

***Appendix
XII***

**Mechanical and HVAC Hydronic Piping
Requirements**

Revision 05
Date: 06/12/2014

Outline Mechanical and HVAC Hydronic Piping requirements

No	Abbreviation	Service	Location	Pipe Material	Class / Compliance	Tube	Joint	Failure	Valves	Insulation Material	Insulation Size	Backdrop Color / Letter Color	Remarks	Special Handling	Pressure Testing / Chemicals, Cleanout and Passivation	Red Size / Hazard / Storage
H1	CHWS and CHWR	Chilled Water Supply and Return	Direct Buried, Below Grade	Pipe 4" and above: Domestic (US Made) seamless steel pipe (No ERW, longitudinal seam and lap jointing are allowed.) Pipe 4" and below: ASTM A53, S, Grade A or Grade B	Pipe 4" to 10": Schedule 40, 12" and above: Standard weight	Welded AWS D1.1 Standard weight	Standard weight carbon steel, butt weld ASTM B 16.3.	Pipes up to 2": NIBCO T- Apollo series 77-140, pipes 3"-5": NIBCO LD3122.3. Pipes 6" and above: NIBCO LD3122.5 lug style butterfly valves.	Polyisocyanurate Rigid Foam, Min Service Temp: -29°F; Max Service Temp: 300°F; Max Moisture Absorption: 0.2% by volume; Tymer 2000XP by Dow Plastics. 2" thick "PIVWRAP" is acceptable insulation material.	Pipe 4" and above: 2.5" thick foam	Green / White with arrows in the direction of flow	Provide stem extensions on all pipes to accommodate operation of the valve handle.	Design engineer or contractor shall analyze the pipe work and make any necessary provisions for thermal expansion and contraction.		N/A	
H2	CHWS and CHWR	Chilled Water Supply and Return	Direct Buried, Below Grade	Pipe up to 3": Hard drawn seamless copper tubing Pipe up to 3": Hard drawn seamless copper tubing	ASTM B88	Type K, cold drawn	Brace with 15% silver content silver solder sweat type, ANSI B16.22 or brass castings, ANSI B16.18 unions and valves	Wrought copper solder sweat type, carbon steel, butt weld ASTM B 16.3.	Pipes up to 2": NIBCO T- Apollo series 77-140, pipes 3"-5": NIBCO LD3122.3. Pipes 6" and above: NIBCO LD3122.5 lug style butterfly valves.	Polyisocyanurate Rigid Foam, Min Service Temp: -29°F; Max Service Temp: 300°F; Max Moisture Absorption: 0.2% by volume; Tymer 2000XP by Dow Plastics. 2" thick "PIVWRAP" is acceptable insulation material.	Pipe up to 2": 2" thick foam	Green / White with arrows in the direction of flow	Provide stem extensions on all ball valves serving insulated pipes to accommodate operation of the valve handle. Braze threaded fittings with 15% Silver Solder. Threaded fittings shall be soft-soldered using 95/5 lead-free solder. Care should be taken during the brazing process to prevent formation of oxides.	No soft solder allowed except within 6" of threaded fittings and couplings. Design engineer or contractor shall analyze the pipe work and make any necessary provisions for thermal expansion and contraction.		N/A
H3	CHWS and CHWR	Chilled Water Supply and Return	Above Ground	Pipe up to 3": Domestic (US Made) seamless steel pipe (No ERW, longitudinal seam and lap jointing are allowed.) Pipe 4" and above: Domestic (US Made) seamless steel pipe (No ERW, longitudinal seam and lap jointing are allowed.)	ASTM B88 or B	Type L, hard drawn	Brace with 15% silver content silver solder sweat type, ANSI B16.22 or brass castings, ANSI B16.18 unions and valves	ANSI / ASME B16.22, Shder wrought copper	Pipes up to 1.5": Pipe 1.25", 1.5", 2" thick foam	Exposed Insulation: PVC Outdoors: AS/ + 0.016" Aluminum	Green / White with arrows in the direction of flow	No soft solder allowed except within 6" of threaded fittings and couplings. Design engineer or contractor shall analyze the pipe work and make any necessary provisions for thermal expansion and contraction.	As per latest edition of NFPA 704, CMC, NFPA, FM global and fire marshal requirements. Supports shall be designed for seismic zone 4.			
H4	CHWS and CHWR	Chilled Water Supply and Return	Above Ground	Pipe 4" and above: Domestic (US Made) seamless steel pipe (No ERW, longitudinal seam and lap jointing are allowed.)	ASTM A53, S, Grade A or B	Schedule 40, 12" and above: Standard weight	Butt welded AWS D1.1 or flanged, raised face, metal gaskets, mechanical joint connections to facilitate de-maintenance.	Standard weight carbon steel, butt weld ASTM B 16.3.	Pipes 4", 5", 1.5" thick foam and above: 2" thick foam	Exposed Insulation: PVC Outdoors: AS/ + 0.016" Aluminum	Green / White with arrows in the direction of flow	Provide stem extensions on all pipes to accommodate operation of the valve handle.	Design engineer or contractor shall analyze the pipe work and make any necessary provisions for thermal expansion and contraction.	As per latest edition of NFPA 704, CMC, NFPA, FM global and fire marshal requirements. Supports shall be designed for seismic zone 4.		
