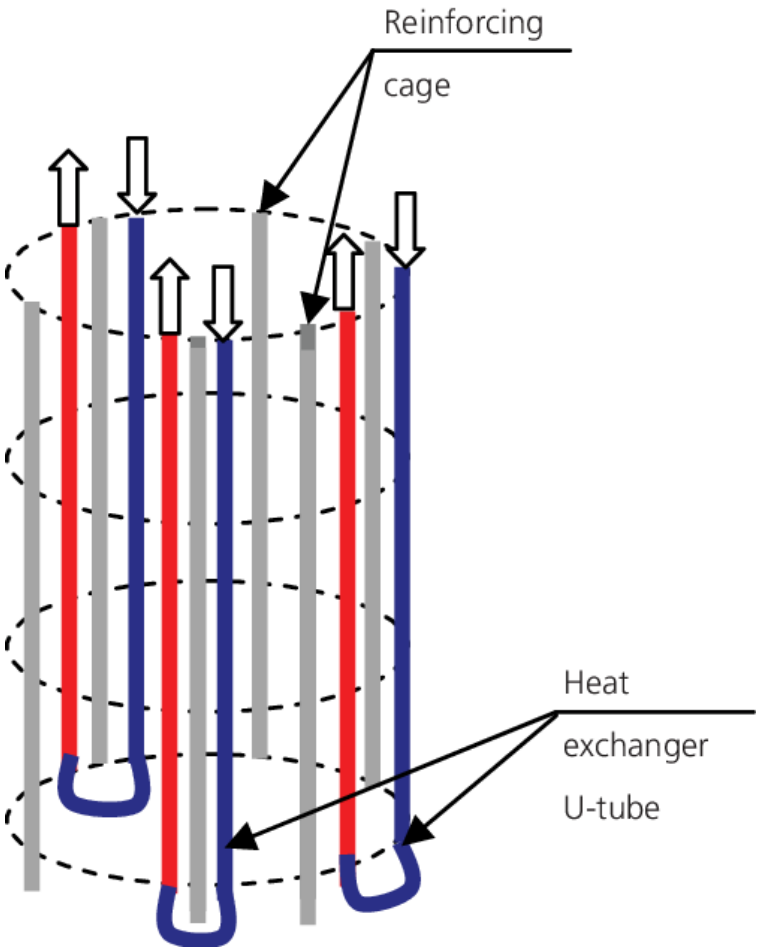
Pressure test requirements are based on ASTM F2164 but adapted to this Standard specifically for ground heat exchangers.

Test includes an initial expansion phase, a *stabilization phase* and then the pressure is set to the test pressure (established by the designer) and a 60-minute test is conducted. A passing test in indicated if no visual leak is observed and the test pressure does not reduce by more than 5% during the 60-minute test.

Additions:

Energy Foundations

New standard C448.9: **Design and Installation of ground source heat pump systems connected to energy foundations.**



Additions:

District Energy Systems

ANSI/CSA/IGSHPA C448.3, Planning, design, installation, and commissioning of district energy systems

- District energy systems definition
- Inclusions
- Exclusions

Image from Interreg North-West Europe4DHC technology guide

A slight deviation from the standard format:

- 0 Introduction
- 1 Scope
- 2 Reference publications
- 3 Definitions
- 4 Project Planning
  - Master planning
  - Pre-planning
  - Site Survey
  - Geothermal suitability assessment
  - Preliminary concept plan
  - Confirmatory investigations
  - Refined concept plan
  - Detailed engineering design
- 5 Equipment and materials
- 6 Design of district energy systems
- 7 Installation of systems
- 8 System start-up
- 9 System commissioning
- 10 Decommissioning and abandonment

