



Division 23 Heating, Ventilating and Air Conditioning (HVAC)

23 00 00 Heating, Ventilating, and Air Conditioning (HVAC)

23 05 00 Common Work Results for HVAC

23 05 05 General Requirements for HVAC

1. The HVAC system design for all UW-Madison facilities shall comply with all of the provisions of the latest version of the Division of Facilities Development (DFD) HVAC Design Guidelines, which is available from the DFD website.
2. References within the DFD Guidelines regarding the DFD Project Manager shall apply to the UW-Madison Project Manager on UW-Madison Managed Projects.
3. Project Specifications shall use as their basis all appropriate sections of the latest edition of the DFD Master Specifications.
4. Deviations from DFD's Minimum Design Guidelines or the DFD Master Specification sections shall be made only upon approval from the UW-Madison Project Manager.
5. The Guidelines for Planning and Design of UW-Madison Facilities shall take precedence over DFD Guidelines, but the A/E shall discuss all conflicts within the guidelines and specifications with the UW-Madison Project Manager.
6. The goals and guiding principles of the UW-Madison Campus Master Plan (latest edition) shall be considered and referenced as part of the planning, design, detailing, and material section for every project.
7. Owner training shall be included for all equipment and systems and training shall be scheduled, take place, and be videotaped.
8. Record drawings shall be kept up to date on the job site and turned over to the A/E prior to final pay requests. The drawings shall be prepared by the A/E in a clear AutoCAD format.
9. If a project is being carried out in an existing building the new equipment will follow existing similar building equipment naming scheme. Contact owner agency to confirm equipment tag naming to be used.
10. Pitch air intake plenum bottoms shall drain out louver.
11. Louvers shall be sized for low velocity (<300 fpm) through free area.
12. Pans shall be required to be water-proof.
13. All primary heating systems shall require redundancy.
14. All AHU's with return air shall be required to have air blenders.
15. Unconditioned spaces shall be required to have sealed PVC jackets on all piping.



16. All roof caps shall be required to be painted with factory finish.
17. Standing seams shall be required on coping.
18. HVAC units shall be located either on the roof or within the building. HVAC units shall not be placed outside the building on the site.
19. Do not provide both a pot feeder and water filter on heating water systems. The water filter can be used as a pot feeder.
20. UW-Madison prefers Parker water filters.
21. Fans should not be provided with grease lines extending outside the fan housing.
22. All rooftop duct work shall be insulated and well-waterproofed.
23. All thermostats shall be located directly adjacent to light switches in private offices and conference rooms. These shall be placed next to the latch side of the door or side light so the remainder of the wall is open for furniture placement. Coordinate furniture plans with electrical and control plans.

23 05 29 Hangers and Supports for HVAC Piping and Equipment

Specifications *Section 23 05 29 90 Hangers and Supports for Utility Piping and Equipment* is a Division of Facilities Development and Management (DFD) Standard Specification although it may not be available on their website. Use this specification section for all applicable utility work. It can be obtained from UW-Madison FP&M.

23 05 93 Testing, Adjusting, and Balancing for HVAC

1. Copies of the balance report shall be turned over to the UW-Madison Project Manager as soon as they are available.
2. Operating static pressure set points, on direct-digital control systems, during the time of balancing, shall be indicated.

23 08 00 Commissioning of HVAC

UW DDC Metasys Head End Database to have project specific User Views built out by controls vendor prior to any Functional Testing activities occurring by the Commissioning Agent. The CxA should be testing and verifying equipment sequences utilizing the same interface the end user UW DDC interacts with the BAS.

23 09 00 Instrumentation and Control of HVAC

23 09 10 Direct-Digital Control System for HVAC

1. Specifications for Direct Digital Controls shall be based upon the DFD Master Specifications sections for DDC systems
2. Any deviations from the DFD Master Specifications must be approved by the UW-Madison Project Manager
3. A permanent copy of control drawings and sequence of operation document shall be placed inside or next to the control cabinets.



4. High turn-down steam and chilled water meters shall be provided on all campus buildings. Specific meter selections shall be coordinated with UW-Madison Physical Plant.

