2021 Uniform Solar, Hydronics & Geothermal Code

2024 Spring - Montana EduCode

…with a look at the application of the 2024 Uniform Mechanical Code provisions

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2021 Uniform Solar, Hydronics & Geothermal Code

Chapter 1
Administration

- Essentially follows other Uniform Codes' format & content

Chapter 2
Definitions

Many definitions are identical to other Uniform Codes

Selection of USHGC definitions will be considered…
203.0 through 228.0

- Absorber. That part of the solar collector that receives the incident radiation energy.
- Absorptance. The collecting of heat, measured as a percent of total radiation available.
- Appurtenance, Solar. A manufactured device, a prefabricated assembly, or an on-the-job assembly of component parts that is an adjunct to a solar energy system.
- Area, Absorber. The total projected heat transfer area from which the absorbed solar irradiation heats the transfer media.
- Area, Aperture. The maximum projected area of a solar collector through which the unconcentrated solar radiant energy is admitted.
- Area, Gross Collector. The maximum projected area of the complete collector module, including integral mounting means.
- Array. A mechanically and electrically integrated grouping of modules with support structure, including any attached system components such as inverter(s) or dc-to-dc converter(s) and attached associated wiring. [NFPA 70:690.2]
- Auxiliary Energy System. Equipment using non-solar energy sources to supplement or backup the output provided by a solar energy system.

- Balancing Valves. A valve that regulates the flow rate of liquid, to achieve uniform distribution, throughout multiple collectors.
- Borehole. A penetration into the earth at any angle, typically drilled, bored, cored, driven, hydraulically advanced, or otherwise constructed for geothermal system installations.

- Certified Person. A person trained and certified by the equipment manufacturer, or by a recognized organization through a formal certification program for the system to be serviced or cleaned; that is acceptable to the AHJ.
- Circulators (Circulating Pump). A device that circulates liquids within a closed circuit for an intended purpose.
- Closed-Loop System. A system where the fluid is enclosed in a piping system that is not vented to the atmosphere.

- Collector, Concentrating. A solar collector that uses reflectors, lenses, or other optical elements to concentrate the radiant energy passing through the aperture onto an absorber of which the surface area is smaller than the aperture area.
- Collector System. That section of the solar system that includes the collector and piping or ducts from the collector to the storage system.
- Collector Tilt. The angle above horizontal at which a solar heat collector is positioned.
- Cover, Collector (Glazing). The material covering the aperture to provide thermal and environmental protection.

- Drainback System. A closed-loop system, which allows gravity draining of the heat transfer fluid into, lower portions or the solar loop under prescribed circumstances.
- Dual Purpose Water Heater. An appliance utilized as a heat source for both space heating and domestic hot water applications.

- Energy Collector Fluid. That fluid used to transfer energy from the collector to the storage system or point of use.
- Energy Storage Fluid (or Media). That fluid (or media) used in the storage container for storing collected energy.
- Energy Transfer Fluid. That fluid used within a closed system either from the collector to the storage system or from the storage system to the point of use.
- Flat Plate Collector. A panel (nonconcentrating type) of a suitable material that converts solar energy into usable energy and the absorbing surface is essentially planar.

- Geothermal Energy System. A system that exchanges thermal energy with the earth for space heating and cooling, and/or water heating.
- Geothermal Energy System, Closed-Loop. A continuous, sealed, underground, or submerged heat exchanger through which a heat-transfer fluid passes.
- Geothermal Energy System, Open-Loop. A liquidsource system that uses ground water or surface water to extract or reject heat.
- Ground-Heat Exchanger. An underground closed-loop heat exchanger through which a heat-transfer medium passes to and from a heat pump or other rated mechanical equipment. It includes the buried pipe and connecting main(s) up to and terminating with the building.
- Ground-Source Heat Pump. A term that is applied to a variety of systems that use the ground, groundwater, or surface water as a heat source and sink. The general terms include ground-coupled (GCHP), groundwater (GWHP), and surface-water (SWHP) heat pumps. Many parallel terms exist [e.g., geothermal heat pumps (GHP), geo-exchange, and ground-source (GS) systems] and are used to meet a variety of marketing or institutional needs.
- Groundwater Source. A geothermal energy system that uses the groundwater as a heat source or sink.

- Heat Exchanger. A device that transfers heat from one medium to another.
- Heat Transfer Medium. The medium used to transfer energy from the solar collectors to the thermal storage or load.
- Hydronic System. Relating to, or being a system of heating or cooling that involves the transfer of heat by a circulating fluid (such as water or vapor).
- Hydronics. Of or relating to a heating or cooling system that transfers energy by circulating a fluid through a system of pipes or tubing.

- Immersed Heat Exchanger. Heat exchanger, which is completely surrounded with the fluid in the storage tank.
- Integral Collector Storage. A solar thermal heating system that uses a solar collector that has all or most of its heat transfer liquid inside the collector.

- Open-Loop System. A system where the fluid is enclosed in a piping system that is vented to the atmosphere.
- Out-Gassing. As applied to thermal energy, the thermal process by which materials expel gas.
- Oxygen Permeation. The ability of oxygen molecules to pass through a material. Also known as oxygen diffusion.

- Passive Solar Systems. As used in these requirements, are solar systems that utilize elements of a building, without augmentation by mechanical components such as blowers or pumps, to provide for the collections, storage, or distribution of solar energy for heating, cooling, or both.

- Registered Design Professional. An individual who is registered or licensed by the laws of the state to perform such design work in the jurisdiction.
- Rock Storage. A bin, basement, or other container filled with rock to act as an energy reservoir for a solar system.

- Solar Collector. A device used to absorb energy from the sun.
- Solar Energy System. A configuration of equipment and components to collect, convey, store, and convert the sun’s energy for a purpose.
- Solar Energy System Components. Any appliance, assembly, device, equipment, or piping used in the conversion of solar energy into thermal energy for service water heating, pool water heating, space heating and co
- Solar Thermal System. A complete assembly of subsystems which convert solar energy into thermal energy and utilize this energy for service water heating, pool water heating, space heating and cooling purposes.

- Thermal Energy. The amount of sensible heat energy stored within a material or fluid. The product of the mass, specific thermal capacity and temperature increase/decrease of the material or fluid. Also known as sensible heat energy.

- Thermal Storage. A tank or vessel used in a solar thermal, hydronic, or geothermal system, in which thermal energy is stored.
- Thermosiphon. The natural circulation of fluids due to temperature differential.

- Water Well. An excavation that is drilled, cored, bored, washed, driven, dug, jetted, or otherwise constructed for the purposes of extracting groundwater, using the geothermal properties of the earth or injecting water into an aquifer or subsurface reservoir.

Chapter 3
General Regulations

- Essentially follows other Uniform Codes' format & content

Chapter 4
Hydronics
401.1 Applicability.
This chapter shall apply to hydronic piping systems that are part of heating, cooling, ventilation, refrigeration, and air conditioning systems. Such piping systems include steam, hot water, chilled water, steam condensate, condenser water, solar thermal systems, and ground source heat pump systems. The regulations of this chapter shall govern the construction, location, and installation of hydronic piping systems.

401.6 Manifolds.
Manifolds shall be equipped with isolation valves on the supply and return lines. Manifolds shall be capable of withstanding the pressure and temperature of the system. The material of the manifold shall be compatible with the system fluid and shall be installed in accordance with the manufacturer's installation instructions.

402.0 Protection of Potable Water Supply.
402.1 Prohibited Sources
Hydronic systems or parts thereof, shall be constructed in such a manner that polluted, contaminated water, or substances shall not enter a portion of the potable water system either during normal use or where the system is subject to pressure that exceeds the operating pressure in the potable water system. Piping, components, and devices in contact with the potable water shall be approved for such use and where an additive is used it shall not affect the performance of the system.

402.2 Chemical Injection.
Additives or chemicals shall be compatible with system components. Where systems include an additive, chemical injection or provisions for such injection, the potable water supply shall be protected by an air gap in accordance with ASME A112.1.2, an air gap fitting listed and labeled in accordance with ASME A112.1.3, or a reduced-pressure principle backflow prevention assembly listed and labeled in accordance with ASSE 1013.

General
402.3 Protection of Potable Water. The potable water system shall be protected from backflow in accordance with the Uniform Plumbing Code.
402.4 Compatibility. Fluids used in hydronic systems shall be compatible with all components that will contact the fluid. Where a heat exchanger is installed with a dual purpose water heater, such application shall comply with the requirements for a single wall heat exchanger in Section 313.1.

403.2 Dual Purpose Water Heaters.
Water heaters utilized for combined space-and water-heating applications shall be listed and labeled in accordance with the standards referenced in Table 403.2, and shall be installed in accordance with the manufacturer's installation instructions. The total heating capacity of a dual purpose water heater shall be based on the sum of the potable hot water requirements and the space heating design requirements corrected for hot water first-hour draw recovery.

405.2 Pressure Testing.

- System piping and components shall be tested with a pressure of not less than one and one half times the operating pressure but not less than 100 psi (689 kPa). Piping shall be tested with water or air except that plastic pipe shall not be tested with air. Test pressures shall be held for a period of not less than 30 minutes with no perceptible drop in pressure. These tests shall be made in the presence of the AHJ.
- Exceptions:
- (1) For PEX, PP-R, PP-RCT, PEX-AL-PEX, PE-RT, and PE-AL-PE piping systems, testing with air shall be permitted where authorized by the manufacturer's instructions for the PEX, PP-R, PP-RCT, PEX-AL-PEX, PE-RT, and PE-AL-PE pipe and fittings products, and air testing is not prohibited by applicable codes, laws, or regulations outside this code.
- (2) Copper tubing shall be tested at not less than 80 psi (552 kPa).