Distribution piping materials

MATERIAL	PIPING	FITTINGS
Copper/copper alloy	ASTM B88	ASME B16.22, ASME B16.18
Ductile iron	ANSI/AWWA C151/A21.51	AWWA C153/A21.53
Cement-mortar lining for ductile-iron pipe and fittings	AWWA C104/A21.4	
PEX	ASTM F876, ASTM F2788, CSA B137.5, NSF 358-3	ASTM F877, ASTM F1055, ASTM F1807, ASTM F1960, ASTM F2080, ASTM F3347, ASTM F3348, CSA B137.5, NSF 358-3
Steel	ASTM A53/A53M, ASTM A106/A106M, AWWA C200.	ASME B16.5, ASME B16.9, ASTM A420/A420M, ANSI/AWWA C208
PE	ASTM D3035, ASTM F714, AWWA C906, CSA B137.1, NSF/ANSI 358-1	ASTM D2683, ASTM D3261, ASTM F2206, ASTM F1055
PE-RT	ASTM D3035, ASTM F714, ASTM F2623, ASTM F2769, CSA B137.18, NSF 358-4	ASTM D2683, ASTM D3261, ASTM F1055, ASTM F2206, ASTM F1807, ASTM F1960, ASTM F2769, ASTM F3347, ASTM F3348, CSA B137.18, NSF 358-4
PP-R and PP-RCT	ASTM F2389, CSA B137.11	ASTM F2389, CSA B137.11
Prestressed concrete cylinder pipe	AWWA C301, AWWA C304	AWWA C301
FRP	ASTM D2996, ASTM D2997, ASTM D3517, AWWA C950	ASTM D5685

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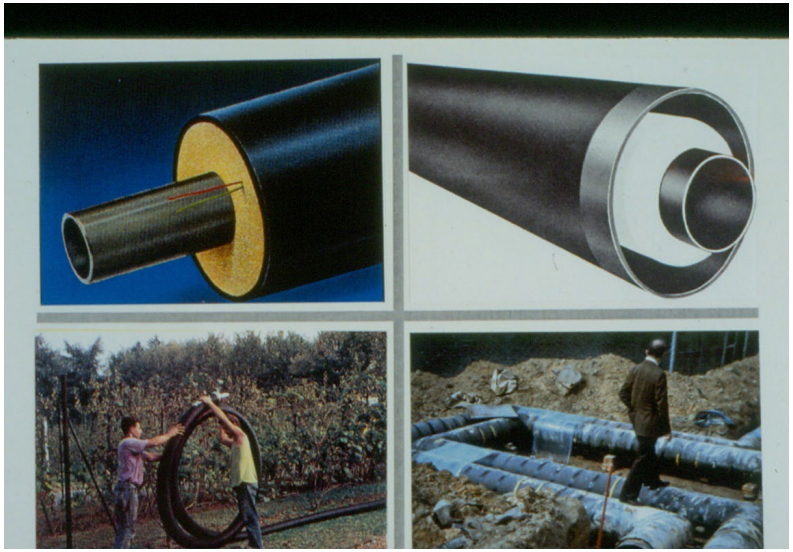
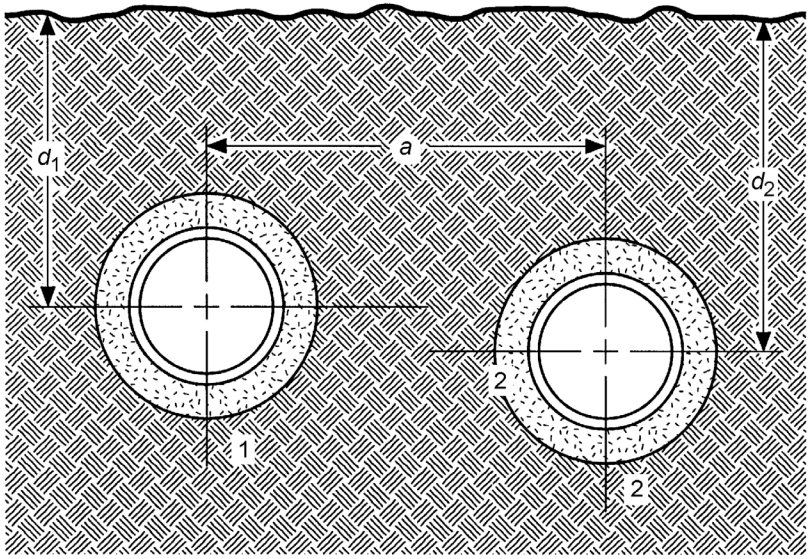
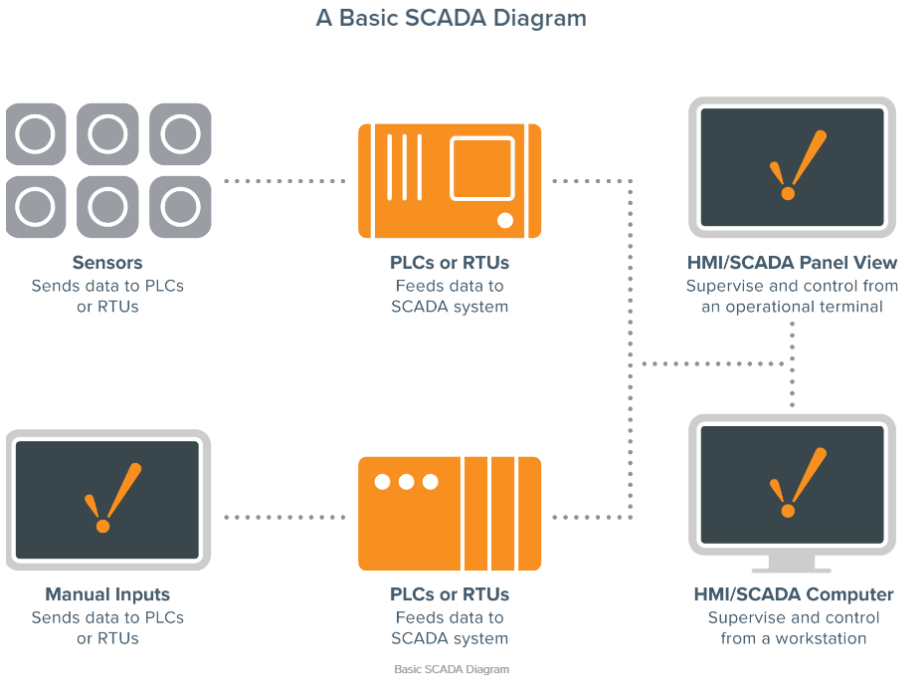
Insulated piping and pre-insulated piping