H5	HHWS and HHWR	Heating Hot Water Supply and Return	Direct Buried, Below Grade	Pipe 4" and above: Domestic (US Made) seamless steel pipe (No ERW, longitudinal seam and lap jointing are allowed.)	ASTM A53, S, Grade A or B	Schedule 40, 12" and above: Standard weight	Welded AWS D1.1 Standard weight	Standard weight carbon steel, butt weld ASTM B 16.3.	Pipes up to 2": NIBCO T- Apollo series 77-140, Pipes 3"-5": NIBCO LD3122.3. Pipes 6" and above: NIBCO LD3122.5 lug style butterfly valves.	Polyisocyanurate Rigid Foam, Min Service Temp: -29°F; Max Service Temp: 300°F; Max Moisture Absorption: 0.2% by volume; Tymer 2000XP by Dow Plastics. 2.5" thick "PIVWRAP" is also acceptable insulation material.	Pipe 4" and above: 2.5" thick insulation	Yellow / Black with arrows in the direction of flow	Provide stem extensions on all pipes to accommodate operation of the valve handle.	Design engineer or contractor shall analyze the pipe work and make any necessary provisions for thermal expansion and contraction.		N/A
H6	HHWS and HHWR	Heating Hot Water Supply and Return	Direct Buried, Below Grade	Pipe up to 3": Hard drawn seamless copper tubing	ASTM B88	Type K, cold drawn	Brace with 15% silver content silver solder sweat type, ANSI B16.22 or brass castings, ANSI B16.18 unions and valves	Wrought copper solder sweat type, carbon steel, butt weld ASTM B 16.3.	Pipes up to 2": NIBCO T- Apollo series 77-140, Pipes 3"-5": NIBCO LD3122.3. Pipes 6" and above: NIBCO LD3122.5 lug style butterfly valves.	Polyisocyanurate Rigid Foam, Min Service Temp: -29°F; Max Service Temp: 300°F; Max Moisture Absorption: 0.2% by volume; Tymer 2000XP by Dow Plastics. As an alternative 2.0" thick "PIVWRAP" is also acceptable insulation material.	Pipe up to 2": 2.0" thick insulation, Pipe 2.5" to 3": 3" thick insulation	Yellow / Black with arrows in the direction of flow	Provide stem extensions on all pipes to accommodate operation of the valve handle. Braze copper pipe joints and non-threaded fittings with 15% Silver Solder using 95/5 lead-free solder. Care should be taken not to anneal the threads. Purge with Nitrogen gas during the brazing process to prevent formation of oxides.	No soft solder allowed except within 6" of threaded couplings. Provide provisions for thermal expansion and contraction as necessary to compensate for long pipe runs and high temperatures fluctuations.		N/A

Appendix XII_HVAC_Spec_Table_09-12-2014_rev05.xlsx

No.	Abbreviation	Service	Location	Pipe Material	Class (Conformance)	Type	Joint	Endure	Valves	Insulation Material	Insulation Sizes	Jacket Color	Background Color / Letter Color	Remarks	Special Handling	Pressure Treatment / Chemicals / Cleaning and Passivation	Red Size / Hanger / Spacing
H7	HHWS and HHWR	Heating Hot Water Supply and Return	Above Ground	Pipe 4" to 3": Domestic (US Made) seamless ERW, longitudinal seam and imported piping are allowed.)	ASTM B88	Type L, Hard drawn	Brace with 15% silver content. Solder. Provide threaded connections at unions and valves.	ANSI / ASME B16.22, wrought copper	Pipes up to 2": NBCCO T-385-7046, Pipe 2.5" to 3": NBCCO T-385-7046, Pipe 3" to 5": NBCCO T-385-7046, Pipe 5" and above: NBCCO LD312-23, raised full faced valves, raised full faced valves, and B16 studs and nuts. Isolation valves installed higher than 10' above finished floor shall have chain operated hand wheel.	Rigid Fiberglass, ASTM C336, K = 0.24 at 75°F; Min Service Temp: -20°F; Max Service Temp: 450°F; Max Moisture Absorption: 0.2% by volume. Owens Corning, Certainteed or John Manville.	Pipe up to 1", 1.5" thick fiberglass. Pipe 1.25", 2", 3", 4" thick fiberglass.	Exposed Inboard: ASJ + 30 mm PVC / Outboard: ASJ + 4.0-0.16" Aluminum	Yellow / Black with arrows in the direction of flow	Provide slim extensions on all ball valves serving insulated pipes to accommodate operation of the valve handle, design and install the piping to analyze the pipe work and make any necessary provisions for thermal expansion and contraction.	No soft solder allowed except within 6" of threaded couplings. For pipe work retained below 6" AFF where insulation provides Calcium Silicate fiberglass. Provide provisions for expansion necessary to compensate for long pipe runs and high temperatures fluctuations.	As per latest applicable CMC, NFPA, FM global and fire marshal requirements. Supports shall be designed for seismic zone 4.	
H8	HHWS and HHWR	Heating Hot Water Supply and Return	Above Ground	Pipe 4" and above: Domestic (US Made) Seamless Steel Pipe (No ERW, longitudinal seam and imported piping are allowed.)	ASTM A53, S, Grade A or B	Pipe 4" to 10": Schedule 40 Pipe 12" and above: Standard weight	Butt welded AWS D1.1 or flanged. For flanged fittings, use raised face flanges and gaskets. Mechanical joint couplings required at all fittings to facilitate de-coupling and maintenance.	Standard weight carbon steel, built to meet the requirements of ASME B16.3.	Rigid Fiberglass, ASTM C336, K = 0.24 at 75°F; Min Service Temp: -20°F; Max Moisture Absorption: 0.2% by volume. Owens Corning, Certainteed or John Manville.	Pipe 4", and above: 2" thick fiberglass	Exposed Inboard: ASJ + 30 mm PVC / Outboard: ASJ + 4.0-0.16" Aluminum	Yellow / Black with arrows in the direction of flow	Provide slim extensions on all ball valves serving insulated pipes to accommodate operation of the valve handle, design and install the piping to analyze the pipe work and make any necessary provisions for thermal expansion and contraction.	As per latest applicable CMC, NFPA, FM global and fire marshal requirements. Supports shall be designed for seismic zone 4.			