405.3 Flushing.
Heating and cooling sources, system piping and tubing shall be flushed after installation with water or a cleaning solution. Cleaning and flushing of the heating and cooling sources shall comply with the manufacturer's instructions. The cleaning solution shall be compatible with all system components and shall be used in accordance with the manufacturer's instructions.

406.0 Pressure and Safety Devices.
406.1 General
Each closed hydronic system shall be protected against pressures exceeding design limitations with not less than one pressure relief valve. Each closed section of the system containing a heat source shall have a relief valve located so that the heat source is not capable of being isolated from a relief device. Pressure relief valves shall be installed in accordance with their listing and the manufacturer's installation instructions.

406.2 Discharge Piping
The discharge piping serving a temperature relief valve, pressure relief valve, or combination of both shall be in accordance with Section 311.3.

Chapter 5
Solar Thermal Systems
501.0 General.
501.1 Applicability.

- …provisions of this chapter address construction & installation of solar thermal systems, including components.
- …solar thermal system shall include solar collector, thermal storage, system piping & appurtenances.

501.2 Connections.
Connections that are required for filling, draining, and flushing shall be readily accessible. Solar thermal systems using liquid as a heat transfer medium shall have means for purging air.

501.3 Stagnation Condition.
The solar thermal assembly shall be capable of withstanding stagnant conditions in accordance with the manufacturer's instructions where high solar flux and no flow occurs.

501.5 Materials

- Comply with Table 409.1
- Joining See Section 410.0
- Unions between dissimilar materials follow Section 305.2 and 410.13
- Plastics approved for solar thermal
- Combustible materials approved by AHJ
- Adhesives meet all design standards
- Potable water materials comply with NSF 61
- Potable water flushing and disinfection follow UPC
- Racking to prevent corrosion
- Fasteners of corrosion-resistant materials
- Carbon steel meets ASME SA 194

501.6 Thermosiphon Systems.
The storage tank in a thermosiphon system shall be installed above the collector.

501.7 Drainback Systems.
The circulating pump shall be sized to overcome the static head pressure height of the collector, pressure losses, and provide the required flow rate to the collector. The drainback reservoir shall be located in a conditioned space to prevent freezing. A sight

glass, or other method of monitoring the level of fluid in the solar loop shall be installed in the solar loop, or on the drainback reservoir. A drainback system shall be capable of being manually isolated and drained.

501.9 Auxiliary Heating.
An auxiliary heating system shall be installed in conjunction with the solar thermal system and shall be adequate to provide service in the absence of solar thermal energy input. Auxiliary heating that utilizes electricity as the energy source shall be in accordance with Section 315.0. Auxiliary heating that utilizes solid fuel or fuel gas as the energy source shall be in accordance with the mechanical code.

501.10 Automatic Air Vents.
Where installed, automatic air release vents shall be installed at high points of the solar thermal system in accordance with the system design requirements and manufacturer's installation instructions.

501.11 Waterproofing.
Joints between structural supports and buildings or dwellings, including penetrations made by bolts or other means of fastening, shall be made watertight with approved materials.

501.12 Protection.
Solar thermal systems shall be protected from excessive pressures, temperature, and vacuum in accordance with Section 311.0. Where required, freeze protection shall be provided in accordance with Section 501.13.

501.13 Freeze Protection.

- Protect when temps <46°F (8°C) by means of fail-safe in accordance with Section 501.13.1 through Section 501.13.5
- Antifreeze use manufacturer's instructions
- Drainback when approved for temps not < -60°F (-51°C)
- Integral collector storage systems when temps not <23°F (-5°C); 18-hr exposure time in freezing temps; exterior piping insulated with R-5
- Indirect thermosiphon systems installed when temps not <23°F (-5°C); exterior piping insulated with R-5
- Air solar heating systems see manufacturer's instructions
- Label freeze protection type
- Fittings, pipe slope, and collector:
- gravity draining & air filling of system components;
- pipe horizontal slope not <1/4" per foot (20.8 mm/m);
- other slops refer to manufacturer's instructions;
- install a drain valve

501.14 Circulators.
Circulating pumps follow Section 310.0… Drainback systems pump overcome total head and collector flow rates… Other systems overcome friction head and maintain collector flow rates

501.15 Protection Against Decay.
Wood used for outdoor construction must be pressure-treated with preservative or shall be a naturally durable, decay resistant species of lumber

501.16 Flash Points.
The flash point of a heat-transfer medium shall be 50°F (28°C) or more above the design maximum temperature.

501.17 Storage Tanks.
Storage tanks shall comply with Chapter 6 and be installed in accordance with the manufacturer's installation instructions. Access ports and connections shall be accessible.

502.0 Solar Collectors.
502.1 General.

- AHJ approved frames and braces exposed to outdoor conditions.
- Collectors must be watertight, prevents out-gassing and continues transmission properties as designed

502.2 Fire Safety Requirements.
Collectors that function as building components shall be in accordance with the building code.

502.3 Flat Plate Collector Glass.
Flat plate collector glass shall be tempered.

502.4 Air Collectors.
Materials exposed within air collectors shall be noncombustible or shall have a flame spread index not to exceed 25 and a smoke developed index not to exceed 50 where tested as a composite product in accordance with ASTM E84 or UL 723.

- **502.4.1 Testing.** Materials used within an air collector shall not smoke, smolder, glow, or flame where tested in accordance with ASTM C411 at temperatures exposed to in service. In no case shall the test temperature be less than 250°F (121°C).

502.5 Installation
Collectors:

- Anchored according to Section 317.1
- Minimize debris collection
- Piping is not a support for collector
- Read the manufacturer's installation instructions

Roof Installation:

- Through roof anchors maintain watertight seal
- Unimpaired roof drainage
- Preserve roofing system integrity

Above or on the Roof

- Maintain all fire protection ratings when functioning as a building component

Exceptions:

- One- and two-family dwellings
- Building 3-stories or less; 9,000 ft2 floor area; or both
- Collectors noncombustible
- Plastic covers and plastic film covers following the details provided in code section 502.5.2 (2)(b)(c)

For Sections 502.5.5 through 502.5.6 See the 2021 Uniform Solar, Hydronics and Geothermal Code
Scan the Code for IAPMO's read only code page to view the complete text, scroll down to locate the code.

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502.6 Listing.
Collectors that are manufactured as a complete component shall be listed and labeled by an approved listing agency in accordance with ICC 901/SRCC 100, UL 1279, or equivalent standard.

503.0 Insulation.
503.1 General.

- Protect surfaces that exceed 140°F (60°C) from building occupants; continuous coverage within sleeves
- Piping insulation meets temp of system; has fire-rating not to exceed 25, smoke index of 50, ASTM E84 or UL 723

503.3 Piping.
Pipe & fittings, other than unions, flanges, or valves, shall be insulated. Insulation material shall be approved for continuous operating temperatures of not less than 220°F (104°C).

503.4 Fittings.
Fittings shall be insulated with mitered sections, molded fittings, insulating cement, or flexible insulation.

503.5 Installation.
Secure insulation to pipe… Insulation jacket seams overlap according to installation instructions… Joints/seams sealed with approved materials… Molded insulation every 9” (229 mm) secured with 16-gauge galvanized ties

- **503.5.1 Exterior Applications.** Approved for application, correctly sealed… Flexible insulation protect against weather penetration… Rated for outdoor temps, UV exposure, and moisture

503.6 Ducts.
Circulating air ducts shall be insulated in accordance with Table 503.6.

504.0 Testing.
504.1 Piping.

- Manufacturer’s instructions determine method:
  - Water
  - Air, except plastic pipe
  - Heat transfer liquid
- AHJ shall be permitted to require removal of plugs, etc., to ascertain pressure has reached all parts of the system.

504.2 System Requirements. Prior to installation of insulation & startup system tested to be airtight

- **504.2.1 Direct (Open-Loop) Systems.**
- Withstand 15-minute water pressure test 1-1/12 times max design pressure or 150 psi (1034 kPa) without leaking
- **504.2.2 Indirect (Closed-Loop) Systems.**
- Withstand 15-minute hydrostatic test 1-1/2 times max design pressure

505.0 Swimming Pools, Spas, and Hot Tubs.
505.1 Water Chemistry.
Where water from a swimming pool, spa or hot tub is heated by way of circulation through solar collectors, the chemistry of such water shall comply with the requirements of Section 505.2, and shall be filtered in accordance with Section 505.3 and Section 505.3.1.

505.2 Parameters.
Parameters for chemicals used within a swimming pool, spa, or hot tub shall be in accordance with Table 505.2.

505.3 Filter.
A filter shall be provided to remove debris from the water entering the solar loop.
Exception: A solar swimming pool, spa, or hot tub heating system with a heat exchanger.

- **505.3.1 Location.** A filter shall be located upstream of a pump used to direct water to solar collectors.

505.4 Corrosion Resistant.
Glazed solar collectors made of copper shall not be used for solar pool, spa, or hot tub heating. Exception: Where a heat exchanger is provided between the collector circuit and the swimming pool, spa, or hot tub water.

Chapter 6 - Thermal Storage

Chapter 7 - Geothermal Energy Systems

Part 1 - General

RPA, Hydronics Industry Alliance Partner with Egg Geothermal
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701.1 Applicability.

- Part 1 of this chapter covers geothermal energy systems:

  - building systems coupled with a ground-heat exchanger
  - submerged heat exchanger using water-based fluid as a heat transfer medium
  - groundwater (well)
- Indoor piping, fittings, & accessories:
  - See Section 703.5 & Chapter 4

701.1.1 Prior to Construction. AHJ issues permits
701.1.2 Equipment, Accessories, Components, & Materials. All equipment and materials rated for use in geothermal systems

701.2 Construction Documents. Submit to AHJ

701.3 Site Survey.

- …site survey prior to designing system…

(1) Ground-heat exchanger dimensions.
(2) Grout or sealing specifications, as applicable.
(3) Dimensions from building to water well, ground-heat exchanger, or submerged heat exchanger.
(4) Operating temperatures and pressures.
701.1

701.4 Used Materials. SHALL NOT BE USED
701.5 Contact with Building Material. Geothermal system materials shall not contact building materials that will cause damage or corrosion.