Nomenclature for two buried pipes, Fig. 4.11, DCG; Fig. 6.6, DHG; Fig. 10, Ch. 12, 2020 ASHRAE Handbook

Energy Transfer Stations, Communications, and Storage



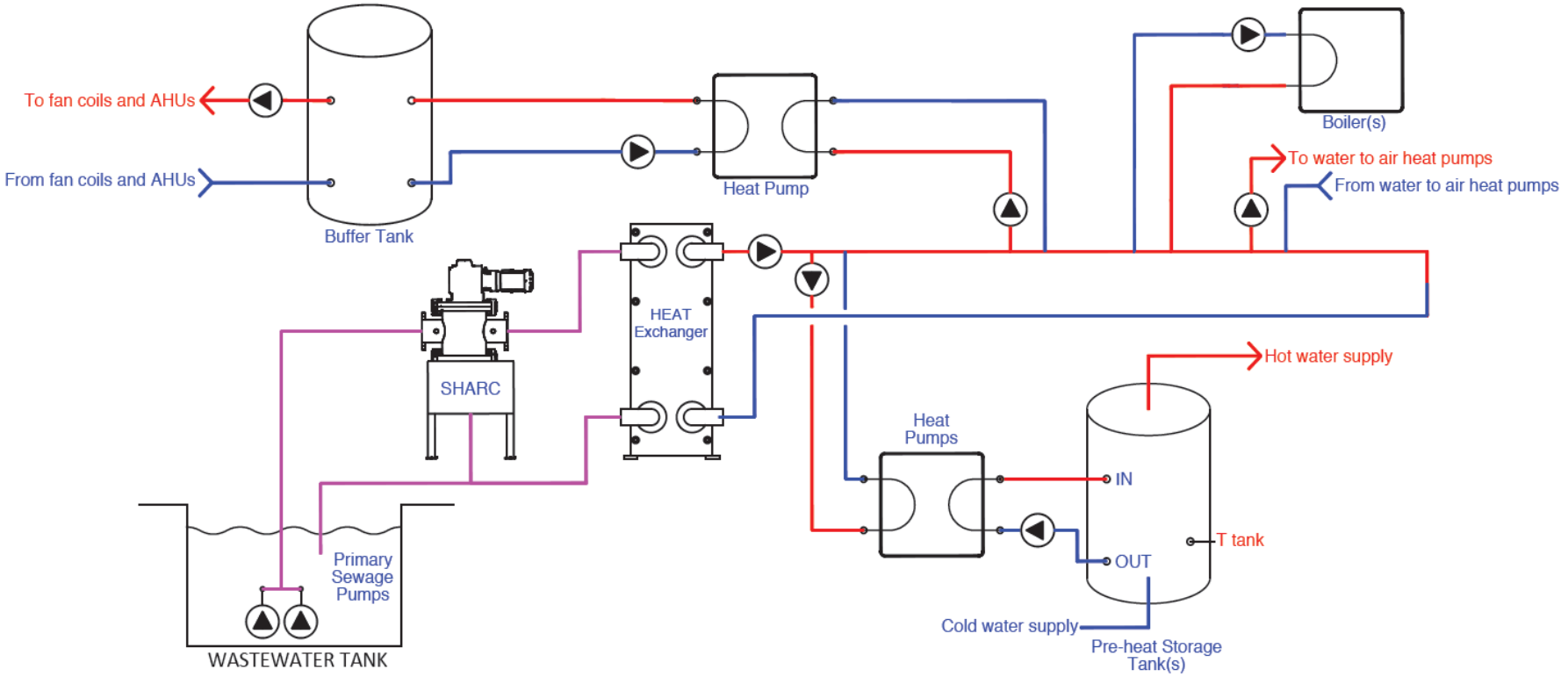
Additions:

Annex E

ANSI/CSA/IGSHPA C448 – Annex E

Wastewater energy transfer systems design and installation

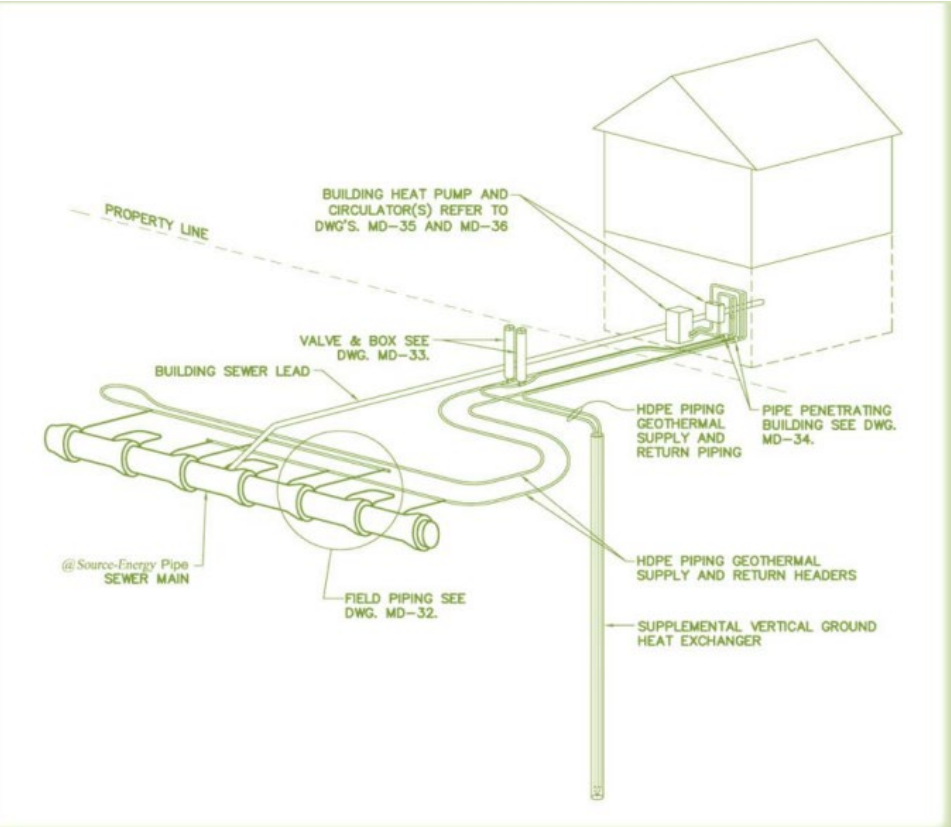
Pumped heat exchangers



Courtesy of SHARC Energy Systems

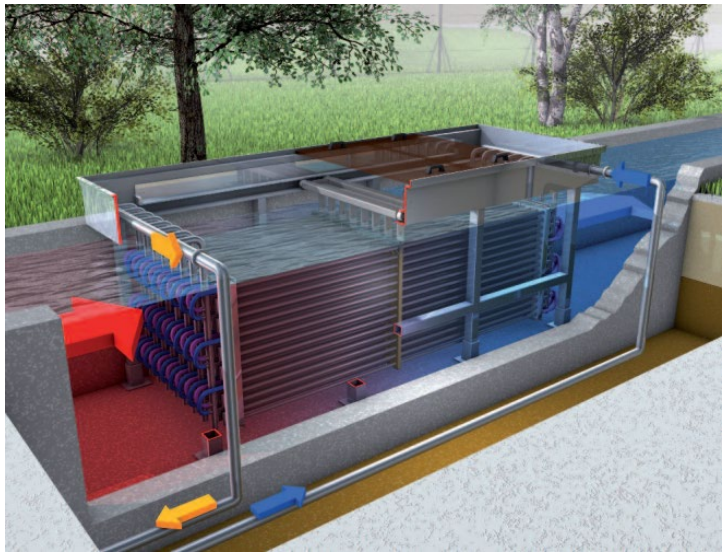
ANSI/CSA/IGSHPA C448 – Annex E

In-pipe or in-trench energy exchangers



Courtesy of Renewable Resource Recovery, Corp.

In-tank/channel heat exchangers



Courtesy of Huber Technology Wastewater Solutions

Final notes on Annex E

- Inclusions
- Exclusions
- Reference: German Association for Water Management, Wastewater, and Waste: DWA Set of Rules, Leaflet DWA-M 114, April 2020.

Next Steps

- Public review ended August 6, 2024
- Editing by CSA staff – ongoing
- Approval ballot by CSA C423 Technical Committee on Ground and Water Source Heat Pumps
- Final production/editing by CSA Staff
- Targeted release date: December 2024

Conclusion

The International Ground Source Heat Pump Association (IGSHPA) board of directors voted to sunset the 2017 IGSHPA Standards when the next edition of the bi-national C448 standard is published to promote consistency of design and installation in the U.S. and Canada.

Through the bi-national standard the ground-source heat pump industry continues to come together to create a reasonable and relevant standard which may be applied by designers, installers, and building owners. Additionally, this document will provide useful guidance and references for regulators and their jurisdictions as this industry continues to grow.

As we move through this next standard cycle this standard will continue to evolve and adapt to reflect the coming changes in the ground source heat pump industry including

- A2L refrigerants
- Equipment rating standards
- District energy systems

and will continue to support the global effort to reduce green house gasses in North America.

Opportunities

and

Challenges

We face them together

Thank you & Questions

Mark Metzner - ViceChair, TC C423
Lisa Meline - PE