H9	CD, OCD, V	Equipment Cold Drains, Overflows, Cold Drains, Air Vent Pipes	Above Ground	Domestic (US Made) seamless copper tubing (No ERW, longitudinal seam and imported piping are allowed.)	ASTM B88	Type L, Hard drawn	Brace with 15% silver content. Solder. Provide threaded connections at unions and valves.	ANSI / ASME B16.22, wrought copper	N/A	Elastomeric, ASTM C524 Type 1, 15' long, 1/2" thick, Armaflex by Armstrong Industries. Vent pipes do not need to be insulated.	0.5" thick elastomeric	Exposed Inboard: ASJ + 30 mm PVC / Outboard: ASJ + 4.0-0.16" Aluminum	Green / White with arrows in the direction of flow	Brace copper pipe joints and non-threaded fittings with 15% Silver. Threaded fittings shall be soldered. Solder shall be taken not to anneal the threads. Purge with Nitrogen gas during the brazing process to prevent oxidation of leads.	No soft solder allowed except within 6" of threaded couplings.	As per latest applicable CMC, NFPA, FM global and fire marshal requirements. Supports shall be designed for seismic zone 4.	
H10	SV or RV	Steam vent relief Piping	Above Ground	Domestic (US Made) Seamless copper tubing (No ERW, longitudinal seam and imported piping are allowed.)	ASTM B88	Type L, Hard drawn	Brace with 15% silver content. Solder. Provide threaded connections at unions and valves.	ANSI / ASME B16.22, wrought copper	N/A	Rigid Fiberglass, ASTM C336, K = 0.24 at 75°F; Min Service Temp: -20°F; Max Service Temp: 450°F; Max Moisture Absorption: 0.2% by volume. Owens Corning, Certainteed or John Manville.	Refer to 2013 CEC manual, Table 4-15-Standard table 120.3-A Pipe Insulation Thickness	Exposed Inboard: ASJ + 30 mm PVC / Outboard: ASJ + 4.0-0.16" Aluminum	Green / White with arrows in the direction of flow	Provide provisions for expansion and contraction as necessary to compensate for long pipe runs and high temperatures fluctuations.	No soft solder allowed except within 6" of threaded couplings.	As per latest applicable CMC, NFPA, FM global and fire marshal requirements. Supports shall be designed for seismic zone 4.	
H11	HUW	Humidifier water supply Deionized water	Above Ground	Seamless stainless steel pipe/tubing Grade 304L (ERW or seamless) or stainless steel pipe/tubing are unacceptable. Domestic (US Made, German and Japanese) are acceptable.	ASTM A312 / ASME SA312	Options 1, Gas Tungsten arc welding (GTAW) for longitudinal joints. Options 2, SMAW for spiral wound fittings. Also acceptable.	Options 1, Gas Tungsten arc welding (GTAW) for longitudinal joints. Options 2, SMAW for spiral wound fittings. Also acceptable.	ASTM A312/ASME SA312 schedule 10 stainless stainless steel pipe valve with threaded union Option 2, SWAGELOK ball valve with threaded fittings, raised faced spiral wound fittings with B16 studs and nuts	Options 1, 80psi class steel gate valve with threaded union Option 2, SWAGELOK ball valve with threaded fittings, raised faced spiral wound fittings with B16 studs and nuts	N/A	N/A	Green / White with arrows in the direction of flow	Provide slim extensions on all ball valves serving insulated pipes to accommodate operation of the valve handle, design and install the piping to analyze the pipe work and make any necessary provisions for thermal expansion and contraction.	As per latest applicable CMC, NFPA, FM global and fire marshal requirements. Supports shall be designed for seismic zone 4.			

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No	Abbreviation	Service	Location	Pipe/Material	Class/Compliance	Type	Joint	Failure	Valves	Insulation Material	Insulation Size	Exposed	Background Color/Letter	Remarks	Special Handling	Pressure Testing / Chemical Cleaning and Passivation	Ref. Size / Material / Specification
H12	MUW	General equipment Humidifier Equipment make-up water	Above Ground	Domestic (US Made) seamless ERW (longitudinal seam and imported piping are allowed.)	ASTM B88	Type L, Hard drawn	Brazed with 15% Ag brazing alloys. Provided threaded connections at unions and valves	ANSI / ASME B16.22, Solder wrought copper	Pipes up to 2", NBCCO T-565-70-66, Pipes 2.5", Apollo series 77-140, Pipes 3" - 48" NBCCO T-565-70-66, Apollo series 77-140, LD3122-5 lug style butterfly spiral wound gaskets and bolting valves installed higher than 10' above finished floor shall have chain operated hand wheel.	N/A	N/A	N/A	Green / White	No soft solder allowed except within 6' of threaded couplings.	Install backflow preventer, pressure regulator and pressure relief valve on steam systems, as per detail in the design guide. Braze copper pipe joints and non-threaded fittings using 95:5 lead-free solder. Care should be taken not to anneal the threads. Purge with Nitrogen gas during brazing process to prevent oxidation.	As per latest applicable CMC, NFPA, FM global and fire marshal requirements. Supports shall be designed for seismic zone 4.	
