



Design Standard

Hydronic Piping in Buildings

This standard was revised on May 5, 2021, and the latest changes are underlined. Please refer to Part 4 of this standard for full revision history.

Detailed specifications follow.

PART 1 - GENERAL

- 1.01** Above ground hydronic piping 4 inches and less in diameter shall be as follows:⁵
- A. Copper
 - 1. Pipe: ASTM B88, hard drawn copper, Type L.¹
 - 2. Fittings: ASTM B16.22 Wrought copper and copper alloy.
 - 3. Viega propress fittings or approved equal required¹⁰
 - B. Polypropylene
 - 1. Pipe: ASTM F2389 polypropylene pipe and fittings.
 - 2. Pipe shall have certification from NSF to meet NSF 14 and 61 and be listed with ICC.
 - 3. Joints: Socket fusion, electrofusion, or butt fusion as applicable.
 - 4. All installers and equipment used for fusing shall be certified by piping manufacturer. All fusion joints shall be prepared using a data logging system. Each joint shall be uniquely identified with a permanent marker¹²
 - 5. Manufacturer: Aquatherm, Niron or approved equal.^{7,13}
- 1.02** Above ground hydronic piping greater than 4 inches in diameter shall be as follows:⁶
- A. Carbon Steel⁹
 - 1. Pipe: ASTM A53, Grade B Type E or S, standard weight black steel pipe.
 - 2. Fittings: ASTM A234 WPB, ANSI B16.11 standard weight seamless carbon steel.
 - 3. Victaulic grooved fittings required for 3/4" and larger¹¹
 - B. Polypropylene
 - 1. Pipe: ASTM F2389 polypropylene pipe and fittings.
 - 2. Pipe shall have certification from NSF to meet NSF 14 and 61 and be listed with ICC.
 - 3. Joints: Socket fusion, electrofusion, or butt fusion as applicable.
 - 4. All installers and equipment used for fusing shall be certified by piping manufacturer. All fusion joints shall be prepared using a data logging system. Each joint shall be uniquely identified with a permanent marker¹²



5. Manufacturer: Aquatherm, Niron or approved equal. ^{7,13}
- 1.03 For condensate drain piping, provide one of the following:
 - A. Copper piping as specified above.
 - B. Schedule 40 conforming to ASTM Standard Specifications for black and hot-dipped zinc coated galvanized welded and seamless steel pipe, ASTM designation A135.
- 1.04 For polypropylene applications, piping shall be terminated at the control valve at the AHU. Piping from the control valve to the coil shall be copper.
- 1.05 Isolation Valves
 - A. Provide the piping systems with line size shutoff valves located at risers, at main branch connections at each floor, at branch takeoffs serving equipment and at each heating and cooling coil. Valves shall be provided on both supply and return lines.
 - B. At air handling units where multicoil (stacked) arrangement is used, provide each supply and return line to and from each stacked coil section with a union, pressure gauge, thermometer and a balancing valve with memory stop and valves for isolation of each coil.
- 1.06 Provide insulation with minimum thickness and conductivity values in compliance with the version of IECC specified in the Building Energy Efficiency Design Standard. ¹⁴
- 1.07 All hydronic piping systems (CHW and HHW) shall have automatic air venting at the highest point in the system.
- 1.08 Stainless steel fine wire mesh strainers shall be installed at all pumps and air handling units to mitigate problems with particulate matter.
- 1.09 The methodology for initial flushing and treatment of hydronic systems contained in Appendix A, or equivalent approved in advance by UES, is required for any new hydronic system (chilled water or heating hot water) prior to start up.
- 1.10 The methodology contained in Appendix B, or equivalent approved in advance by UES, is required for any hydronic system (chilled water or heating hot water) shutdown or layup of more than 30 days duration.
- 1.11 Di-electric insulating flanges shall be provided at all connections between copper and steel piping and maintained for the life of the piping system.



PART 2 - POLYPROPYLENE PIPE REQUIREMENTS

- 2.01** Standard Grade hydrostatic pressure ratings from Plastic Pipe Institute in accordance with TR-3 as listed in TR-4. The following three standard-grade hydrostatic ratings are required as a minimum:
- A. 200 Degrees F at 80 psi
 - B. 180 Degrees F at 100 psi
 - C. 73.4 Degrees F at 160 psi.
 - D. The project design engineer shall ensure that pipe specified meets the temperature and pressure requirements of the project.⁸
- 2.02** Certification of flame spread/smoke development rating of 25/50 in accordance with ASTM E84 when wrapped with standard pipe insulation, field installed.
- 2.03** Where installed in systems with pumps in excess of 7.5 HP, piping shall be protected from excessive heat generated by operating the pump at shut-off conditions. Where the possibility exists that the pump will operate with no flow, the protection method shall be a temperature relief valve or comparable level of protection, set to a maximum temperature of 185° F.