23 09 14 Pneumatic and Electric Instrumentation and Control Devices for HVAC

1. Individual thermostats for offices shall be reviewed on a per project basis. As a general rule, all private offices occupied by principal investigators or by faculty shall receive individual controls since their work hours can be irregular. Some staff or supporting offices, sharing the same building exposure and with occupancy consistent across an 8 hour work day, may be zoned.
2. Freeze protection sensors shall be included on heating and cooling coils.
3. In buildings where an air dryer is to be installed for a lab/house air system, the control air shall be tied in after, rather than having another air dryer installed just for control air.
4. All control devices in the system shall be identified with a tag or marker beside the device and not on the device. As devices get replaced in time, identification disappears.
5. Sequencing of air handling units and exhaust fans shall allow reasonable ability for a small adult to open doors of buildings during an alarm condition.
6. All thermostats shall be located directly above light switches in private offices and conference rooms. These shall be placed next to the latch side of the door or side light. Coordinate with the electrical and furniture plans.
7. All new and replacement HVAC control components will be electric (actuators & controllers).
8. All TCP must have at least 3 foot uninterrupted clearance in front of panel.
9. Communicating Thermostats and ASC are not allowed to be integrated onto the campus BAS.
10. Control Vendors Point to Point wiring checkout reports shall be shared with owner/UW DDC prior to or during As Built Submittal handover for proper record sharing.
11. For remodel project scopes affecting terminal units planned to be reused that are deemed >10years old from original install requires a functional checkout at beginning of project construction to confirm proper operation of the following components: All actuators, VAV box flow stations, all sensors, valve & air damper seals. If these components checkout to be in suitable working order they can be reused if deficiencies are found fully replace components in kind. Coordinate with agency DDC group to assist with pre device checkout as needed.
12. Owner related training needs to be performed after approved As Built submittal is provided to owner. Training to include a walkthrough of the project area lead by the control contractor lead pointing out physical locations of all controls related devices that aren't easily found within an open mechanical room. As Built submittal should corroborate with the walkthrough tour.



Guidelines for Planning and Design of UW-Madison Facilities
Division 23 Heating, Ventilating and Air Conditioning (HVAC)
 University of Wisconsin – Madison

13. Specifications for Direct Digital Controls shall be based upon the DFD Master Specifications sections for DDC systems.
14. All installed DDC hardware & communication protocol will be implemented per manufacturers specifications otherwise instructed by the owner agency.
15. All project Control Vendors shall submit final as built drawings to owner/UW DDC in 'PDF' and 'MS Visio/other editable file format' for future owner editing internally as needed.
16. Valves serving animal and animal related (i.e. feed rooms, storage...) areas must have Fail Position of Closed.
17. All Minimum Outside Air flow stations must have filters installed upstream of them with a filter differential pressure sensor wired to DDC.
18. Probe sensor data shall match DFD specification.
19. Fume hoods that are greater than 8 feet must have two presence sensors for presence detection.
20. All steam valve actuators should have a 6-inch copper whip on the valve for the pneumatic air signal to prevent the poly from heat stress that causes the poly to become brittle over time.
21. Each Control Damper operator shall serve a maximum damper area of 25 square feet and not 36 square feet. Where larger dampers are used, provide multiple operators.

23 09 15 Direct Digital Control Input/Output Point Summary Tables

1. The UW DDC Points Guide naming standard will be used as principle document by the DDC contractor while creating the programing as a reference for best practices used on campus.
2. For existing buildings where existing control systems are being touched/demolished as part of new work a I/O Point demo table should be provided for the contractor to follow. The A/E will need to coordinate with UW DDC when this applies to help flush out all existing points on the BAS that will need to be demoed as part of intended project work.

23 09 23 & 23 09 24 Direct Digital Control System for HVAC

1. All bid set and as built set control drawings submitted for a project must be reviewed and accepted by the UW DDC shop to help confirm for accuracy and proper UW DDC standards are being followed in the submittal.
2. A dedicated team of control techs will be established before the beginning of the project, The dedicated team must be available throughout the project through commissioning phases to owner training.
3. Every effort should be made to segregate Zone level control devices and major mechanical systems (i.e. AHU's, HWS, HRUs...) across different communication trunks.
4. No split control layout is allowed on the BAS for the same equipment (i.e. NO partial pneumatic and DDC layout, NO OEM and main project controls intermixing, NO splitting of multiple controllers to control the same equipment).



Guidelines for Planning and Design of UW-Madison Facilities
Division 23 Heating, Ventilating and Air Conditioning (HVAC)
 University of Wisconsin – Madison

5. Prior to final owner handover all supervisory level devices (aka engines) should be upgraded to the latest firmware revision available and be set within manufacturer published communication network standards.
6. Venturi valves installed with the intent of being controlled by a DDC field controller, shall have actuators controlled by an analog output from the DDC Controller. A LOM (Linearization Output Module) shall be installed to provide volume feedback to the DDC field controller.
7. Where possible, when integrating 3rd party vendor devices (i.e. VFD's, Meters) efforts should be made to segregate them to individual MSTP trunks.
8. UW DDC Metasys Head End Database to have project specific User Views built out by controls vendor prior to any Functional Testing activities occurring by the Commissioning Agent. The CxA should be testing and verifying equipment sequences utilizing the same interface the end user UW DDC interacts with the BAS.
9. All installed DDC hardware & communication protocol will be implemented per manufacturer's specifications otherwise instructed by the owner agency.
10. All project Control Vendors shall submit final as built drawings to owner/UW DDC in 'PDF' and 'MS Visio/other editable file format' for future owner editing internally as needed.
11. Room flow matrixes shall be included in the design/record documents for all lab spaces with setback fume hood controls. Room Flow matrix template can be provided by owner agency DDC group by request.