H13	HUD	Humidifier Equipment Hot Drains	Above Ground	Domestic (US Made) seamless ERW (longitudinal seam and imported piping are allowed.)	ASTM B88	Type L, Hard drawn	Brazed with 15% silver content Silver brazing alloys. Provided threaded connections at unions and valves	ANSI / ASME B16.22, Solder wrought copper	Pipes up to 2", NBCCO T-565-70-66, Pipes 2.5", Apollo series 77-140, Pipes 3" - 48" NBCCO T-565-70-66, Apollo series 77-140, LD3122-5 lug style butterfly spiral wound gaskets and bolting valves installed higher than 10' above finished floor shall have chain operated hand wheel.	Rigid Fiberglass, ASTM C335, K = 0.24 at 75F; Min Service Temp: -20F; Max Service Temp: 450F; Max Moisture Absorption: 0.2% by volume; Certainteed or Johns Manville	Title 24 compliant, non-residential CEC Refer to 2013 15-Standards table 120.3-A Pipe Insulation Thickness	Exposed Indoors: ASJ + 30 mm PVC / + 0.016" Aluminum	Yellow / Black	Humidifier shall incorporate an automatic drain cover with blow down cycle and thermostatically controlled mixing valve to cool down condensate drainage to approved plumbing receptor.	Gravimetric systems shall be hydrostatic tested for 4 hours up to 10' of head. Close opening in system and fill with water and use a Bleed Gauge to record any observed leakage. Provide provisions for expansion and contraction as necessary to compensate for long pipe runs and high temperatures fluctuations	As per latest applicable CMC, NFPA, FM global and fire marshal requirements. Supports shall be designed for seismic zone 4.	
H14	STM	Campus Steam Piping	Above Ground	Pipe up to 2", Domestic (US Made) seamless steel pipe (No ERW, longitudinal seam and imported piping are allowed.)	ASTM A53, S, Grade B	Pipe up to Schedule 40	Shielded metal arc welding (SMAW) But welded/AWS D1.1 or flanged.	Fittings: Class 300# ANSI / ASTM A234 Maleable iron carbon steel butt welded or cast steel flanges class raised full faced spiral wound with B16 studs and nuts	Rigid Fiberglass, ASTM C335, K = 0.24 at 75F; Min Service Temp: -20F; Max Service Temp: 450F; Max Moisture Absorption: 0.2% by volume; Certainteed or Johns Manville	Title 24 compliant, non-residential CEC Refer to 2013 15-Standards table 120.3-A Pipe Insulation Thickness	Exposed Indoors: ASJ + 30 mm PVC / + 0.016" Aluminum	Yellow / Black	Insulate valves and associated pipe runs with fiberglass damsel, blanket or boxed insulation. Provide preformed insulation. Provide preformed insulation for flange and valves, or approved equal.	Steel and copper piping system shall be chemically cleaned and passivated for a minimum of 48 hours. Pressure test piping systems as per design and record the results with the name of the inspector and date of approval noted. Pressure test shall be observed by a Caltech engineer. Neutralize the chemicals and flush the system immediately after cleaning is completed and discharge the chemicals in a code-approved manner in compliance with local regulations. Provide Calcium Silicate insulation in lieu of fiberglass insulation provisions for expansion and contraction as necessary to compensate for long pipe runs and high temperatures fluctuations	As per latest applicable CMC, NFPA, FM global and fire marshal requirements. Supports shall be designed for seismic zone 4.		
H15	STM	Campus Steam Piping	Above Ground	Pipe 2.5" and above (US Made) seamless steel pipe (No ERW, longitudinal seam and imported piping are allowed.)	ASTM A53, S, Grade B	Pipe 2.5" Schedule 40, Pipe above 12" and above: Schedule 40 and weight	Shielded metal arc welding (SMAW) But welded/AWS D1.1 or flanged.	Fittings: Class 300# ANSI / ASTM A234 Maleable iron carbon steel butt welded or cast steel flanges class raised full faced spiral wound with B16 studs and nuts	Rigid Fiberglass, ASTM C335, K = 0.24 at 75F; Min Service Temp: -20F; Max Service Temp: 450F; Max Moisture Absorption: 0.2% by volume; Certainteed or Johns Manville	Title 24 compliant, non-residential CEC Refer to 2013 15-Standards table 120.3-A Pipe Insulation Thickness	Exposed Indoors: ASJ + 30 mm PVC / + 0.016" Aluminum	Yellow / Black	Insulate valves and associated pipe runs with fiberglass damsel, blanket or boxed insulation. Provide preformed insulation. Provide preformed insulation for flange and valves, or approved equal. Analyze the pipe work and make any necessary provisions for thermal expansion and contraction.	Steel and copper piping system shall be chemically cleaned and passivated for a minimum of 48 hours. Pressure test piping systems as per design and record the results with the name of the inspector and date of approval noted. Pressure test shall be observed by a Caltech engineer.	As per latest applicable CMC, NFPA, FM global and fire marshal requirements. Supports shall be designed for seismic zone 4.		

