

**Description:**

The purpose of this section is to provide guidelines for the applicable UMD standards and requirements for the design of mechanical systems including (but not limited to), mechanical, plumbing, and fire protection.

**Related Sections:**

- TBD

**Effective Date:**

January 1, 2020

**Applicable Standards:**

Mechanical Designs shall comply with codes and standards including, but not limited to the following (or the latest version);

- ASHRAE 62
- ASHRAE 55
- ASHRAE 15
- IMC
- ARI 550/590
- ASHRAE 110
- ARI 360
- ASHRAE 90.1

**General Requirements:**

Alternative HVAC System Designs (New Building and Renovations over \$1 million) - the designer shall complete the following on new building and major renovation (over \$1 million) designs with this evaluation submitted at schematic design:

- Evaluate a minimum of three alternative HVAC systems that are in compliance with energy requirements. Propose a recommendation from the three evaluated.
- Provide a conceptual single-line of the proposed HVAC system. Identify the capacity and locations of major equipment items.
- Provide a life-cycle cost analysis which includes capital, operating, and maintenance costs, and a comparison made between the three systems. Provide a simple payback schedule.
- If existing systems are utilized, identify the capacity of those existing system, based on an examination of the Facility's record Drawings, and inspection of the existing system, and test reports.

**Equipment Specifications:**

- When the designer specifies equipment installation to be "In accordance with the manufacturer's direction," the specification shall list the applicable manufacturer's publication, title, and date. The specification shall state which instructions in that publication, if any, do not apply to the particular application.
- The specification shall require that, if equipment other than that which is the basis of design is submitted, the submittal will be accompanied by the applicable manufacturer's installation instructions, again with instructions that do not apply clearly noted.
- Interrelated Systems will be so identified on the design documents. With regard to submittals of the components of interrelated mechanical, electrical, life safety and/or other systems, the specification shall include words to the following effect:
- The design documents depict a coordinated system comprised of equipment which is selected as the basis of design, but is not intended to exclude others. Submission of any one component other than that which is the basis of design is considered to be a substitution of the entire Interrelated System and the submittal must be identified by the Contractor to be:
  - An interrelated system
  - A substitution

- The Contractor, as part of the submittal, must provide supporting documentation to show that the submitted equipment has been coordinated to the same extent as the equipment, which is the basis of design. All coordination for substitutions shall be the responsibility of the Contractor to coordinate. Increases in project cost shall be borne by the Contractor where deviation is a result of Contractor substitution.

**Piping identification:**

- Piping shall be identified via painting or color coding as noted in the Piping Identification Table. In a mechanical space, the entire pipe and insulation system shall be identified and color coded. Where exposed throughout the entire building, the piping and insulation system shall be marked.

**Piping Identification Table:**

DRAWINGS	MARKER	DESCRIPTION	LABEL TEXT COLOR	LABEL COLOR	PIPE(SCUB) COLOR	DIRECTION ARROW REQUIRED
	DRAIN	Air Conditioning Condensate Drain	White	Green		
AW	ACID	Acid Waste	Black	Yellow		
CHWR	CHILLED WATER RETURN	Chilled Water Return	White	Green	OSHA Blue	Yes
CHWS	CHILLED WATER SUPPLY	Chilled Water Supply	White	Green	OSHA Blue	Yes
COM	COMMON WATER PIPING	Common Water Piping (Decoupler)	White	Green	OSHA Blue	
A	COMPRESSED AIR	Compressed Air	White	Blue		Yes
CDWR	CONDENSER WATER RETURN	Condenser Water Return	White	Green	OSHA Green	Yes
CDWS	CONDENSER WATER SUPPLY	Condenser Water Supply	Green White	Green	OSHA Green	Yes
DI	DEIONIZED WATER	Deionized Water	White	Green		Yes
	DOMESTIC COLD WATER	Domestic Cold Water	White	Green	Light Blue	Yes
	DOMESTIC HOT WATER	Domestic Hot Water	Black	Yellow	Red	Yes
	DOMESTIC HOT WATER RETURN	Domestic Hot Water Return	Black	Yellow	Red	Yes
DTS	DUEL TEMP SUPPLY	Duel Temperature Supply Water	White	Green	Light Grey	Yes
DTR	DUEL TEMP RETURN	Duel Temperature Return Water	White	Green	Light Grey	Yes
F	FIRE PROTECTION WATER	Fire Protection	White	Red		Yes
FO	FUEL OIL	Fuel Oil	Black	Yellow		Yes
HPS	HIGH PRESSURE STEAM	High Pressure Steam (>125#)	Black	Yellow	OSHA Orange	Yes
HHWR	HEATING HOT WATER RETURN	Hot Water Return	Black	Yellow	OSHA Orange	Yes
HHWS	HEATING HOT WATER SUPPLY	Orange Hot Water Supply	Black	Yellow	OSHA Orange	Yes