701.6 Strains and Stresses. No unwarranted strains on piping… Account for normal pipe movement & structural changes

701.7 Flood Hazard. Special design considerations for flood zones

701.8 Pipe Support. See Section 313.7

701.9 Velocities. All systems designed to meet flow velocities of material specifications… Reduce/eliminate water hammer

701.10 Chemical Compatibility. Materials compatibility with other materials & antifreeze chemicals

701.11 Heat Transfer Fluid. All system fluids shall be compatible

702.0 Groundwater Systems.
702.1 General.
Potable water supply connected to a groundwater system shall be protected with an approved backflow prevention device. The connection of a discharge line to the sanitary

or storm sewer system, or private sewage disposal system, shall be in accordance with the plumbing code or in accordance with the AHJ.

For Sections 703.0 Design of Systems. Through 709.0 Decommissioning and Abandonment.
Scan QR Code on page 9 to view the complete text in IAPMO's read only Code.

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Part II - Closed-Loop Systems

710.0 General.

710.1 Applicability.

Part II of this chapter shall apply to geothermal closed-loop systems such as, but not limited to, building systems coupled with a closed-loop system using water-based fluid as a heat transfer medium.

710.2 Piping and Tubing.

Piping and tubing for closed-loop systems shall be in accordance Section 703.2 and Table 703.2.

710.3 Borehole Piping and Tubing.

Borehole piping or tubing for vertical and horizontally drilled closed-loop systems shall have a minimum wall thickness equal to SDR-11 and shall have a minimum pressure rating of not less than 160 psi (1103 kPa) at 73°F (23°C).

710.4 Underground Fittings.

Underground fittings for closed-loop systems shall be in accordance with Section 703.3 and Table 703.3.

710.5 Verification.

For closed-loop systems, system shall be flushed of debris & purged of air after completion of the entire ground-heat exchanger. Flow rates & pressure drops shall be compared to calculated values to assure no blockage or kinking of pipe. A report shall be submitted to owner to confirm the loop flow is in accordance with construction documents.

710.6 Vertical Bores.

- Vertical bores shall be drilled to a depth to provide complete insertion of the u-bend pipe to its specified depth.
- Borehole diameter shall be sized for installation & placement of heat exchange u-bend tremie used to place grouting material.
- ANSI/CSA/IGSHPA C448 shall be used for vertical loop depth & borehole diameter sizing guidance.
- U-bend joint & pipe shall be visually inspected for integrity in accordance with manufacturer's installation instructions.
- U-bend joint & pipe shall be pressurized to not less than 100 psi (689 kPa), not to exceed pressure rating of pipe at the test temperature, for 1-hour to check for leaks before insertion into the borehole.
- **710.6.1 Backfill.** Bentonite grout & thermally-enhanced bentonite grout, where used to seal & backfill each borehole, shall comply with NSF/ANSI/CAN 60. Boreholes shall be backfilled in accordance with the AHJ.

- **710.6.2 U-Bends and Headers**. Headers, u-bends & ground loop pipes shall be pressure-tested in accordance with ANSI/CSA/IGSHPA C448, or as required by the AHJ. …
    - **710.6.2.1 Test Pressure.** The maximum test pressure shall be 1.5 times system design pressure, as determined by Section 710.6.2.3, or Section 710.6.2.4, not to exceed 100 psi (689 kPa). …With Exception
    - **710.6.2.2 Testing Procedure.** The test section & test liquid shall be at the same temperature. Test section shall be filled with liquid & purged of air. Test section shall be brought to specified test pressure. Test pressure shall be maintained for 4 hours, with additional fluid added as needed. Test pressure shall be reduced by 10 psi (69 kPa) & monitored for 1 hour with no addition of pressure or additional fluid. A passing test is indicated where after a period of 1 hour no visual leakage is observed, & pressure remains equal to or greater than 95 percent of original pressure.
    - **710.6.2.3 Calculation of Static Pressure (Water).** For water, the static pressure applied shall be equivalent to 0.43 psig (2.96 kPa) per foot (305 mm) of elevation.
    - **710.6.2.4 Calculation of Static Pressure (Other Fluids).** For fluids of different density, the static pressure shall be calculated using the density of the system fluid.

711.0 Ground-Heat Exchanger Testing.
711.1 Testing. Pressure-testing of ground-heat exchanger shall be performed in accordance with the testing method in Section 1710.6.

711.2 Individual Loop Pressure Testing. Individual loop testing shall be performed as required by the AHJ.

711.3 Field Pressure Testing – Final. System shall be cleaned of all contaminants and tested to design flow ratings.

711.4 Field Flow Testing – Final. Final field flow testing shall be performed as required by the AHJ.

Part III - Open-Loop Systems

712.0 General.
712.1 Applicability.

- Part III of this chapter shall apply to geothermal open-loop systems such as, but not limited to, building systems coupled with a groundwater (well) or surface water open-loop system using water-based fluid as a heat transfer medium. The regulations of this chapter shall govern the construction, location and installation of geothermal energy systems.
- Indoor piping, fittings, and accessories that are part of the groundwater system shall be in accordance with Section 703.5 and Chapter 4.

712.2 Test Wells.
Test wells drilled to investigate subsurface conditions shall provide details of groundwater location, chemical & physical characteristics, rock strata, & temperature profiles. Number of test wells shall be determined in accordance with the AHJ. Each test well shall be tested for flow rate for a period of not less than 24 hours. Water samples shall be collected in accordance with NGWA-01 from each well to establish existing water quality levels are approved for groundwater system use. Water samples shall be analyzed for standard drinking water, fecal and coliform content, bacterial iron, nitrate, dissolved minerals, pH, hardness, & other compounds in accordance with NGWA-01 or in accordance with the AHJ. Wells shall be tested for water production & recovery. Monitoring wells shall be protected, & marked to allow for monitoring of ground temperature, groundwater levels, & groundwater quality.

712.3 Installation of Water Wells.
Water supply, recharge wells, and pumping equipment shall be hydraulically tested, sealed, and grouted in accordance with approved well construction practices and submitted to the AHJ for approval. Wells shall be tested for water production and recovery, water quality before final system design. Wells shall be disinfected upon completion in accordance with NGWA-01 or in accordance with the AHJ. A copy of the water quality test results and the log of well construction in accordance with NGWA-01 shall be provided to the owner.

712.4 Setbacks.
Open-loop ground-heat exchangers shall maintain the following minimum setbacks or at distances specified by the AHJ:

(1) Ten feet (3048 mm) horizontally from a pressure-tested sewer lateral into a building.
(2) Twenty feet (6096 mm) horizontally from a non-pressure tested sewer lateral into a building.
(3) Three feet (914 mm) horizontally from buried utilities such as electrical, gas, or water.
(4) Fifty feet (15 240 mm) from a water well.
(5) Fifty feet (15 240 mm) from a septic tank and 100 feet (30 480 mm) from a subsurface sewage leaching field.
(6) One hundred feet (30 480 mm) from a spring.

713.0 Open Ground Water Systems.
713.1 General. Installation & use of water wells shall be in accordance with the AHJ. Water well records shall include well logs, pumping tests, & aquifer information.

713.2 Open-Loop Water Well Drilling Logs. The water-well drilling logs shall include the following:

(1) Subsurface stratigraphy.
(2) Aquifer type & conditions such as, but not limited to, confined, unconfined, flowing & depth.
(3) Drilling method used & penetration speed.
(4) Presence of substances known to have a potential risk to health & safety shall be documented in drill logs & property owner shall be advised of potential risk to health & safety.

713.3 Design Considerations. A groundwater heat pump system shall be designed by a registered design professional. Due design consideration shall be given to the following:

(1) Where multiple heat pumps or fan coils are connected to a common water loop, a diversified building design load shall be used to design a ground water heat pump.
(2) Water supply well(s) and injection wells, or water discharge system, shall be capable of being operated at sustainable pumping rates that exceed the maximum daily requirements without causing an adverse impact to existing or future offsite uses of groundwater or surface water bodies.
(3) The water temperature and the quality and chemical composition of the water resource are in accordance with the system manufacturer's recommendations.
(4) The groundwater and surface water resources shall be protected by returning water to the source aquifer or an aquifer with the same water quality, or a surface water body.
(5) The return capacity of the injection, or surface water body discharge system, shall be suitable under winter conditions.
(6) The temperature of the return water shall have no adverse thermal impacts on offsite existing or future uses of groundwater, or on surface water bodies, in accordance with the requirements of the AHJ
(7) Pressure gauges shall be provided to aid in start-up and monitoring of the system during operation.
(8) The ability to switch over operation of supply and return wells for 100 percent standby, redevelopment, cleaning of wells, and the thermal balancing of the ground and aquifer shall be provided.
(9) There shall be no adverse effects on the quality and quantity of offsite existing or future users of groundwater, in accordance with the requirements of the AHJ.

713.4 Open Ground Water Systems. Water Wells and Injection Wells. Water wells & injection wells for groundwater heat pump systems shall be installed & tested by a registered design professional who is qualified to drill wells that comply with requirements of the AHJ. Water supply wells & injection wells shall be developed in accordance with NGWA-01.

713.5 Testing and Sampling. Pumping tests and water sampling shall be done as required by the registered design professional.

713.6 Disinfection. Water wells shall be disinfected upon completion in accordance with the requirements of the AHJ and NGWA-01.

714.0 Testing & Verification.
714.1 Pumping Test. Water supply wells and injection wells shall undergo a stop and start pumping test to demonstrate the sand-free yield.