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No	Abbreviation	Service	Location	Pipe Material	Class (Constraint)	Type	Joint	Fittings	Valves	Insulation Material	Insulation Status	Jacket	Background Color/Letter Color	Remarks	Special Handling	Pressure Testing (Chemistry, Cleanout, and Passivation)	Rod Size / Hangers / Spacers
H16	SCR	Steam Condensate Piping	Above Ground	Pipe up to 2" Domestic (US Make), seamless pipe, black welded ends (No ERW, longitudinal seam and imported piping are allowed.)	ASTM A53, S, Grade B	Schedule 80	Threaded or AWS D11.1 Welded	ANSI / ASTM B6.3, Maleable iron, 300 lb.	Higher than 10' above finished floor shall have chain operated hand wheel	Rigid Fiberglass, ASTM C335, K = 0.24 at 75°F; Min Service Temp: -20°F; Max Moisture Absorption: 0.2% by volume; Owens Corning, Certithread or John Manville. In areas where physical damage, insulate with Calcium Silicate, ASTM C533, ASTM C335, K = 0.38 at 75°F; Min Service Temp: 120°F; Max Moisture Absorption: 0.2% by volume; Calatite Manufacturing Corp. only.	Title 24 compliant. Refer to 2013 nonresidential CEC manual, Table 4-15 Standards table 120.3-A Pipe Insulation Thickness	Exposed + 0.015" + 0.016" Aluminum	Yellow / Black with arrows in the direction of flow	Isolate valves and associated trim components with fiberglass insulation. Provide preformed demethyl for fittings and valves, or approved equal. Design engineer or contractor shall analyze the pipe work and make any necessary provisions for thermal expansion and contraction.	For pipe work installed below 8' or 4'F where insulation is subject to damage, provide Calcium Fiberglass. Provide provisions for expansion and contraction as necessary to compensate for long pipe runs and high temperatures fluctuations	Pressure Test (Chemistry, Cleanout, and Passivation) Representative and signed off in writing. Neutralize the chemicals and flush the system. Complete and discharge the chemicals in a code-approved manner in compliance with CT design guide. Refer to campus design guide document for the details of cleaning and passivation procedures and chemicals.	As per latest applicable CMC, NFPA, FM global and fire marshal requirements. Supports shall be designed for seismic zone 4.
H17	SCR	Steam Condensate Piping	Above Ground	Pipe 2.5" and above Domestic (US Make), seamless pipe, black welded longitudinal seam and imported piping are allowed.)	ASTM A53, S, Grade B	Schedule 80	Butt welded AWS D11.1 Welded. For larger pipe fittings, use raised face flanges and metal wound Mechanical joint couplings required at final connections to coupling and maintenance.	Standard weight, carbon steel butt weld, ASTM A234, Class 300.		Rigid Fiberglass, ASTM C335, K = 0.24 at 75°F; Min Service Temp: -20°F; Max Moisture Absorption: 0.2% by volume; Owens Corning, Certithread or John Manville. In areas where physical damage, insulate with Calcium Silicate, ASTM C533, ASTM C335, K = 0.38 at 75°F; Min Service Temp: 120°F; Max Moisture Absorption: 0.2% by volume; Calatite Manufacturing Corp. only.	Title 24 compliant. Refer to 2013 nonresidential CEC manual, Table 4-15 Standards table 120.3-A Pipe Insulation Thickness	Exposed + 0.015" + 0.016" Aluminum	Yellow / Black with arrows in the direction of flow	Isolate valves and associated trim components with fiberglass insulation. Provide preformed demethyl for fittings and valves, or approved equal. Design engineer or contractor shall analyze the pipe work and make any necessary provisions for thermal expansion and contraction.	For pipe work installed below 8' or 4'F where insulation is subject to damage, provide Calcium Fiberglass. Provide provisions for expansion and contraction as necessary to compensate for long pipe runs and high temperatures fluctuations	Pressure Test (Chemistry, Cleanout, and Passivation) Representative and signed off in writing. Neutralize the chemicals and flush the system. Complete and discharge the chemicals in a code-approved manner in compliance with CT design guide. Refer to campus design guide document for the details of cleaning and passivation procedures and chemicals.	As per latest applicable CMC, NFPA, FM global and fire marshal requirements. Supports shall be designed for seismic zone 4.
H18	SCD	Steam drain from humidifiers	Above Ground	Pipes up to 2" Domestic (US Make), seamless copper tubing (No ERW, longitudinal seam and imported piping are allowed.)	ASTM B88	Type L, Hard drawn	Brace with 15% Fire brazing alloy. Provide threaded connections at unions and valves	ANSI / ASME B16.22, Pipes up to 2" NIBCO T-585-70-66	Pipes up to 2" NIBCO T-585-70-66	Rigid Fiberglass, ASTM C335, K = 0.24 at 75°F; Min Service Temp: -20°F; Max Moisture Absorption: 0.2% by volume; Owens Corning, Certithread or John Manville	Title 24 compliant. Refer to 2013 nonresidential CEC manual, Table 4-15 Standards table 120.3-A Pipe Insulation Thickness	Exposed + 0.015" + 0.016" Aluminum	Yellow / Black with arrows in the direction of flow	Isolate valves and associated trim components with fiberglass insulation. Provide preformed demethyl for fittings and valves, or Approved Equal. Provide stem insulations on all ball valves serving insulated pipes to prevent operation of the valve handle.	Brace copper pipe joints and non-threaded fittings with 15% Si-Fee. Threaded fittings shall be lead free solder. Care should be taken not to anneal the threads. Purge with nitrogen gas during installation to prevent formation of oxides. Provide provisions for expansion and contraction as necessary to compensate for long pipe runs and high temperatures fluctuations.	Pressure Test (Chemistry, Cleanout, and Passivation) Representative and signed off in writing. Neutralize the chemicals and flush the system. Complete and discharge the chemicals in a code-approved manner in compliance with CT design guide. Refer to campus design guide document for the details of cleaning and passivation procedures and chemicals.	As per latest applicable CMC, NFPA, FM global and fire marshal requirements. Supports shall be designed for seismic zone 4.