LPS	LOW PRESSURE STEAM	Low Pressure Steam (0-15#)	Black	Yellow	Alum Jacket	Yes
MPS	MEDIUM PRESSURE STEAM	Medium Pressure Steam (0-15#) MPS	Black	Yellow	Alum Jacket	Yes
G	GAS	Natural Gas	Black	Yellow	Yellow	Yes
O	OXYGEN	Oxygen	White	Blue		Yes
RL	REFRIGERATED LIQUID	Refrigerant Liquid	Black	Yellow	Yellow	
RV	REFRIGERATED VAPOUR	Refrigerant Vapor	Black	Yellow	Yellow	
SAN	SANITARY SEWER	Sanitary Waste	White	Green		
LPC	CONDENSATE RETURN / LOW PRESSURE	Steam Condensate Return	Black	Yellow	OSHA Purple	Yes
SD	STORM DRAIN	Storm Drain	White	Green	Black	
VAC	VACUUM	Vacuum	Black	Yellow		Yes
		Glycol			Grey	
		Safety Vents (All)			Yellow	

**MATERIAL**

Indoor Marker shall be a vinyl film with self-sticking Adhesive.

Outdoor Marker shall be a vinyl film with UV protection and snap-type Connections.

**DIRECTIONAL ARROW**

Indoor Vinyl film with self-sticking adhesive.

Outdoor Arrow to be included with snap-type connection markers.

Color	Manufacturer					
	John's Zeston	Manville	P.I.C. Series	Plastics FG	Proto PVC LoSmoke	Speedline SmokeSafe
Black	Black 14587-E1		Black 14587-E1		Black	Black
Grey	Dark Gray 14609-E1		Dark Gray		Grey	Dark Gray 14609-E1
Light Blue	Light Blue 41073-R1		Light Blue		Light Blue	Light Blue 41073-R1
Light Grey	-----		Light Gray		-----	Light Gray 41619-R1
Safety Blue	Dark Blue 14612-E1		Blue		Blue	Dark Blue 14612-E1
Safety Green	Pea Green 42307-R1		Pea Green		Light Green	Pea Green 42307-R1
Safety Orange	Orange 41137-R2		Orange		Orange	Orange 41137-R2
Safety Purple	Purple 41932-R1		Purple		Purple	Purple 41932-R1
Red	Red 41086-R1		Red		Red	Red 41086-R1
Yellow	Yellow 41148-R1		Yellow		Yellow	Yellow 41148-R1

Color	Manufacturer		
	Sherwin Williams – Dura Clad*	Benjamin Moore - Enamel P22*	Home Depot – Glidden Vantage*
Black	SW 6237 Dark Night	2132-10 Black	S-H-790 Black Suede
Grey	SW 6256 Serious Grey	2140-40 Whale Gray	780F-5 Anonymous
Light Blue	SW 6953 Candid Blue	2059-50 Pool Party	530B-5 Azurean
Light Grey	SW 7658 Gray Clouds	2134-50 Gull Wing Gray	780F-4 Sparrow
Safety Blue	SW 6959 Blue Chip	2060-30 Seaport Blue	560B-7 Cerulean
Safety Green	SW 6935 Straightforward	2032-10 Neon Green	450B-6 Formal Garden

	Green		
Safety Orange	SW 6893 Kid's Stuff	2011-10 Orange	190B-7 Fire Island
Safety Purple	SW 6983 Fully Purple	2071 Mystical Grape	S-G-650 Berry Syrup
Red	SW 6871 Positive Red	2001-10 Ruby Red	S-G-150 California Poppy
Yellow	SW 6907 Forsythia	2022-10 Yellow	350B-7 Chickadee

\* Urethane Alkyd Enamel

### Ductwork Identification:

- Exhaust, supply, return, and outside air shall be labeled with a marker or it shall be stenciled. Marker shall be a vinyl film with a self-sticking adhesive.

### Design Conditions:

The following information should be clearly shown on the drawings, expanded or modified as required by the application. Where values are indicated they should be the basis of the design.