714.2 Retesting. Where sediment is present, the problem shall be corrected and the test shall be repeated until acceptable results are obtained.

714.3 Variable Rate Pump Test. Operating conditions of water supply wells & injection wells shall be evaluated & verified with a variable rate pumping.

714.4 Constant Rate Pump Test. The sustainable well yield, aquifer coefficients, and zones of influences on the groundwater flow requirements shall be confirmed with a constant rate-pumping test. The constant rate-pumping test shall be done on the water supply and injection wells at rates and durations as specified by the registered design professional.

714.5 Water Level Monitoring. Water levels shall be monitored in the pumping well and observation wells during pumping and recovery periods. The monitoring time intervals shall be as specified by the registered design professional.

714.6 Injection Wells. Injection testing shall be performed on water wells that are designated to be used as injection wells at rates specified by the registered design professional. The results of the drilling and pumping tests shall be provided to the owner or the owner's representative and provided in accordance with requirements of the AHJ.

714.7 Re-Injected Water. The water quality of re-injected water into the earth shall comply with the requirements of the AHJ

Part IV- Direct Exchange (DX) Systems

715.0 Direct Exchange (DX) Systems.
715.1 General.
The installation and use of Direct Exchange (DX) wells shall be in accordance with the AHJ. The DX well records shall include well logs, pressure tests, and aquifer information.

715.2 Applicability. Part IV of this chapter shall apply to geothermal energy systems such as, but not limited to, building systems coupled with a DX closed-loop using refrigerant as a heat transfer medium. The regulations of this Chapter shall govern the construction, location and installation of geothermal energy systems.
Indoor piping, fittings, and accessories that are part of the ground source system shall be in accordance with Section 703.5 and Chapter 4.

715.0 Direct Exchange (DX) Systems.
715.3 DX Systems. Copper pipe and tubing installed for DX systems shall be manufactured in accordance with ASTM B280 and copper fittings in accordance with ASME B16.22. Joints shall be purged with an inert gas and brazed with a brazing alloy having 15 percent silver content in accordance with AWS A5.8. Underground piping and tubing shall have a cathodic protection system installed.

715.4 DX System Testing. For direct exchange (DX) systems, each refrigerant u-bend shall be tested and proved tight with an inert gas at not less than 315 psi (2172 kPa) and maintained for 15 minutes without pressure drop. The pressure reading after tremie grouting of the boreholes shall be maintained in the ground-heat exchanger for not less than 2 hours, in accordance with ANSI/CSA/IGSHPA C448.

715.5 Indoor Piping. For DX systems, joints shall be purged with an inert gas and brazed with a brazing alloy having 15 percent silver content in accordance with AWS A5.8.

715.6 On Site Storage. For DX systems, copper piping and fittings shall be stored to prevent physical damage, contamination, and each pipe or tubing shall be pressurized with an inert gas and sealed with a cap.

715.7 System Start-Up. DX system start-up shall be in accordance with Section 1708.1 and the following:

(1) DX systems shall be pressurized using nitrogen for not less than 1 hour. There shall be no allowable variance to the test pressure after being corrected for ambient temperature changes during the test. The test pressure shall not exceed 150 psig (1034 kPa) when pressure testing the compressor unit and indoor system components.
(2) DX systems shall have permanent type labels installed and affixed on the compressor unit with the refrigerant type and quantity.
(3) For DX systems, refrigerant liquid and vapor lines from the loop system shall be identified and tagged.

715.8 DX Piping. DX Piping should be installed in accordance with approved plans and specifications, including provisions for cathodic protection.

Chapter 12 – UMC Hydronics

1201.1 General.

Applicability. This chapter shall apply to hydronic piping systems that are part of heating, cooling, ventilation, refrigeration, and air conditioning systems. Such piping systems include steam, hot water, radiant heating and cooling, chilled water, steam condensate, condenser water, ground source heat pump systems, snow and ice melting systems, ambient temperature loops (ATL), and district ambient temperature loops. The regulations of this chapter shall govern the construction, location, and installation of hydronic piping systems.

Chapter 2 Definitions

Hydronics.

Of or relating to a heating or cooling system that transfers energy by circulating a fluid through a system of pipes or tubing.

1201.2 Insulation.

Surfaces within reach of building occupants shall not exceed 140°F (60°C). Where sleeves are installed, the insulation shall continue full size through them.
Coverings and insulation used for piping shall be of material approved for the operating temperature of the system and the installation environment. Where installed in a plenum, the insulation, jackets, and lap-seal adhesives, including pipe coverings and linings, shall have a flame spread index not to exceed 25 and a smoke-developed index not to exceed 50 where tested in accordance with ASTM E84 or UL 723.

1201.3 Water Hammer.

Piping system shall be designed to prevent water hammer.

1201.4 Terminal Units.

Terminal units, valves, and flow control devices shall be installed in accordance wit the manufacturer's installation instructions.

1201.5 Return-Water Low-Temperature Protection.

Where a minimum return-water temperature to the heat source is specified by the manufacturer, the heating system shall be designed and installed to meet or exceed the minimum return-water temperature during the normal operation of the heat source.

1201.6 Heat Transfer Fluid Quality.

Heat transfer fluid used in closed loop hydronic systems shall be in accordance with IAPMO/ANSI H1001.1.

1201.6.1 Ethylene Glycol.

Ethylene glycol shall not be used in one- and two-unit residential systems. In existing systems, where ethylene glycol is used, there shall be no direct or permanent potable water connections. Where a temporary potable water connection is required, a backflow preventer shall be installed.

1201.8 Mechanical Devices.
Where listed mechanical devices are used, the manufacturer's installation instructions as to the location and method of installation shall be followed.

1201.9 Flexible Connectors.
Listed flexible connectors shall be installed in readily accessible locations.

1201.10 Freeze Protection.
Hydronic systems & components shall be designed, installed, and protected from freezing. The percent of glycol by volume shall be determined based on the freezing point of the solution & type of mixture in accordance with Table 1201.10 or manufacturer's specifications.

1201.10.1 Antifreeze Requirements.
Antifreeze shall be added to a closed hydronic system where one or more of the following conditions exists:

(1) System component(s) are exposed to freezing conditions.
(2) The hydronic system serves as a snow and ice melt system in accordance with Section 1220.0.
(3) Where required by the equipment manufacturer.

Exception: Antifreeze shall not be required where a system is continuously monitored or specifically designed not to require antifreeze, and is subject to freezing as a result of either of the following:

(1) Loss of electrical power.
(2) Loss of a fuel source.

1201.5 Heat Emitters.
Heat emitters shall be installed in accordance with the manufacturer's installation instructions.

1202.0 Protection of Potable Water Supply.
1202.1 Prohibited Sources.
Hydronic systems or parts thereof, shall be constructed in such a manner that polluted, contaminated water, or substances shall not enter a portion of the potable water system either during normal use or where the system is subject to pressure that exceeds the operating pressure in the potable water system.

For Sections 1202.2 Chemical Injection. Through 1209.5 Sizing.
Scan QR Code on page 9 to view the complete text in IAPMO's read only Code.

1210.1 Materials.
1210.1 Piping, Tubing, & Fittings. Hydronic pipe and tubing shall comply with the applicable standards referenced in Table 1210.1 and shall be approved for use based on the intended purpose…

1210.3 Hangers & Supports.
Pipe & tubing shall be supported in accordance with Section 313.0. Equipment that is part of the piping system shall be provided with additional support in accordance with this code & manufacturer's installation instructions. Radiant systems utilizing heat emission or transfer plates shall have a gap of at least ¼ inch (6.4 mm) between adjacent plates.

1210.4 Oxygen Diffusion Corrosion.
PEX and PE-RT tubing in closed hydronic systems shall contain an oxygen barrier.

1210.4.1 Vented Closed-Loop Systems.
All components installed in a vented closed-loop system shall be constructed of non-ferrous or other corrosion resistant materials.

1210.4.2 Non-Oxygen Barrier Closed-Loop Systems.
All components installed in a non-oxygen barrier system shall be constructed of non-ferrous or other corrosion resistant materials.

1210.0 Joints & Connections.
1211.1 General. Joints and connections shall be of an approved type. Joints shall be gas and watertight and designed for the pressure of the hydronic system. Changes in direction shall be made by the use of fittings or with pipe bends. Joints between pipe and fittings shall be installed in accordance with the manufacturer's installation instructions. Joints used underground shall be of an approved type for buried applications in accordance with Section 1221.2.3.

1211.2 Pipe Bends.
Pipe bends shall be formed in accordance with Section 1211.2.1 for PEX or Section 1211.2.2 for PE.

1211.2.1 Crosslinked Polyethylene (PEX) Tubing.
Crosslinked polyethylene (PEX) tubing bends shall have a bend radius of not less than eight times the outside diameter of the tubing or shall be in accordance with the manufacturer's installation instructions.

1211.2.2 Polyethylene (PE) Plastic Pipe/Tubing.
Polyethylene pipe & tubing bends shall have a bend radius in accordance with Table 1211.2.2. When a fitting or flange connection is present in the pipe bend, the minimum bend radius shall be one hundred times the pipe outside diameter (OD) for a distance of five times the pipe diameter on either side of the fitting location.

1211.2.3 Polyethylene of Raised Temperature(PE-RT) Tubing.
Polyethylene of raised temperature (PE-RT) tubing bends shall have a bend radius of not less than eight times the outside diameter of the tubing or shall be in accordance with the manufacturer's installation instructions.

1211.3 Chlorinated Polyvinyl Chloride (CPVC) Pipe.
Joints between chlorinated polyvinyl chloride (CPVC) pipe and fittings shall be installed in accordance with one of the following methods:

(1) Mechanical joints shall include flanged, grooved, and push fit fittings. Removable and non-removable push fit fittings with an elastomeric O-ring that employ quick assembly push fit connectors shall be in accordance with ASSE 1061.