H19	CS and CSCK	Clean Steam and Steam Condensate return Piping	Above Ground	Seamless stainless steel pipe/hubing, Grade 304L, ERW, seamless pipe, seamless pipes are unacceptable.	ASTMA312 / ASME-SA312	Schedule 10S	Options 1, Gas Tungsten arc (GTAW) gas welding (TIG) for Tungsten metal gas welding (TIG) Options 2, SWAGELOK tube connections are also acceptable.	Seamless stainless, Grade 304L, ASTM A312, ASME SA312	Option 1, 800R class steel gate valve with threaded union; Option 2, SWAGELOK ball valve need for steam application. SWAGELOK ball valve isolation valves installed higher than 10' above finished floor shall have chain operated hand wheel	Rigid Fiberglass, ASTM C335, K = 0.24 at 75°F; Min Service Temp: -20°F; Max Moisture Absorption: 0.2% by volume; Owens Corning, Certithread or John Manville. In areas where physical damage, insulate with Calcium Silicate, ASTM C533, ASTM C335, K = 0.38 at 75°F; Min Service Temp: 120°F; Max Moisture Absorption: 0.2% by volume; Calatite Manufacturing Corp. only.	Title 24 compliant. Refer to 2013 nonresidential CEC manual, Table 4-15 Standards table 120.3-A Pipe Insulation Thickness	Yellow / Black with arrows in the direction of flow	Isolate valves and associated trim components with fiberglass insulation. Provide preformed demethyl for fittings and valves, or Approved Equal. Provide stem insulations on all ball valves serving insulated pipes to prevent operation of the valve handle.	Brace copper pipe joints and non-threaded fittings with 15% Si-Fee. Threaded fittings shall be lead free solder. Care should be taken not to anneal the threads. Purge with nitrogen gas during installation to prevent formation of oxides. Provide provisions for expansion and contraction as necessary to compensate for long pipe runs and high temperatures fluctuations.	Pressure Test (Chemistry, Cleanout, and Passivation) Representative and signed off in writing. Neutralize the chemicals and flush the system. Complete and discharge the chemicals in a code-approved manner in compliance with CT design guide. Refer to campus design guide document for the details of cleaning and passivation procedures and chemicals.	As per latest applicable CMC, NFPA, FM global and fire marshal requirements. Supports shall be designed for seismic zone 4.	

No	Abbreviation	Service	Location	Pipe Material	Class/Compliance	Type	Joint	Fittings	Valves	Insulation Material	Insulation Sizes	Jacket	Background Color/Letter	Remarks	Special Handling	Passivation	Approval/Signatures
H20	STM	Campus Steam Piping mains	Inside utility tunnels and areas	Domestic (US Made), seamless carbon steel pipe, Schedule 40 ERW (No ERW) longitudinal seam and imported piping are allowed.)	ASTM A53 S, Grade B	Pipe 2.5" to 10" - Schedule 40, 12" and above - Standard weight	Shielded metal arc welding (SMAW)	Malleable iron carbon steel butt welded. Fittings: forged steel with B16 studs and nuts	Pipe up to 2" - 80# cast, class rising stem gate valves. Make and model to be approved by Cathex. Isolation valves installed. Finished floor shall have chain operated hand wheel	Calcium Silicate, ASTM C533, Min Service Temp: -100F; Max Service Temp: 100F; Max Moisture Absorption: 0.2% by volume; Calstate Manufacturing Corp only	Title 24 compliant. Refer to 2013 residential CEC 15-Standards table 120.3.A. Pipe Insulation Thickness	12 ounce / heavy canvas and arbol jacking + 2 coats of high glass water proof white paint	Yellow / Black	Insulate valves and associated components with fiberglass blanket or boxed insulation. Provide preformed clambath for fittings and valves. Or Approved Equal. Insulate expansion loops to compensate for thermal expansion and contraction.	Clean and Chemically Passivate carbon steel pipe. Provide provisions for expansion and contraction as necessary for long runs and high temperatures fluctuations.	Steel and copper piping system shall be chemically cleaned and passivated for a minimum of 48 hours. Pressure test piping system with compressed air for a minimum of 24 hours at 150 psig. Record initial and final pressures. Regular any leaks and record the results with the name of the inspector and date of approval noted. Pressure test shall be observed by a Cathex representative and signed off in writing. Insulation shall be installed immediately after cleaning is completed and discharge the chemicals in a code-approved manner in compliance with CTT design guide. Refer to campus design and passivation procedures and chemicals.	As per latest applicable CMC, NFPA, FM global and fire marshal requirements. Supports shall be designed for seismic zone 4.