PART 3 - FLUSHING AND TREATMENT

- 3.01** All new metallic, hydronic piping systems shall be flushed and treated before the building piping system is connected to the central hydronic piping system.
- 3.02** Flushing and treatment shall be initiated by the university's project manager for the piping project (FP&C or SSC) upon completion of the installation.
- 3.03** Flushing and treatment shall be done in accordance with the specification in Appendix A.
- 3.04** Flushing and treatment shall be witnessed by representatives of the mechanical contractor, SSC and UES.
- 3.05** The chemical treatment firm shall complete the report in Appendix A. It shall be signed by the chemical treatment firm and all witnesses. The signed report shall be submitted to the UES Technical Services manager before the building system is connected to the central system.
- 3.06** Installation contractor shall cover the flushing and treatment costs for the building hydronic piping systems.
- 3.07** ChemTreat CT38 or approved equal is the chemical to be used for flushing. University Project Manager shall notify UES (darryl.petersen@tamu.edu) one week prior to flushing and treatment.^{2, 15}



3.08 After witnessing and verifying satisfactory completion of flushing and treatment, UES will open valve connecting the building to the campus hydronic systems. ³

PART 4 - REVISIONS TO DESIGN STANDARD

Revision #	Date	Location	Brief Description
1	6/1/2017	Part 1.01 A1	"Type K" pipe changed to "Type L".
2	1/18/2019	Part 3.07	FQ7101 is approved chemical to be used for flushing
3	1/18/19	Part 3.08	Witness and verification of flushing and treatment is needed before reconnection
4	1/18/19	Appendix A, Section 1.2	Recommended doses for pipe cleaning procedure
	10/6/2020	ALL	PEX-A removed from standard
5	10/6/2020	Part 1.01	Above ground hydronic piping changed from 2" to 4"
6	10/6/2020	Part 1.02	Above ground piping designation changed to 4" or greater
7	10/6/2020	Part 1.01 B4 and Part 1.02 A4	Niron removed from standard
8	5/5/2021	2.01D	Project design engineer shall ensure pipe specifications
9	5/5/2021	1.02A	Carbon Steel pipe added to standard
10	5/5/2021	Part 1.01 A	Viega propress fittings added to standard
11	5/5/2021	1.02 A	Victaulic grooved fittings added to standard
12	5/5/2021	1.01 B and 1.02 B	Fusing shall be certified by piping manufacturer
13	5/5/2021	1.01 B and 1.02 B	Niron added to standard
	5/5/2021	1.03	Polypropylene removed from standard
14	5/5/2021	1.06	Insulation thickness and conductivity values will comply with version of IECC
15	5/5/2021	3.07	ChemTreat CT38SUEZ replaces FerroQuest (FQ) 7101



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APPENDIX A

FLUSHING FOR CLOSED HYDRONIC SYSTEMS

SECTION 232500 - FLUSHING FOR CLOSED HYDRONIC SYSTEMS

PART 1 – METALLIC PIPING SYSTEMS

- 1.1 After the mechanical contractor has prepared the building and the piping to be flushed after it has been tested. Provide a complete water flushing and cleaning of the closed loop chilled and hot water systems as specified herein. Systems must be commissioned as clean and meet the water treatment specifications.
- 1.2 All chilled, and hot water piping and related equipment shall be thoroughly flushed out with pre-cleaning chemicals designed to remove deposits such as pipe dope, oils, loose rust, mill scale and other extraneous materials. Recommended dosages of pre-cleaner chemical products shall be furnished by water treatment supplier, added and circulated throughout the water systems. The water systems shall then be drained, refilled and flushed thoroughly until no foreign matter is observed and total alkalinity of the rinse water is equal to or better than that of the make-up water. Recommended dosages of pre-cleaner chemicals are listed in the Ferroquest (FQ) Preoperational pipe cleaning procedure.⁴
- 1.3 All temporary connections required for cleaning, purging, and circulating shall be included. Provide suitable pipe bypasses at each coil and heat exchanger during this cleaning operation.
- 1.4 Flushing & Cleaning – a third party flushing company should be used. Permanent facility pumps should not be used for circulating the cleaning water. However, if its impractical to use temporary pumps, the permanent facility pump may be used provided that the pump is unconditionally warranted for two years, parts and labor, after the date of substantial completion by the mechanical contractor. A documented flush plan may be required at the discretion of the engineer. All operators should be aware of and abide by the Safety and PPE regulations of the project site. Operation should be manned continuously during the flushing process.
- 1.5 Self-Contained Flush Unit Requirements – Should contain a pump or pumps connected that will meet or exceed the volume required to flush and purge the system at the required velocity rate through the largest pipe. A pump curve will be submitted along with other important documentation for the related equipment on the unit. This will include, at minimum, filtration, flow meter(s), pressure gauges, and unit description or picture.
- 1.6 Pre Flush - Bypass loops should be installed at all equipment components. Strainers can be removed when a self-contained purge unit is used in conjunction with on board filtration. Flush ports should be identified along with the type of high pressure hose or piping that will be used to connect to the system. The water source should be identified and must be adequate to fill and make up water in a timely manner to the system during the flush process.
- 1.7 Clear Water Flush – Fill the piping system with clean potable water. The first flush is a clear-water flush intended to circulate water through the system and force loose debris to low point drains and the flush cart filtration system. This flush should be at minimum velocity throughout the system of 5 to 7 ft/sec. Filtration should be 25 micron.
- 1.8 Cleaning & Passivation - The second flush cycle is a combined flushing cycle where cleaning and passivation chemicals are introduced into the system to clean the oils and treat the inside