<b>Occupied</b>	
Summer Outside	95°F db, 78°F wb
Summer Inside	74°F (+/- 2°F) db, 50% rh c.
Winter Outside	0°F db
Winter Inside	74°F (+/- 2°F) db, 30% rh
<b>Unoccupied</b>	
Summer	85°F db
Winter	68°F db
Total Cooling Capacity Avail.	Tons
Total Cooling Max. Demand Load	Tons
Chilled Water Delta T	12°F minimum
Total Heating Capacity	BTUh
Total Heating Max. Demand	BTUh
Hot Water Delta T	20 degrees F
Population	# of persons
Ventilation (outside) air handled by the equipment:	
occupied	cfm
unoccupied	cfm
Domestic Hot Water, Capacity Available	gph
Domestic Hot Water Max. Demand Load	gpm
Domestic Hot Water Temperature Rise	degrees F
Total Water Supply Fixture Units	Fixture units
Water Supply Fixture Units	Fixture units
Hot Water Supply Fixture Units	Fixture units
. Drainage Fixture Units	Fixture units
Design Street Water Pressure	psig
Steam, Capacity Available	#/hr
Steam Max. Demand Load	#/hr
Steam Design Pressure (high)	125 psig
Steam Design Pressure (low)	15 psig
Gas, natural, demand load (max.)	cfh
Gas, natural, street pressure	wg
Gas, natural, service demand	cfh

Design Components shall include all of the following:

- Control logic diagrams
- System schematics
- Points lists
- Component descriptions
- Sequence of operation
- Flow diagrams
- Building Riser diagrams for supply, return, and exhaust systems
- Building air pressure calculation or matrix

## Drawings

- All elements of the Work shall be properly coordinated to insure that there are no conflicts between disciplines or between the drawings and the specifications.
- In general, abbreviations should be avoided except those which are generally understood and accepted and listed in the legend and symbols list.
- Drawings shall indicate university assigned room numbers, and have column line designations.
- Mechanical areas – The designer shall provide a layout ( $\frac{1}{4}'' = 1$  foot scale or larger) of all of the following rooms, to ensure that the equipment will fit in the allotted space.
  - Mechanical rooms; shall provide of maintenance clearance to meet at minimum NEC clearance and manufacturer equipment clearances at 4' all sides and above highest point
  - Kitchens
  - Labs
  - Clean rooms
  - Areas with a large quantity of mechanical equipment
  - Drawing shall include mechanical elevation drawings
- Congested areas:  
The designer shall identify potential congested areas where mechanical, electrical, plumbing, and fire protection piping and/or equipment are to be installed, and shall provide cross sections (at a minimum  $\frac{1}{4}''$  scale).
- Site utility plans  
The mechanical designer shall coordinate with the civil designer to provide a site plan ( $1'' = 40$  foot or larger) that shows the following:
  - The routing of propose new external utilities from each new building to each point of connection to the facilities utility systems. Indicate all utility lines that are to be abandoned, rerouted, or removed.
  - The location of all existing utilities within the project site based on the information provided by the university and the designer's field investigation.
  - Pipe runs shall indicate the type and size, and shall show all valves, etc.
- Mechanical Drawings - The designer shall provide a site plan ( $1/8'' = 1$  foot or larger) that shows the following:
  - The location of each piece of equipment including, but not limited to, air handling units, chillers, cooling towers, pumps, converters, expansion tanks, boilers, fans, fan coil units, and other equipment.
  - All ductwork.
  - Indicate all piping runs (including type and sizes). Show all valves, fixtures, etc.
  - Show all areas served for each air handler on small scale drawings, with cross-hatched areas to differentiate between the air handling units.
  - Plumbing, HVAC, and sprinkler drawings shall be presented as three separate drawings.
  - Column lines shall be shown on all building plans and part plans.
  - Locate all pressure sensors that serve Variable Frequency Drives (VFD) on the plans and on the schematics.
  - Drawing shall include mechanical elevation drawings

## Specifications:

- Operation and Maintenance manuals:
  - It is a requirement for the contractor to provide operation and maintenance manuals. Manuals shall be supplied with each major piece of equipment. O&M manuals shall include all applicable design calculations used in sizing components. Wiring diagrams, spare parts list, vendor contact numbers, warranty information, and certificates shall be included.
- Testing and Balancing:
  - Static pressure profiles are required for air handling units.
  - Static pressure profiles are required for ductwork systems.
  - It is the testing and balancing contractor's responsibility the project site prior to taking any measurements to confirm there is enough access to make each and every measurement. "Access Not Available" and similar comments noted in the testing and balancing report are not acceptable. It shall be the responsibility of the general and mechanical contractor to provide access to the system components that will be tested and balanced again, with no additional charges to the University.

## **Boiler Inspections:**

A boiler or pressure vessel requires state inspection from the Maryland Department of Labor, Licensing, and Regulation and from an inspector from the State's Insurance Company. This section addresses many issues concerning Maryland mandated pressure vessel inspection requirements. For current requirements contact the Maryland Department of Labor, Licensing and Regulation (DLLR) (<http://www.dllr.state.md.us/labor/boil.html>). Projects that require the use of the boiler during the construction phase shall have it fully pass the inspection process prior to its use.