H21	SCR option 1	Steam Condensate Piping mains	Inside utility tunnels and areas	Seamless stainless steel pipe/tubing (No ERW) longitudinal seam and imported piping are unacceptable.	ASTM A312 / ASME SA312	Gas Tungsten arc electrode (GTAW) or Tungsten inert gas welding (TIG)	ASTM A312/ASME SA312 stainless steel seamless blank pipe. 150# class rising stem gate valves. Make and model to be approved by Cathex. Isolation valves installed. Finished floor shall have chain operated hand wheel	Pipe up to 2" - pipe 80# cast, class rising stem gate valves. Make and model to be approved by Cathex. Isolation valves installed. Finished floor shall have chain operated hand wheel	Calcium Silicate, ASTM C533, Min Service Temp: -100F; Max Service Temp: 100F; Max Moisture Absorption: 0.2% by volume; Calstate Manufacturing Corp only. Eslin filament E-Class fibers is also acceptable.	Pipe up to 6", 1.5" Silicate or 1" thick Eslin	12 ounce / heavy canvas and arbol jacking + 2 coats of high glass water proof white paint	Yellow / Black	Insulate valves and associated components with fiberglass blanket or boxed insulation. Provide preformed clambath for fittings and valves. Or Approved Equal. Insulate expansion loops to compensate for thermal expansion and contraction.	Clean stainless steel pipe. Provide provisions for expansion and contraction as necessary for long runs and high temperatures fluctuations.	Stainless steel piping system shall be chemically cleaned and passivated as necessary. Pressure test piping system with compressed air for a minimum of 24 hours at 150 psig - record initial and final pressures. Regular any leaks and record the results with the name of the inspector and date of approval noted. Pressure test shall be observed by a Cathex representative and signed off in writing. Insulation shall be installed immediately after cleaning is completed and discharge the chemicals in a code-approved manner in compliance with CTT design guide. Refer to campus design and passivation procedures and chemicals.	As per latest applicable CMC, NFPA, FM global and fire marshal requirements. Supports shall be designed for seismic zone 4.	
H22	SCR option 2	Steam Condensate Piping mains	Inside utility tunnels and areas	Pipe up to 2", Domestic (US Made), seamless carbon steel pipe, back welded ends longitudinal seam and imported piping are allowed.)	ASTM A53 S, Grade B	Schedule 80	Shielded metal arc welding (SMAW)	Malleable iron carbon steel butt welded or spiral wound with B16 studs and nuts	Pipe up to 2" - pipe 80# cast, class rising stem gate valves. Make and model to be approved by Cathex. Isolation valves installed. Finished floor shall have chain operated hand wheel	Calcium Silicate, ASTM C533, Min Service Temp: -100F; Max Service Temp: 100F; Max Moisture Absorption: 0.2% by volume; Calstate Manufacturing Corp only. Eslin filament E-Class fibers is also acceptable.	Pipe up to 6", 1.5" Silicate or 1" thick Eslin	12 ounce / heavy canvas and arbol jacking + 2 coats of high glass water proof white paint	Yellow / Black	Insulate valves and associated components with fiberglass blanket or boxed insulation. Provide preformed clambath for fittings and valves. Or Approved Equal. Insulate expansion loops to compensate for thermal expansion and contraction.	Clean and Chemically Passivate carbon steel pipe. Provide provisions for expansion and contraction as necessary for long runs and high temperatures fluctuations.	Steel and copper piping system shall be chemically cleaned and passivated for a minimum of 48 hours. Pressure test piping system with compressed air for a minimum of 24 hours at 150 psig - record initial and final pressures. Regular any leaks and record the results with the name of the inspector and date of approval noted. Pressure test shall be observed by a Cathex representative and signed off in writing. Insulation shall be installed immediately after cleaning is completed and discharge the chemicals in a code-approved manner in compliance with CTT design guide. Refer to campus design and passivation procedures and chemicals.	As per latest applicable CMC, NFPA, FM global and fire marshal requirements. Supports shall be designed for seismic zone 4.
H23	CHWS and CHWR	Chilled Water Supply and Return mains	Inside utility tunnels and areas	Pipe up to 3", Domestic (US Made), German or copper tubing (No ERW, longitudinal seam and imported piping are allowed.)	ASTM B88	Type L, Schedule 40	Braze with 15% silver content (Silver content 15% or higher) Provide brazed connections at joints, unions and valves	ANSI / ASME B16.22, Solder wrought copper	Polyisocyanurate Rigid Foam, ASTM C591, K = 0.19 @ 75F; Min Service Temp: -30F; Max Service Temp: 200F; Moisture Absorption: 0.2% by volume; Tymer 200MP by Dow Plastics	Pipe up to 1.5" - 2" - 1.25" - 3"; 2" thick foam.	12 ounce / heavy canvas and arbol jacking + 2 coats of high glass water proof white paint	Green / White	Insulate valves and associated components with fiberglass blanket or boxed insulation. Provide preformed clambath for fittings and valves. Or Approved Equal. Insulate expansion loops to compensate for thermal expansion and contraction.	No soft solder allowed except within 6" of couplings, design and make any necessary provisions for thermal expansion and contraction.	Steel and copper piping system shall be chemically cleaned and passivated for a minimum of 48 hours. Pressure test piping system with compressed air for a minimum of 24 hours at 150 psig - record initial and final pressures. Regular any leaks and record the results with the name of the inspector and date of approval noted. Pressure test shall be observed by a Cathex representative and signed off in writing. Insulation shall be installed immediately after cleaning is completed and discharge the chemicals in a code-approved manner in compliance with CTT design guide. Refer to campus design and passivation procedures and chemicals.	As per latest applicable CMC, NFPA, FM global and fire marshal requirements. Supports shall be designed for seismic zone 4.	