(2)…Listed solvent cement in accordance with ASTM F493 that does not require the use of primers, yellow, green, or red in color, shall be permitted for pipe and fittings manufactured in accordance with ASTM D2846, 1/2 of an inch (15 mm) through 2 inches (50 mm) in diameter or ASTM F442, 1/2 of an inch (15 mm) through 3 inches (80 mm) in diameter…

(3) Threaded joints for CPVC pipe shall be made with pipe threads in accordance with ASME B1.20.1. A minimum of Schedule 80 shall be permitted to be threaded, and the pressure rating shall be reduced by 50 percent…

1211.4 CPVC/AL/CPVC Plastic Pipe & Joints.
Joints between chlorinated polyvinyl chloride/aluminum/ chlorinated polyvinyl chloride (CPVC/AL/CPVC) pipe and fittings shall be installed in accordance with one of the following methods:

(1) Mechanical joints shall include flanged, grooved, and push-fit fittings.

(2) Solvent cement joints for CPVC/AL/CPVC pipe & fittings shall be clean from dirt & moisture. Solvent cements in accordance with ASTM F493, requiring use of a primer shall be orange in color. Primer shall be colored & be in accordance with ASTM F656. Listed solvent cement in accordance with ASTM F493 that does not require use of primers, yellow in color, shall be permitted for pipe & fittings manufactured in accordance with ASTM D2846, 1⁄2 of an inch (15 mm) through 2 inches (50 mm) in diameter, 1⁄2 of an inch (15 mm) through 3 inches (80 mm) in diameter…

1211.4 Copper or Copper Alloy Pipe & Tubing.
Joints between copper or copper alloy pipe or tubing and fittings shall be installed in accordance with one of the following methods:

(1) Brazed joints between copper pipe, tubing, or fittings shall be made with brazing alloys having a liquid temperature above 1000ºF (538ºC).
The joint surfaces to be brazed shall be cleaned bright by either manual or mechanical means. Tubing shall be cut square and reamed to full inside diameter. Brazing flux shall be applied to the joint surfaces where required by manufacturer's recommendation. Brazing filler metal in accordance with AWS

A5.8 shall be applied at the point where the pipe or tubing enters the socket of the fitting.
(2) Flared joints for soft copper or copper alloy tubing shall be made with fittings that are in accordance with the applicable standards referenced in Table 1210.1. Pipe or tubing shall be cut square using an appropriate tubing cutter. The tubing shall be reamed to full inside diameter, resized to round, and expanded with a proper flaring tool.
(3) Mechanically formed tee fittings shall have extracted collars that shall be formed in a continuous operation consisting of drilling a pilot hole and drawing out the pipe or tube surface to form a collar having a height not less than three times the thickness of the branch tube wall.
(4) Pressed fittings for copper or copper alloy pipe or tubing shall have an elastomeric O-ring that forms the joint…
(5)…Push fit fittings for copper or copper alloy pipe or tubing shall have an approved elastomeric O-ring that forms the joint. Pipe or tubing shall be cut square, chamfered, and reamed to full inside diameter…
(6) Soldered joints between copper or copper alloy pipe or tubing and fittings shall be made in accordance with ASTM B828. Flux shall be applied to pipe or tubing and fittings and shall be in accordance with ASTM B813 and shall become noncorrosive and nontoxic after soldering. Solder in accordance with ASTM B32 shall be applied to the joint surfaces…
(7) Threaded joints for copper or copper alloy pipe shall be made with pipe threads in accordance with ASME B1.20.1.

1211.6 Cross-Linked Polyethylene (PEX) Pipe.
Joints between cross-linked polyethylene (PEX) pipe and fittings shall be installed with fittings for PEX tubing that comply with the applicable standards referenced in Table 1210.1. PEX tubing labeled in accordance with ASTM F876 or ASTM F3253 shall be marked with the applicable standard designation for the fittings specified for use with the tubing. Mechanical joints shall be installed in accordance with manufacturer's installation instructions.

1211.7 Cross-Linked Polyethylene/Aluminum/Cross-Linked Polyethylene (PEX-AL-PEX) Pipe.
Joints between cross-linked polyethylene/aluminum/cross-linked polyethylene (PEX-AL-PEX) pipe and fittings shall be installed in accordance with one of the following methods:
(1) Mechanical joints between PEX-AL-PEX pipe and fittings shall include mechanical and compression type fittings and insert fittings with a crimping ring. Insert fittings utilizing a crimping ring shall be in accordance with ASTM F1974 or ASTM F2434.
(2) Compression joints shall include compression insert fittings and shall be joined to PEX-AL-PEX pipe…

1211.8 Ductile Iron Pipe.
Joints between ductile iron pipe and fittings shall be installed in accordance with one of the following methods:

(1) Mechanical joints for ductile iron pipe and fittings shall consist of a bell that is cast integrally with the pipe or fitting and provided with an exterior flange having bolt holes and a socket with annular recesses for the sealing gasket and the plain end of the pipe or fitting. The elastomeric gasket shall comply with AWWA C111/A21.11. Lubricant recommended for the application by the pipe manufacturer shall be applied to the gasket and plain end of the pipe.
Ductile Iron Pipe.
(2) Push-on joints for ductile iron pipe & fittings shall consist of a single elastomeric gasket that shall be assembled by positioning the elastomeric gasket in an annular recess in the pipe or fitting socket & forcing the plain end of pipe or fitting into socket.
Plain end shall compress elastomeric gasket to form a positive seal & shall be designed so that elastomeric gasket shall be locked in place against displacement. Elastomeric gasket shall comply with AWWA C111/A21.11.
Lubricant recommended for the application by pipe manufacturer shall be applied to the gasket & plain end of the pipe.

1211.9 Polyethylene (PE) Plastic Pipe/Tubing.
Joints between polyethylene (PE) plastic pipe or tubing and fittings shall be installed in accordance with one of the following methods:

(1) Butt-fusion joints shall be installed in accordance with ASTM F2620 and shall be made by heating the squared ends of two pipes…
(2) Electro-fusion joints shall be heated internally by a conductor at the interface of the joint…
(3) Socket-fusion shall be installed in accordance ASTM F2620 and shall be made by simultaneously heating the outside surface of a pipe end and the inside of a fitting socket…
(4) Mechanical joints between PE pipe or tubing and fittings shall include insert and mechanical compression fittings that provide a pressure seal resistance to pullout...
Clamps shall be positioned equal to 180 degrees (3.14 rad) apart and shall be tightened to provide a leak tight joint…
Mechanical joints shall be designed for their intended use.

1211.10 Polyethylene/Aluminum/Polyethylene (PE-AL-PE).
Joints between polyethylene/aluminum/polyethylene (PE-AL-PE) pipe and fittings shall be installed in accordance with one of the following methods:

(1) Mechanical joints for PE-AL-PE pipe or tubing and fittings shall be either of the metal insert fittings with a split ring and compression nut or metal insert fittings with copper crimp rings. Metal insert fittings shall comply with ASTM F1974…

(2) Compression joints for PE-AL-PE pipe or tubing and fittings shall be joined through the compression of a split ring, by a compression nut around the circumference of the pipe.

1211.11 Polyethylene of Raised Temperature (PE-RT).
Joints between polyethylene of raised temperature (PE-RT) tubing and fittings shall be installed with fittings for PE-RT tubing that comply with the applicable standards referenced in Table 1210.1. Metal insert fittings, metal compression fittings, and plastic fittings shall be manufactured to and marked in accordance with the standards for fittings in Table 1210.1.

1211.12 Polypropylene (PP) Pipe.
Joints between polypropylene pipe and fittings shall be installed in accordance with one of the following methods:

(1) Heat fusion joints for polypropylene (PP) pipe shall be installed with socket-type heat-fused polypropylene fittings, butt-fusion polypropylene fittings or pipe, or electro-fusion polypropylene fittings. Joint surfaces shall be clean and free from moisture. The joint shall be undisturbed until cool. Joints shall be made in accordance with ASTM F2389 or CSA B137.11.

(2) Mechanical and compression sleeve joints shall be installed in accordance with the manufacturer's installation instructions. Polypropylene pipe shall not be threaded. Polypropylene transition fittings for connection to other piping materials shall only be threaded by the use of copper alloy or stainless-steel inserts molded in the fitting.

1211.13 Polyvinyl Chloride(PVC) Pipe.
Joints between polyvinyl chloride pipe and fittings shall be installed in accordance with one of the following method:

(1) Mechanical joints shall be designed to provide a permanent seal and shall be of the mechanical or push-on joint. The mechanical joint shall include a pipe spigot that has a wall thickness to withstand without deformation or collapse; the compressive force exerted where the fitting is tightened. The push-on joint shall have a minimum wall thickness of the bell at any point between the ring and the pipe barrel. The elastomeric gasket shall comply with ASTM D3139, and be of such size and shape as to provide a compressive force against the spigot and socket after assembly to provide a positive seal.