## **Design Guidelines**

Combustion air for the boiler shall be supplied via wall louvers or be directly ducted to the burner.

- Size and location of the louvers shall be in compliance with the NFPA.
- The boiler burner must be interlocked with motorized open-closed dampers in the combustion air intake louvers or intake ductwork.

The lockable knife handle type disconnect switch shall be provided for each boiler.

- Disconnect to turn-off all power to the boiler and its control functions and shall be mounted on or near the boiler.

An emergency shut down switch shall be provided for each mechanical room exit.

- Locate switch outside mechanical room entrance, or if tampering is an issue, immediately inside the mechanical room door with a sign posted outside the mechanical room door.
- The switch shall kill power to all burners located in the mechanical room and it shall be accessible.
- The switch shall be on a dedicated circuit breaker.

A relief valve shall be provided for each boiler and the discharge shall be piped to a safe location.

- The size of the piping to match the valve outlet and it shall not be reduced.
- Only one elbow is allowed in the discharge drain piping. Use a pipe site drain with an air gap, if the equipment layout dictates it.

The pilot supply line shall be provided for each boiler.

- The valve shall be connected to the gas fuel train upstream of the main shut off valve.

Interlock mechanical draft dampers with the boiler burner controls

- Clearances around boiler shall be in accordance with name plate data or manufacture's product literature. If not available maintain a minimum of 3 feet on all sides. Clearance is measured from the object, or boiler appurtenance, furthest protruding from the side.

Low pressure hot water heating boilers operating less than 160# and do not exceed 250 degrees F.

- Requires high-temperature cut-off with a manual reset.
- Controls are such that they cannot be set to exceed the boiler's temperature rating.

High pressure boilers shall follow ASME Code Section I and low pressure boilers shall follow ASME Section IV and ASME CSD-1.

Notifying the Maryland Department of Labor, Licensing and Regulation and the insurance inspector.

- Contractor is responsible for submitting the “Notice of Installation of a Boiler or Pressure Vessel” form to the Chief Inspector 30 days prior to the installation of the boiler.
- Contractor is responsible for notifying the insurance provider once the boiler is ready for start-up.
- After passing insurance company inspection the Contractor is responsible for notifying the State Deputy Boiler Inspector to receive state inspection and the application of DLLR state registration numbers.

## Plumbing

The provisions of WSSC apply, as well as industry standard good design practice for educational institutions. The design must reflect the University’s need to perform maintenance and repair without interruption to educational activity. The University encourages the Plumbing consultant to employ water saving and energy-efficient design, consistent with goals of LEED and the project budget.

## Products

Piping:

- See the Piping / Valves section.
- See the Mechanical Design Standards section for the required color code.

Values

- See the Piping / Valves section.
- Gate and plug valves shall not be used without approval from the Plumbing Shop.

Fixtures

- Furnish fixtures and appurtenances in accordance with the following schedule.

Fixture	Material	Manufacturers	Notes
Water Closet	Flush valve, wall hung with heavy-duty carrier, white vitreous china elongated bowl and open toilet seat. Tank type will not be permitted.	American Standard, Toto, and Kohler	Valve by Sloan, American Standard, Toto, Zurn and Delany
Urinal	Wall hung vitreous china, without strainers.	American Standard, Toto, and Kohler	by Sloan, American Standard, Toto, Zurn and Delany
Lavatory	Wall hung or oval self-rimming where installed in countertops. Vitreous china material.	American Standard, Toto, and Kohler	Faucet by American Standard, Kohler and Chicago Faucet
Sink	Stainless steel, self-rimming. Compartment quantity and size as required for function.	Elkay and Just	Faucet by American Standard, Kohler and Chicago Faucet
Mop Sink	Wall mounted, cast iron, self-supporting P-trap with clean out	American Standard and Kohler	Faucet by American Standard and Kohler
Electric Water Cooler	Wall mounted, ADA compliant with hand-operated (valve-type) bubblers.	Oasis, Elkay and Halsey Taylor	American Standard and Kohler

Emergency Eye Wash	Squeeze handle operation and ABS plastic eye/face wash head. Thermostatic mixing valve with built-in shutoff in the event of hot or cold water supply failure.	Gardian and Haws	
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### Design Guidelines

- Provide a back-up pump for all domestic hot water re-circulating systems.
- Provide a separate re-circulating pump for each domestic hot water system that has a different temperature setpoint.
- Provide a valved by-pass on pressure reducing valve assemblies.
- Waterless urinals are not allowed.