23 09 93 Sequence of Operations for HVAC Controls

1. For all projects that interact with new/updated system level equipment control sequences, the A/E shall plan to arrange a Control Submittal page turn between the controls vendor, Engineer, & UW DDC shop.
2. Outdoor lighting control must be operated through a dedicated contactor. The contactor coil shall be energized indirectly by use of a 24V relay controlled from the BAS field controller. The 24V relay shall have a hand/off/auto switch to facilitate local override control.
3. Owner Training needs to include a recorded session with the lead control tech demonstrating the key operational control sequences portion to owner agency. Key control sequences to be demonstrated to be identified by UW DDC shop.
4. Individual spaces requiring 24/7 cooling (IT Rooms, Elec. Vaults, etc...) or specific pressure requirements to be maintained shall be designed and sequenced to be satisfied in a standalone state not reliant on larger AHU systems so as to allow the AHU system to go into unoccupied scheduling/setback for energy savings opportunities.
5. The UW DDC Points Guide naming standard will be used as principle document by the DDC contractor while creating the programming as a reference for best practices used on campus.



23 20 00 HVAC Piping and Pumps

23 22 00 Steam Condensate Piping and Pumps

1. Campus steam usually has a fair amount of superheat. Provisions shall be made for proper venting of flash steam from condensate. Receivers and vents shall be directed to discharge well away from outside air intakes and other areas susceptible to vapor freezing damage. Returns shall not be insulated in Mechanical rooms, for sub cooling.
2. Campus superheated steam tends to have its condensate flash in the return piping. Provisions shall be made for proper condensate cooling, particularly on large steam heating coils.

23 26 00 Valves

1. All valves shall have a method of determining position – either rising stem or pointer. Do not use non-rising stem valves.
2. Valves in campus steam and chilled water systems shall be specified to handle the higher than usual operating pressures and temperatures found in the central systems.

23 30 00 HVAC Air Distribution

23 31 00 HVAC Ducts and Casings

1. Flammable storage cabinets shall be vented with low volume exhaust (10-20 cfm) to prevent accumulation of vapors. Use only metal duct or pipe. Include a blast gate to adjust air volume. The opening from the cabinet to the duct must have a flame arrester, usually provided with the cabinet. Flammable liquid cabinets shall be vented from the bottom with make-up air supplied to the top.
2. Corrosive storage cabinets shall be vented with low volume exhaust (10-20 cfm) to prevent accumulation of vapors. Use corrosion-resistant metal or appropriate not-metal duct. Include a blast gate to adjust air volume.
3. Duct lining shall be limited to un-powered short transfer ducts for noise control.
4. If fibrous lining is used for noise control in laboratory fume hood exhausts, the fibrous material shall not be exposed to the exhaust stream. (Rationale: Exposed fibrous material could pick up contamination over many years and require disposal as hazardous waste).

23 33 00 Air Duct Accessories

1. The mixed air section in air handlers shall be properly designed for air blending. Return air and outside air shall enter mixing box very close to each other and in a position that forces the two streams into each other, preferably with the cold outside air on the top. Ideally the two air streams shall be forced together at a higher velocity in the duct upstream of the mixing box. Air blenders alone do not solve the problem of poor entering duct arrangements. Be careful when using multiple air blenders side by side.
2. Screens in air intakes shall be mounted in such a way that they can be easily removed and cleaned. If the intake is in an area well, the grating sections shall be sized so one person can remove them. If the intake is not in an area well, sufficient space (about 3')



inside of intake plenums shall be provided where a person can get inside, remove and clean the screens. If this is not possible, the screens shall be placed on the exterior.

3. Air intakes shall be designed to prevent problems with plugged frozen filters. Intakes shall be kept as high off horizontal surfaces as possible. Low intake velocities shall be used. Ducts shall be attached high on intake plenums and plenums shall be deep enough to prevent high velocity concentrations near intake duct.
4. Filters shall be at least 4 feet from any outside louver and have added duct section on exterior of louver if the filters are less than 8 feet from the exterior to prevent precipitation from saturating the filters. Entering velocities shall not exceed 300 fpm.

23 36 00 Air Terminal Units

Variable flow devices shall not be used on biological safety cabinets.

23 40 00 HVAC Air Cleaning Equipment

23 40 50 General Requirements for Filters

Each filter type shall have its own separate filter bank.

23 70 00 Central HVAC Equipment

23 72 00 Air-to-Air Energy Recovery Equipment

1. All heat recovery units for critical systems where system shutdown is dangerous or difficult to schedule (e.g. fume exhaust) shall have tight dampers and a bypass arrangement so coils can be cleaned and maintained. Seal shall also lock into damper blades. Dampers shall be sized for full face.
2. Heat wheels shall be used anywhere possible to reduce heating and cooling loads. Where contaminated air streams might be present, UW-Madison Environment, Health and Safety shall be contacted.
3. Heat recovery coils shall be protected by filters.

23 80 00 Decentralized HVAC Equipment

23 82 00 Convection Heating and Cooling Units

23 82 16 Air Coils

Chilled water coils have a history of freezing problems. Individual coils shall be blown out with 90 psi air then the air dry shall be turned on. Coils shall be installed properly. Coils shall be leveled so they do not hold water in the return bends.