(2) Solvent cement joints for PVC pipe and fittings shall be clean from dirt and moisture. Pipe shall be cut square and pipe shall be deburred. Where surfaces to be joined are cleaned and free of dirt, moisture, oil, and other foreign material, apply primer purple in color in accordance with ASTM F656. Primer shall be applied until the surface of the pipe and fitting is softened. Solvent cements in accordance with ASTM D2564 shall be applied to all joint surfaces…

(3) Threads shall comply with ASME B1.20.1. A minimum of Schedule 80 shall be permitted to be threaded; however, the pressure rating shall be reduced by 50 percent…

1211.14 Steel Pipe & Tubing.
Joints between steel pipe or tubing and fittings shall be installed in accordance with one of the following methods:

(1) Mechanical joints shall be made with an approved and listed elastomeric gasket.
(2) Threaded joints shall be made with pipe threads that are in accordance with ASME B1.20.1. Thread sealant tape or compound shall be applied only on male threads, and such material shall be of approved types, insoluble in water, and non-toxic.
(3) Welded joints shall be made by electrical arc or oxygen/acetylene method. Joint surfaces shall be cleaned by an approved procedure. Joints shall be welded by an approved filler metal.
(4) Pressed joints shall have an elastomeric O-ring that forms the connection. Pipe or tubing shall be fully inserted into fitting, & pipe or tubing marked at the shoulder of the fittings. Pipe or tubing shall be cut square, chamfered, & reamed to full inside diameter. Fitting alignment shall be checked against the mark on pipe or tubing to ensure pipe or tubing is fully inserted into fitting. Joint shall be pressed using the tool recommended by the manufacturer.

1211.15 Stainless Steel Pipe & Joints.
Joining methods for stainless steel pipe and fittings shall be installed in accordance with the manufacturer's installation instructions and shall comply with Section 1211.15.1 or Section 1211.15.2.

1211.15.1 Mechanical Joints.
Mechanical joints shall be designed for their intended use. Such joints shall include compression, flanged, grooved, press-connect, and threaded.

1211.15.2 Welded Joints.
Welded joints shall be either fusion or resistance welded based on the selection of the base metal. The chemical composition of the filler metal shall comply with AWS A5.9 based on the alloy content of the piping material.

1211.16 Joints Between Various Materials.
Joints between various materials shall be installed in accordance with the manufacturer's installation instructions and shall comply with Section 1211.16.1 and Section 1211.16.2.

1211.16.1 Copper/Copper Alloy Pipe/Tubing to Threaded Pipe Joints.

- Joints from copper or copper alloy pipe or tubing to threaded pipe of a material other than copper or copper alloy shall be made by the use of copper alloy adapter, copper alloy nipple [minimum 6 inches (152 mm)], dielectric fitting, or dielectric union in accordance with ASSE 1079.

- The joint between the copper or copper alloy pipe or tubing and the fitting shall be a soldered, brazed, flared, or pressed joint and the connection between the threaded pipe and the fitting shall be made with a standard pipe size threaded joint.

1211.16.2 Plastic Pipe to Other Materials. Where connecting plastic pipe to other types of plastic or other types of piping material; approved listed adapter or transition fittings and listed for the specific transition intended shall be used. Except as provided in the plumbing code, PVC pipe and fittings shall not be solvent welded to any other unlike material.

For Sections 1212.0 Valves. Through 1220.5 Hydronic Makeup Air Units.
Scan QR Code on page 9 to view the complete text in IAPMO's read only Code.
Notes Pag

1221.0 Piping Installation.
1221.1 General.
Piping, fittings, & connections shall be installed in accordance with conditions of their approval & manufacturer's installation instructions.
1221.2 Embedded Piping Materials and Joints.
Piping embedded in concrete shall be steel pipe, Type L copper tubing or plastic pipe or tubing not less than 80 psi at 1800 F (552kPa at 820 C). Joints of pipe or tubing that are embedded in a portion of the building, such as concrete or plaster shall be installed in accordance with Section 1221.2.1 through Section 1221.2.3.

1221.2.1 Steel Pipe. Steel pipe shall be welded by electrical arc or oxygen/acetylene method.
1221.2.2 Copper Tubing. Copper tubing shall be joined by brazing with filler metals having melting point not less than 10000 F (5380C).
1221.2.3 Plastics. Plastic pipe and tubing shall be installed in continuous lengths or shall be joined by heat fusion methods or other approved fittings in accordance with Table 1210.1 and the manufacturer's installation instructions. Solvent cement joints shall not be used in embedded applications.

1221.3 Pressure Testing.
Piping to be embedded in concrete shall be pressure-tested in accordance with Section 1205.2…

1221.4 System Drainage.
Hydronic piping systems shall be installed to permit the system to be drained. The system shall drain by indirect waste in accordance with Section 1001.4…

1221.5 Condensate Drainage.
Condensate drains from dehumidifying coils shall be constructed and sloped for condensate removal. Drains shall be installed in accordance with Section 310.0.

1221.6 Hydronic Fluid Disposal.
Hydronic system fluids that contain additives such as antifreeze, corrosion inhibitors, and cleaning solutions shall be recycled or disposed of in an approved manner in accordance with Environmental Protection Agency (EPA), Department of Health, & as required by the AHJ.

1212.7 Clearance to Combustibles.
Hydronic piping where the exterior temperature exceeds 250°F (121°C) shall have a clearance of not less 1 inch (25.4 mm) to combustible materials.

Chapter 17 UMC Geothermal Energy Systems & Ambient Temperature Loops

Part 1 - General

1701.0 General.

1701.1 Applicability.

- Part 1 of this chapter covers geothermal energy systems:
  - building systems coupled with a ground-heat exchanger
  - submerged heat exchanger using water-based fluid as a heat transfer medium
  - groundwater (well)
- Part I through V cover geothermal energy systems and district ambient temperature loop:
  - permit independent and bi-directional heating and cooling
  - building systems coupled with ground district ambient temperature loops
  - a ground-heat exchanger
  - Submerged heat exchanger using water-based fluid as a heat transfer medium
  - groundwater (well)

1701.1.1 Prior to Construction. AHJ issues permits
1701.1.2 Equipment, Accessories, Components, and Materials. All equipment and materials rated for use in geothermal systems
1701.1.3 Indoor Piping. Must comply with Section 1703.5 and Chapter 12

1701.2 Construction Documents. Submit to AHJ

1701.3 Site Survey. Prior to designing system… AHJ possible document examples
(1) Ground-heat exchanger dimensions.
(2) Grout or sealing specifications, as applicable.
(3) Dimensions from building to water well, ground-heat exchanger, or submerged heat exchanger.
(4) Operating temperatures and pressures.

1701.4 Used Materials. Shall not be used…

1701.5 Contact with Building Material. Geothermal system materials shall not contact building materials that will cause damage or corrosion.

1701.6 Strains and Stresses.

- No unwarranted strains on piping
- Account for normal pipe movement and structural changes

1701.7 Flood Hazard. Special design considerations for flood zones

1701.8 Pipe Support. See Section 313.1

1701.9 Velocities.

- All systems designed to meet flow velocities of material specifications
- Reduce/eliminate water hammer

1701.10 Chemical Compatibility. Materials compatibility with other materials and antifreeze chemicals

1701.11 Heat Transfer Fluid. All system fluids shall be compatible

1701.11.1 Water Quality…. in accordance with IAPMO/ANSI H1001.1, ANSI/CSA/IGSHPA C448, or Table 1701.11.1 potable water quality according to the ANJ

1701.11.2 Compatibility. System fluids and components shall be compatibility with each other.

1702.0 Groundwater Systems.
1702.1 General.
Potable water supply connected to a groundwater system shall be protected with an approved backflow prevention device. Connection of a discharge line to sanitary or storm sewer system, or private sewage disposal system, shall be in accordance with plumbing code or in accordance with AHJ.

1706.0 Specific System Components Design.
1706.1 General.

- Heat pumps:
- Must comply with Table 1706.1
- Be listed and labeled UL 1995 or UL 60335-2-40
- Ground/water pumps:
- Water-to-air AHRI/ASHRAE/ISO 13256-1
- Water-to-water AHRI/ASHRAE/ISO 13256-2
- DX heat pumps- ASHRAE 194
- DX systems AHRI 870

1707.0 Installation Practices.
1707.1 Prior to Construction.
Documents for permits shall be submitted prior to the construction of a building system, or water well. Permits shall be issued by the AHJ.

1707.2 Equipment, Accessories, Components, and Materials.
The mechanical equipment, accessories, components, and materials used shall be of the type and rating approved for the specific use.

1707.3 Construction Documents.
The construction documents for the building system portion of the geothermal energy system shall be submitted to the AHJ.

1707.4 Site Survey Requirements.
Detailed description of the any limitations of the land area, should include but not limited to:

- Existing structures
- Ground wells (if any)
- Proximity of other geothermal systems
- Hardscapes
- Septic systems
- Right-of-ways
- Etc.

1707.5 Subsurface Investigation. Complying with Section 1707.6

1707.6 Subsurface Conditions. Provide water well logs and other geological records… Permafrost and building stability

1707.7 Ground-Heat Exchanger Installation Practices.

(1) Pipe insulation and protection
(2) Freeze protection
(3) Horizontal lines 12” (305 mm) below frost line
(4) Secure submerged heat exchangers
(5) AHJ approves backflow protection of the potable water
(6) Set-back requirements for vertical and horizontal ground-heat exchangers
(7) Requirements for wells and boreholes

1707.11 Protection of Piping, Materials, and Structures.

- Sections 316.1 and 316.2
- Tracer wire (at least AWG 14)

1707.12 Sleeves.

- Watertight seal between building and sleeve
- Sections 316.7 thru 316.7.2

1707.13 Steel Nail Plates. When working with plastic and copper pipes Section 316.6

1707.14 Exterior Piping Protection. End caps; protect against damage
1707.15 Heat Pump and Distribution System Installation.
Installed according to design, code requirements and manufacturer’s installation instructions

1707.16 Pressurizing During Installation. Pressure tested before and during concrete pours

1708.0 System Start-Up.
1708.1 General.
The following requirements shall be verified prior to system start-up:

(1) Piping shall be cleaned, flushed, and purged.
(2) …where required, shall be filled with the heat transfer fluid medium. …tested at the design flow rate(s) and differential pressure(s) recorded.
(3) A method for the removal of air and a method for adding heat transfer fluid (where necessary) shall be provided.
(4) System operation and adjustments according to the manufacturer's installation instructions.
(5) All flow tests completed prior to heat pump start-up.
(6) Complete system operating as required.
(7) Permanently labeled, listing type of heat transfer fluid or antifreeze (with concentration) used.
(8) Supply and return lines, as well as associated isolation valves from individual boreholes or water wells, shall be identified and tagged.
(9) Supply and return lines on submerged systems shall be identified in an approved manner, at the point of entry to a surface water resource.