wall of the piping system. This process will be monitored by the chemical treatment company to meet the chemical specifications of the water. The cleaning velocity should be between 3 to 5 ft/sec and the circulation time will be based on the chemical testing but will typically be up to 48 hours.

- 1.9 Treatment – After cleaning and before adding chemical initial charge, system must be flushed to meet these minimum requirements:**
- A. Conductivity no higher than 20 mmho above domestic water level**
 - B. No foam**
 - C. Copper level less than 0.5 ppm**
 - D. Iron level less than 1.0 ppm**
 - E. pH 9.4 or less**
 - F. Less than 1 ppm phosphates (ortho-phosphate PO₄)**
- 1.10 Final Clear Water Flush – The system will be continuously flushed while discharging chemicals into the sanitary system as approved locally. As the existing treated water is being discharged a fresh water make-up source will be utilized to ensure air is not introduced into the system. Continue to drain the system while adding domestic water to dilute the treated water. The chemical treatment company will monitor the outgoing water composition and compare the composition with the incoming water. Flush with fresh water until the conductivity is reduced to that of the make-up water and iron level is 1.0 ppm or less The final system water should be approved by the chemical treatment company. Filtration should be 5 micron.**
- 1.11 Final Chemical Fill – Once the chemical treatment company has determined the system has been brought back to the correct composition, the chemical treatment company will inject the final chemicals into the system. Once the system is filled with the final chemicals it is important that the water is not to be left stagnant. Chemical treatment shall be comparable to existing treatment program.**
- 1.12 Verify satisfactory completion of clean pipe and a final flushing and chemical treatment report should be signed by field personnel and submitted.**

PART 2 – PEX-A, POLYPROPYLENE, HDPE PIPING SYSTEMS

- 2.1 After the mechanical contractor has prepared the piping to be flushed after it has been tested. Provide a complete water flushing and cleaning of the polypropylene piping as specified herein. Systems must be commissioned as clean and meet the water treatment specifications.**
- 2.2 All polypropylene piping and related equipment shall be thoroughly flushed out with high volume and velocity water designed to remove deposits such as pipe shavings, dirt, debris and any other and other extraneous materials.**
- 2.3 All temporary connections required for cleaning, purging, and circulating shall be included. Provide suitable pipe bypasses at any equipment or building feeds during this cleaning operation.**
- 2.4 Flushing & Cleaning – a third party flushing company should be used. Permanent facility pumps should not be used for circulating the cleaning water. However, if its impractical to use temporary pumps, the permanent facility pump may be used provided that the pump is unconditionally warranted for two years, parts and labor, after the date of substantial completion by the mechanical contractor. A documented flush plan may be required at the discretion of the engineer. All operators should be aware of and abide by the Safety and PPE regulations of the project site. Operation should be manned continuously during the flushing process.**
- 2.5 Self-Contained Flush Unit Requirements – Should contain a pump or pumps connected that will meet or exceed the volume required to flush and purge the system at the required velocity rate through the largest pipe. A pump curve will be submitted along with other important documentation for the related equipment on the unit. This will include, at minimum, filtration, flow meter(s), pressure gauges, and unit description or picture.**
- 2.6 Pre Flush - Bypass loops should be installed at all equipment components. Strainers should be removed when a self-contained purge unit is used in conjunction with on board filtration. Flush ports should be identified along with the type of high pressure hose or piping that will be used to connect to the system. The water source should be identified and must be adequate to fill and make up water in a timely manner to the system during the flush process.**
- 2.7 Clear Water Flush – Fill the piping system with clean potable water. The flush intended to circulate water through the system and force loose debris to low point drains and the flush cart filtration system. This flush should be at minimum velocity throughout the system of 5 to 7 ft/sec. Filtration should be 25 micron. Minimum duration should be calculated using a formula of 1 hour per 1000 linear feet of pipe and until system water is comparable to make up water source.**
- 2.8 Final Chemical Fill – Once the chemical treatment company has determined the system has been brought back to the correct composition, the chemical treatment company will inject the final chemicals into the system. Once the system is filled with the final chemicals it is important that the water is not to be left stagnant. Chemical treatment shall be comparable to existing treatment program.**
- 2.9 Verify satisfactory completion of clean pipe and a final flushing and chemical treatment report should be signed by field personnel and submitted.**