H24	CHWS and CHWR	Chilled Water Supply and Return mains	Inside utility tunnels and areas	Pipe 4" and above Domestic (US Made) Seamless Steel Pipe (No ERW, longitudinal seam and imported piping are allowed.)	ASTM A53 S, Grade A or B	Schedule 40, 12" and above - Standard weight	Shielded metal arc welding (SMAW) or Mechanical joint	Standard weight carbon steel, but weld ASTM B16.3	Polyisocyanurate Rigid Foam, ASTM C591, K = 0.19 @ 75F; Min Service Temp: -30F; Max Service Temp: 200F; Moisture Absorption: 0.2% by volume; Tymer 200MP by Dow Plastics	Pipe diameter of 4" - 5"; 2.5" thick foam. Pipe 6" in diameter - 3"; 2" thick foam.	12 ounce / heavy canvas and arbol jacking + 2 coats of high glass water proof white paint	Green / White	Insulate valves and associated components with fiberglass blanket or boxed insulation. Provide preformed clambath for fittings and valves. Or Approved Equal. Insulate expansion loops to compensate for thermal expansion and contraction.	No soft solder allowed except within 6" of threaded fittings and flanges. Design and make any necessary provisions for thermal expansion and contraction.	Steel and copper piping system shall be chemically cleaned and passivated for a minimum of 48 hours. Pressure test piping system with compressed air for a minimum of 24 hours at 150 psig - record initial and final pressures. Regular any leaks and record the results with the name of the inspector and date of approval noted. Pressure test shall be observed by a Cathex representative and signed off in writing. Insulation shall be installed immediately after cleaning is completed and discharge the chemicals in a code-approved manner in compliance with CTT design guide. Refer to campus design and passivation procedures and chemicals.	As per latest applicable CMC, NFPA, FM global and fire marshal requirements. Supports shall be designed for seismic zone 4.	

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No	Abbreviation	Service	Location	Pipe Material	Class Compliance	Type	Joint	Fittings	Valves	Insulation Material	Insulation Size	Jacket	Background Color	Remarks	Social Handling	Pressure Testing / Chemical Clean and Preservation	Red Size / Min. Spacing
H25	HHWS and HHWR	Heating Hot Water Supply and Return mains	Inside utility tunnels and airways	Pipe up to 3": Domestic US Made seamless ERW (No seam and imported piping are allowed.)	ASTM B88	Type L, Hard drawn	Brace with 15% Fos brazing alloy. Provide threaded connections at unions and valves	ANSI / ASME B16.22, Solder wrought pipe	Calcium silicate, ASTM C336, K = 0.24 at 75F; Min Service Temp: -450F; Max Moisture Absorption: 0.2% by volume;	Pipe up to 1", 1.5" thick fibreglass, 2" to 3" 2" thick Calcium silicate	12 ounce / square yard heavy canvas and arabinol jacking + 2 coats of high glass water-proof white paint	Yellow / Black with arrows in the direction of flow	Provide stem extensions on all ball valves serving insulated pipes to accommodate operation of the valve handle. Design engineer or contractor shall make any necessary provisions for thermal expansion and contraction.	Brace copper pipe joints and non-threaded fittings with 15% Si-Fos. Lead-free solder. Care should be taken not to anneal the threads. Purge with Nitrogen gas during welding to prevent formation of oxides. Provide provisions for expansion and contraction necessary to compensate for long pipe runs and high temperatures fluctuations.		As per latest applicable CMC, NFPA, FM global and fire marshal requirements. Supports shall be designed for seismic zone 4.	
H26	HHWS and HHWR	Heating Hot Water Supply and Return mains	Inside utility tunnels and airways	Pipe 4" and above: ASTM A53-S, Grade A or B Steel Pipe (No seam and imported piping are allowed.)	ASTM A53-S, Grade A or B	Schedule 40, Pipe and above. Standard weight	8th verified AWS D1.1 or flanged. For flanged, use raised face flanges and gaskets. Mechanical joint couplings required at final connections to facilitate de-coupling and maintenance.	Standard weight carbon steel, butt weld ASTM B16.3	Pipe up to 2", NIBCO T-595-70-66, Pipes 2.5", Apollo series 77-140, Pipes 3"-5", NIBCO LD3122-3, LD3122-5 lug valve butterfly valves. Raised full faced B16 studs and nuts higher than 10" above finished floor shall have chain operated hand wheel.	Calcium silicate, ASTM C336, K = 0.24 at 75F; Min Service Temp: -450F; Max Moisture Absorption: 0.2% by volume;	Pipe 4" and above: 2" thick Calcium silicate	12 ounce / square yard heavy canvas and arabinol jacking + 2 coats of high glass water-proof white paint	Yellow / Black with arrows in the direction of flow	Provide stem extensions on all ball valves serving insulated pipes to accommodate operation of the valve handle. Design engineer or contractor shall analyze the pipe work and make any necessary provisions for thermal expansion and contraction.	Steel and copper piping system shall be installed in accordance with minimum of 48 hours. Pressure test piping system with compressed air for a minimum of 24 hours at 150 psig, record initial and final pressures. Repair any leaks and retest piping system. Pressure test fire marshal requirements. Pressure test shall be observed by a Certified Inspector and date of approval noted. Pressure test shall be signed off in inspection representative and signed off in writing. Neutralize the chemicals and flush piping. Neutralize the chemicals in a code-approved manner in compliance with G17 design guide. Refer to campus design guide document for the details of cleaning and preservation procedures and chemicals.	As per latest applicable CMC, NFPA, FM global and fire marshal requirements. Supports shall be designed for seismic zone 4.	

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