1708.2 Operation and Maintenance Manual. Provided: manuals; training, includes maintenance, testing; diagram for system layout.

1708.3 Labeling and Marking. At building entrance label "GROUND SOURCE HEAT PUMP-LOOP SYSTEM."

1708.4 Documentation. Provide as-built installation drawings and instructions

1708.5 Maintenance. Provide maintenance schedule

1708.6 Records. Provide construction documents

1708.7 System Start-up. According to ANSI/CSA/IGSHPA C448 and Section 1708.0

1708.8 Contaminants. Particulate contaminants shall be removed from the indoor piping system prior to initial startup.

1709.0 Decommissioning & Abandonment
1709.1 General. Decommissioning of geothermal systems shall comply with ANSI/CSA/IGSHPA C448. Prior to the abandonment or decommissioning of geothermal systems, the owner shall obtain the necessary permits from the AHJ.

Part II - Closed-Loop Systems

1710.0 General.

1710.1 Applicability.

Part II of this chapter shall apply to geothermal closed-loop systems such as, but not limited to, building systems coupled with a closed-loop system using water-based fluid as a heat transfer medium.

1710.2 Piping and Tubing. Piping and tubing for closed-loop systems shall be in accordance Section 1703.2 and Table 1703.2.

1710.3 Borehole Piping and Tubing. Borehole piping or tubing for vertical and horizontally drilled closed-loop systems shall have a minimum wall thickness equal to SDR-11 and shall have a minimum pressure rating of not less than 160 psi (1103 kPa) at 73°F (23°C).

1710.4 Underground Fittings. Underground fittings for closed-loop systems shall be in accordance with Section 1703.3 and Table 1703.3.

1710.5 Verification. For closed-loop systems, the system shall be flushed of debris & purged of air after completion of the entire ground-heat exchanger. Flow rates & pressure drops shall be compared to calculated values to assure no blockage or kinking of & pipe. A report shall be submitted to owner to confirm loop flow is in accordance with construction documents.

1711.0 Ground-Heat Exchanger Testing.

1711.1 Testing. Pressure-testing of the ground-heat exchanger shall be performed in accordance with the testing method in Section 1710.6.

1711.2 Individual Loop Pressure Testing. Individual loop testing shall be performed as required by the AHJ.

1711.3 Field Pressure Testing – Final. System shall be cleaned of all contaminants and tested to design flow ratings.

1711.4 Field Flow Testing – Final. Final field flow testing shall be performed as required by the AHJ.

1710.6 Vertical Bores.

- Vertical bores shall be drilled to a depth to provide complete insertion of the u-bend pipe to its specified depth.
- Borehole diameter shall be sized for the installation & placement of the heat exchange u-bend and the tremie used to place the grouting material.
- ANSI/CSA/IGSHPA C448 shall be used for vertical loop depth and borehole diameter sizing guidance.

- U-bend joint & pipe shall be visually inspected for integrity in accordance with manufacturer's installation instructions.
- U-bend joint & pipe shall be pressurized to not less than 100 psi (689 kPa), not to exceed pressure rating of pipe at the test temperature, for 1-hour to check for leaks before insertion into the borehole.

1710.6.1 Backfill. Bentonite grout and thermally-enhanced bentonite grout, where used to seal and backfill each borehole, shall comply with NSF/ANSI/CAN 60. Boreholes shall be backfilled in accordance with the AHJ.

1710.6.2 U-Bends and Headers. Headers, u-bends and ground loop pipes shall be pressure-tested in accordance with ANSI/CSA/IGSHPA C448, or as required by the AHJ. …

1710.6.2.1 Test Pressure. The maximum test pressure shall be 1.5 times the system design pressure, as determined by Section 1710.6.2.3, or Section 1710.6.2.4, not to exceed 100 psi (689 kPa). …With Exception

1710.6.2.2 Testing Procedure.

- The test section and the test liquid shall be at the same temperature.
- The test section shall be filled with liquid and purged of air.
- The test section shall be brought to the specified test pressure.
- Test pressure shall be maintained for 4 hours, with additional fluid added as needed.
- The test pressure shall be reduced by 10 psi (69 kPa) and monitored for 1 hour with no addition of pressure or additional fluid.
- A passing test is indicated where after a period of 1 hour no visual leakage is observed, and pressure remains equal to or greater than 95 percent of the original pressure.

1710.6.2.3 Calculation of Static Pressure (Water). For water, the static pressure applied shall be equivalent to 0.43 psig (2.96 kPa) per foot (305 mm) of elevation.

1710.6.2.4 Calculation of Static Pressure (Other Fluids). For fluids of different density, the static pressure shall be calculated using the density of the system fluid.

1711.1 Testing. Pressure-testing of the ground-heat-exchanger shall be performed in accordance with the testing method in Section 1710.6.

1711.2 Individual Loop Pressure Testing. Individual loop testing shall be performed as required by the AHJ.

1711.3 Field Pressure Testing – Final. The ground-heat exchanger and building piping shall be cleaned, flushed, and, where required, shall be filled with the heat transfer fluid medium. The ground loop system shall be tested at the design flow rate(s)

and differential pressure(s) recorded. Where the actual pressure change at design flow is more than +/- 10 percent of the design flow pressure drop, the cause shall be identified, and corrective action taken.

1711.4 Field Flow Testing – Final. Final field flow testing shall be performed as required by the AHJ.

Part III - Open-Loop Systems

1712.0 General.

1712.1 Applicability.

- Part III of this chapter shall apply to geothermal open-loop systems such as, but not limited to, building systems coupled with a groundwater (well) or surface water open-loop system using water-based fluid as a heat transfer medium. The regulations of this chapter shall govern the construction, location and installation of geothermal energy systems.
- Indoor piping, fittings, and accessories that are part of the groundwater system shall be in accordance with Section 1703.5 and Chapter 12. Components installed in a geothermal open-loop system shall be constructed of non-ferrous or other corrosion resistant materials.

1712.2 Test Wells.

- Test wells drilled to investigate subsurface conditions shall provide details of the groundwater location, chemical and physical characteristics, rock strata, and temperature profiles.
- The number of test wells shall be determined in accordance with the AHJ.
- Each test well shall be tested for flow rate for a period of not less than 24 hours.
- Water samples shall be collected in accordance with NGWA-01 from each well to establish existing water quality levels are approved for groundwater system use.
- Water samples shall be analyzed for standard drinking water, fecal and coliform content, bacterial iron, nitrate, dissolved minerals, pH, hardness, and other compounds in accordance with NGWA-01 or in accordance with the AHJ.
- Wells shall be tested for water production and recovery.
- Monitoring wells shall be protected, and marked to allow for monitoring of ground temperature, groundwater levels, and groundwater quality.

1712.3 Installation of Water Wells.

- Water supply, recharge wells, and pumping equipment shall be hydraulically tested, sealed, and grouted in accordance with approved well construction practices and submitted to the AHJ for approval.
- Wells shall be tested for water production and recovery, water quality before final system design.
- Wells shall be disinfected upon completion in accordance with NGWA-01
- A copy of the water quality test results and the log of well construction in accordance with NGWA-01 shall be provided to the owner.

- In accordance with the AHJ.

1712.4 Setbacks.
Open-loop ground-heat exchangers shall maintain the following minimum setbacks or at distances specified by the AHJ:

(1) Ten feet (3048 mm) horizontally from a pressure-tested sewer lateral into a building.
(2) Twenty feet (6096 mm) horizontally from a non-pressure tested sewer lateral into a building.
(3) Three feet (914 mm) horizontally from buried utilities such as electrical, gas, or water.
(4) Fifty feet (15 240 mm) from a water well.
(5) Fifty feet (15 240 mm) from a septic tank and 100 feet (30 480 mm) from a subsurface sewage leaching field.
(6) One hundred feet (30 480 mm) from a spring.

1713.0 Open Ground Water Systems.
1713.1 General. The installation and use of water wells shall be in accordance with the AHJ. The water well records shall include well logs, pumping tests, and aquifer information.

1713.2 Open-Loop Water Well Drilling Logs. The water-well drilling logs shall include the following:

(1) The subsurface stratigraphy.
(2) The aquifer type and conditions such as, but not limited to, confined, unconfined, flowing and depth.
(3) The drilling method used and the penetration speed.
(4) The presence of substances known to have a potential risk to health and safety shall be documented in the drill logs and the property owner shall be advised of the potential risk to health and safety.

1713.3 Design Considerations. A groundwater heat pump system shall be designed by a registered design professional. Due design consideration shall be given to the following:

(1) Where multiple heat pumps or fan coils are connected to a common water loop, a diversified building design load shall be used to design a ground water heat pump.
(2) The water supply well(s) and injection wells, or water discharge system, shall be capable of being operated at sustainable pumping rates that exceed the maximum daily requirements without causing an adverse impact to existing or future offsite uses of groundwater or surface water bodies.
(3) The water temperature and the quality and chemical composition of the water resource are in accordance with the system manufacturer’s recommendations.

(4) The groundwater and surface water resources shall be protected by returning water to the source aquifer or an aquifer with the same water quality, or a surface water body.
(5) The return capacity of the injection, or surface water body discharge system, shall be suitable under winter conditions.
(6) The temperature of the return water shall have no adverse thermal impacts on offsite existing or future uses of groundwater, or on surface water bodies, in accordance with the requirements of the AHJ
(7) Pressure gauges shall be provided to aid in start-up and monitoring of the system during operation.
(8) The ability to switch over operation of supply and return wells for 100 percent standby, redevelopment, cleaning of wells, and the thermal balancing of the ground and aquifer shall be provided.
(9) There shall be no adverse effects on the quality and quantity of offsite existing or future users of groundwater, in accordance with the requirements of the AHJ.