Flush & Cleaning Hydronic Pipe Field Completion Report

Project Name _____

Date of Report: _____

Project Location: _____

Prime Contractor: _____

Mechanical Firm: _____

Chemical Treatment Firm: _____

Lead Flushing Technician On-Site During Process: _____

Project Type:

- Chilled Water Flush _____
- Condenser Water Flush _____
- Hot Water Flush _____
- Geothermal Piping F&P _____
- Other: _____

Scope Summary:

Start Time and Date: _____

End Time and Date: _____

Mechanical Representative

Chemical Representative

FP&C / SSC Representative

UES Representative



APPENDIX 6

***GE @5 MI D'C: '6I =@8 =B; '<<K / '7<K 'GMGH9A G

Lay-Up of Building HHW Systems

If any part or all of a heating hot water system will be taken out of service for a period of time, precautions must be taken to prevent severe corrosion damage, both traditional and microbiologically induced. Freeze protection of coils is briefly covered under this document but may also be a factor. All equipment must be taken into consideration, including heat exchangers and water loops that may be normally isolated.

Preparation

If equipment has become fouled during operation, then a cleaning should be completed first. Depending on the nature of the deposit and the metallurgy, a scale cleaning or iron based corrosion by-product type cleaning may be appropriate.

Wet Layup Method

Drain the system and refill with enough water to adequately circulate. Charge with a molybdate based product such as GE Betz CorrShield* MD4107 at 1250-2000 ppm or 10-17 lbs./1,000 gal and also add additional copper protection such as GE Betz Inhibitor AZ8104 at 100 -140 ppm or 1-1.5 lbs per 1,000 gallons of system volume.

Also add a high dose of a broad-spectrum biocide such as Spectrus* NX1100 at 100-200 ppm (0.83-1.7 lbs./1,000 gal).

Continuous circulation without load is preferred, but if not practical, circulate weekly and test monthly for microbiological activity and chemical residual.

Special Considerations with Freezing Conditions

In the unlikely event that building HHW system will be down and not recirculating during freezing conditions, layup of air coils with propylene glycol may be necessary, in this case a 35% solution of propylene coil is added to the coil system. It is essential if glycol in the coil is used, that it be COMPLETELY DRAINED and flushed with city water. All residual glycol must be removed before interconnecting this system with the larger UES system.

An alternate is to blow warm return air through the coil. Consult UES if you want to consider this as an option.

Lay-Up of Building Chilled Water Systems

If any part or all of a chilled water system will be taken out of service for a period of time, precautions must be taken to prevent severe corrosion damage, both traditional and microbiologically induced. Freeze protection of coils is briefly covered under this document but may also be a factor. All equipment must be taken into consideration, including heat exchangers and water loops that may be normally isolated.

Preparation

If equipment has become fouled during operation, then a cleaning should be completed first. Depending on the nature of the deposit and the metallurgy, a scale cleaning or iron based corrosion by-product type cleaning may be appropriate.

Wet Layup Method

Drain the system and refill with enough water to adequately circulate. Charge with a molybdate based product such as GE Betz CorrShield* MD4107 at 1250-2000 ppm or 10-17 lbs./1,000 gal and also add additional copper protection such as GE Betz Inhibitor AZ8104 at 100 -140 ppm or 1-1.5 lbs per 1,000 gallons of system volume.

Also add a high dose of a broad-spectrum biocide such as Spectrus* NX1100 at 100-200 ppm (0.83-1.7 lbs./1,000 gal).

Continuous circulation without load is preferred, but if not practical, circulate weekly and test monthly for microbiological activity and chemical residual.

Special Considerations with Freezing Conditions

In the event that building chilled water system will be down and not recirculating during freezing conditions, layup of air coils with propylene glycol may be necessary, in this case a 35% solution of propylene coil is added to the coil system. It is essential if glycol in the coil is used, that it be COMPLETELY DRAINED and flushed with city water. All residual glycol must be removed before interconnecting this system with the larger UES system.

An alternate is to blow warm return air through the coil. Consult UES if you want to consider this as an option.