1713.4 Water Wells and Injection Wells. Water wells and injection wells for groundwater heat pump systems shall be installed and tested by a registered design professional who is qualified to drill wells that comply with the requirements of the AHJ. Water supply wells and injection wells shall be developed in accordance with NGWA-01.

1713.5 Testing and Sampling. Pumping tests & water sampling shall be done as required by the registered design professional.

1713.6 Disinfection. Water wells shall be disinfected upon completion in accordance with requirements of AHJ & NGWA-01.

1714.0 Testing & Verification.
1714.1 Pumping Test. Water supply wells and injection wells shall undergo a stop and start pumping test to demonstrate the sand-free yield.

1714.2 Retesting. Where sediment is present, the problem shall be corrected and the test shall be repeated until acceptable results are obtained.

1714.3 Variable Rate Pump Test. The operating conditions of the water supply wells and injection wells shall be evaluated and verified with a variable rate pumping.

1714.4 Constant Rate Pump Test. The sustainable well yield, aquifer coefficients, and zones of influences on the groundwater flow requirements shall be confirmed with a constant rate-pumping test. The constant rate-pumping test shall be done on the water supply and injection wells at rates and durations as specified by the registered design professional.

1714.5 Water Level Monitoring. Water levels shall be monitored in the pumping well & observation wells during pumping & recovery periods. The monitoring time intervals shall be as specified by the registered design professional.
1714.6 Injection Wells. Injection testing shall be performed on water wells that are designated to be used as injection wells at rates specified by the registered design professional. Results of drilling & pumping tests shall be provided to owner or owner's representative & provided in accordance with requirements of the AHJ.
1714.7 Re-Injected Water. The water quality of re-injected water into the earth shall comply with the requirements of the AHJ.

Part IV - Direct Exchange (DX) Systems

1715.0 Direct Exchange (DX) Systems.
1715.1 General.
The installation and use of Direct Exchange (DX) wells shall be in accordance with the AHJ. The DX well records shall include well logs, pressure tests, and aquifer information.

1715.3 DX Systems. Copper pipe & tubing installed for DX systems shall be manufactured in accordance with ASTM B280 & copper fittings in accordance with ASME B16.22. Joints shall be purged with an inert gas & brazed with a brazing alloy having 15 percent silver content in accordance with AWS A5.8. Underground piping & tubing shall have a cathodic protection system installed.

1715.4 DX System Testing. For direct exchange (DX) systems, each refrigerant u-bend shall be tested & proved tight with an inert gas at not less than 315 psi (2172 kPa) & maintained for 15 minutes without pressure drop. Pressure reading after tremie grouting of boreholes shall be maintained in the ground-heat exchanger for not less than 2 hours, in accordance with ANSI/CSA/IGSHPA C448.

1715.5 Indoor Piping. For DX systems, joints shall be purged with an inert gas and brazed with a brazing alloy having 15 percent silver content in accordance with AWS A5.8.

1715.6 On Site Storage. For DX systems, copper piping and fittings shall be stored to prevent physical damage, contamination, & each pipe or tubing shall be pressurized with an inert gas and sealed with a cap.

1715.7 System Start-Up. DX system start-up shall be in accordance with Section 1708.1 and the following:

(1) DX systems shall be pressurized using nitrogen for not less than 1 hour. There shall be no allowable variance to the test pressure after being corrected for ambient temperature changes during the test. The test pressure shall not exceed 150 psig (1034 kPa) when pressure testing the compressor unit and indoor system components.

(2) DX systems shall have permanent type labels installed and affixed on the compressor unit with the refrigerant type and quantity.
(3) For DX systems, refrigerant liquid and vapor lines from the loop system shall be identified and tagged.

1715.8 DX Piping. DX Piping should be installed in accordance with approved plans and specifications, including provisions for cathodic protection.

Part V - Geothermal Ambient Temperature Loops (ATL)

1716.0 Ambient Temperature Loop (ATL) Distributed Energy Systems.
1716.1 General. An Ambient Temperature Loop (ATL) distributed energy system shall be installed in accordance with Section 1716.1.1 through Section 1716.6.3 and Section 1717.0. ATL systems shall comply with Part I through Part IV of this chapter, as applicable.

1716.1.1 Fourth Generation (4G) System Configuration. A fourth-generation system configuration shall be a district geothermal energy system distributing hot water, cold water, or both to the conditioned space or building for a specific use. Where a geothermal energy source is used, such system shall comply with Part I through Part IV of this chapter, Chapter 11, and Chapter 12.

1716.1.2 Fifth Generation (5G) System Configurations.

- An advanced Ambient Temperature Loop (ATL) System or fifth generation (5G) ATL system shall also be capable of interacting with the electric utility system as well as other utility systems and systems components.
- The system components shall include, but not limited to, the following:

1716.2 Permitting. Permits required for the installation and application of an ATL distributed energy system shall be obtained as required by the AHJ.

1716.3 Ambient Loop Temperature Range. Operating loop temperature range of an ambient temperature loop (ATL) system shall be not less than the freeze point of circulating fluid & not more than maximum temperature as required by manufacturer's installation instructions for the attached heat pump equipment in accordance with Section 1716.3.1 and Section 1716.3.2. The ATL system shall use treated water as the heat transfer medium.

1716.3.1 ATL Operating Temperature.

- For equipment listed to AHRI/ASHRAE/ISO 13256-1 and AHRI/ASHRAE/ISO 13256-2, the controlled temperature range of the ambient closed loop shall be not less than 7°F (4°C) above the freeze point of the transport fluid and 10°F (6°C) below the (collective) heat pump lowest maximum inlet supply temperature as recommended by the manufacturer's instructions.

- Exception: Equipment that is not listed to AHRI/ASHRAE/ISO 13256-1 and AHRI/ASHRAE/ISO 13256-2. The controlled temperature range of the ambient closed loop shall be in accordance with Section 1716.3.2 for minimum and maximum temperatures.

1716.3.2 ATL Operating Temperature Range for Mixed Equipment Certifications. The source inlet temperature range of any attached equipment shall govern the design operating temperature range. Such equipment shall be identified in the design documentation. In any case the most restrictive minimum and maximum inlet supply temperatures, as recommended by the manufacturer's instructions, shall determine the system operating temperature range.

1716.4 Shutoff Valve. An automatic shutoff valve shall be provided for each individual building or facility transferring energy to or from an ATL distribution system. The automatic shutoff valve shall automatically shutoff upon operating command.

1716.4.1 Shutoff Valve Operation. The operation of the automatic shutoff valve shall be in accordance with the system operating procedures. Where the operation of a shutoff valve was due to an emergency response, an auxiliary heating or cooling methodology shall be provided in accordance with Section 1717.1.2.

1716.5 Bypass. The ATL distributed energy system shall be provided with bypass path(s) to reroute the circulating fluid when necessary

1716.6 Metering.
Where meters are required by the system design, meter(s) shall be located as specified by the manufacturer on each consumptive or supply source and the range of the metering shall be appropriate to the thermal properties and flow rate(s) of the transport fluid.

1716.6.1 Sub-Metering System Specification.
The entire energy measurement system shall be provided with a sub-metering system. The metering system shall be calibrated and shall consist of a flow meter, temperature sensors, temperature thermowells, or other required mechanical installation metering. The sub-meter traceable calibration shall comply with the National Institute of Standards Technology (NIST) traceable calibration program or in accordance with the AHJ and shall be provided with an ATL distributed energy system.
Refer to code book for other sub-sections.

1717.1 Thermal Resources. Ambient temperature loop shall be permitted to connect to a thermal resource(s). Such resources may be an alternative energy source and sink, such as but not limited to solar photovoltaic (PV), solar thermal, combined heat power (CHP), & phase change thermal storage. These systems shall be installed & comply with respective system requirements. ATL distributed energy systems coupled with solar thermal systems shall comply with Uniform, Solar, Hydronics and Geothermal

Code (USHGC) or equivalent. ATL systems coupled with a solar PV system shall comply with USHGC or NFPA 70, or equivalent. These systems shall optimize use of equipment & energy based on system design intent.

1717.1.1 System Performance. System Coefficient of Performance (SCOP) of the system shall take net COP of each individual members in district. The SCOP shall be provided by the designer & included in the system design documents.

1717.1.2 Emergency Response. An auxiliary heating or cooling methodology shall be provided with ATL controls & shall be adequate to provide temporary service in the absence of an ATL energy transfer. Emergency source/sink measures such as but not limited to control subroutines that move energy between spaces in building, use of locally connected ground source assets, combined heat & power (CHP), conventional equipment, other renewables systems may be used

1717.2 District Load Profiles. The district load profile of an ambient temperature loop (ATL) distributed energy system shall be identified and shall be included in the basis-of-design (BOD).

1717.2.1 System Asset Identification. System assets shall be listed and included in the system design. The system asset shall include, but not be limited to, the following:

(1) Building type and quantity.
(2) Natural or constructed sources and sinks such as ground water, boreholes, etc.
(3) Other renewable assets.
(4) Wasted heat recovery.
(5) Potable and non-potable water or fluid sources.
(6) Conventional assets such as boilers and cooling towers.
(7) Other GeoMicroDistrict or thermal highway.

1717.2.2 Driver Building. The driver building profile shall be identified in an ATL distributed energy system and shall be reported in the design documents.

1717.2.3 Diversity Factor. Diversity factor and/or anticipated wasted energy recovery component of the GeoMicroDistrict shall be identified by designer & this information shall be included in drawings & specifications.
1717.0

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