

SECTION 15010

BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Basic Mechanical Design requirements common to all Sections of Division 15.
2. University of Colorado, Colorado Springs, Department of Facilities Services Basic Mechanical Design Policies and Standards.

B. Related Sections:

1. Division 1 - General Requirements.
2. Division 15 - All Sections.

1.02 REFERENCES

A. General:

1. For products or workmanship specified by Association, Trade, or Federal Standards, comply with requirements of the Standard, except when more rigid requirements are specified or are required by applicable Codes.
2. The Date of the Standard is that in effect as the Date of the Contract Documents, except when a specific Date is specified.

1.03 SYSTEM DESCRIPTION

A. University Philosophy:

1. This section provides an overall philosophy of the University's Guidelines.
2. Consideration should be given to flexibility and adaptive reuse in the building and space design.
3. If appropriate, the design should provide for building additions with appropriate architecture and infrastructure considerations.
4. It is basic policy to study the possibility of future needs (expansion, new equipment) at the time the basic design is being formulated. If appropriate, least one layout shall be made showing expansion possibilities.
5. Innovative designs should be considered but unproven systems and materials are not acceptable. Consider using proven components in creative ways.
6. Exterior mechanical installations must not only be designed for proper functions,

but must be considered in the aesthetics of building design. Large and unsightly installations shall be located so as to be hidden from public view or shall be appropriately enclosed.

All major air handling equipment shall be installed in a mechanical room accessible from the inside of the building. Roof-top air-handling units are not acceptable on the main campus.

7. The Architect shall provide sufficient room for an orderly arrangement of equipment, piping, conduit, etc. Special consideration shall be given to heights of floor to ceiling spaces to allow for maintenance and concealment of systems, as much as practicable.
8. Special attention shall be given early in the design process to provide for sufficient and safe access space for maintenance of mechanical systems. Sufficient space implies the capability to replace major components with minor impact to the Building. Equipment shall be designed to be accessible and maintainable from floor level whenever possible. When not possible, permanent structures will be designed to minimize the necessity of such tools as ladders, hoists and portable lighting (i.e.: platforms and permanent ladders for overhead work, rail systems for removal of pumps in pits, adequate permanent lighting, etc.). The University shall not accept designs unless the drawings clearly indicate locations of ceiling and wall access panels and other necessary access space. Specifications shall clearly identify contractor requirements to maintain these clearances and access points.
9. When equipment, wiring, piping, telecommunications cable, etc. is disconnected or "abandoned," it must be physically removed and disposed of as part of the project.

B. Utilities:

1. In general, utilities will be included in Division 2 and work in this Division 15 will only extend to 5 feet outside of Building or Structure excavation perimeter.
2. Specify the following where exceptions do occur and Building Services extensions and connections are made to Public Utilities:
 - a. Connection charges, system development charges and the like, that in principle allow the right to obtain the services from the Utility will be arranged and paid for by the University.
 - b. Tap fees for water and sanitary sewer shall be arranged and paid for by the Division 15 Contractor.
 - c. Costs incurred due to the Utility Company installing their own taps, service, meters, etc., will be paid by the University.
 - d. Extensions from termination points to connection with building services and systems will be the responsibility of the Division 15 Contractor.

C. Meters:

1. Unless otherwise instructed buildings will be metered for all utilities including electricity, natural gas, and water. Submeters for irrigation to CSU standards. See drawing A-1/UCCS.

D. Energy Conservation Standards:

1. General Requirements:

- a. The University falls under the rule of state mandated reduction of energy use by 20% and construction of LEED Silver certified buildings where 20% of state funds are utilized and no more than 5% of project budget is needed to achieve this goal. The University is therefore dedicated to the principle of conserving energy and will scrutinize proposed construction for means of reducing initial cost, as well as life cycle analysis to inform the design decision. The Architect shall work in close cooperation with the Engineers to provide an integrated design. The International Energy Code shall be implemented, as a minimum.

LEED: Sustainability Director will have final review of inclusion of all LEED Guidelines. These shall be followed with the goal of achieving LEED Silver as a Minimum. This includes the implementation of the appropriate ASHRAE standards (55, 62, 90, 129, etc.) and validation with accepted simulation programs, such as DOE2. If it is determined that the energy load will exceed the stated standards, a conference with the University representative will be required to determine the course of action. Re-design of problematic portions of the building will be required.

- b. The design of the HVAC and electrical systems, shall for conservation of energy during unoccupied or minimum occupancy periods. Buildings generally operate on three time zones: 8-5, 8-11, 24/7. Consideration shall be given to appropriate system design and operation to account for these time zones.
- c. The capability of using alternate sources of energy should be considered.
- d. The Design Consultants shall provide a final energy analysis to the University. It shall show the estimated use of energy for the structure.

2. Building Construction Requirements:

- a. Window design shall be integrated into the overall design strategy with consideration for aesthetics and energy impact. Low emissivity glazing shall be used, with double glazing set 3/4 inch apart, as a minimum.
- b. Operable windows shall be considered where appropriate.
- c. Walls shall have R-19 or greater thermal resistance factor.
- d. Roof and ceiling combinations shall have R-30 or greater thermal resistance at the minimum roof cross-section thickness.
- e. Infiltration should not exceed ASHRAE Guidelines.

f. Daylighting is encouraged, but with minimal glare and solar heat gain.

E. Design Calculation Procedures:

1. Calculations shall be based on methods and data from the most recent issues of the ASHRAE Handbook of Fundamentals.

LEED: Other requirements may apply.

2. Computer analysis, using only programs that meet LEED guidelines, will be acceptable.

F. System Design Requirements:

1. System selection shall consider the environmental requirements for thermal control, indoor air quality and energy use.

2. Design temperatures for heating and air conditioning systems shall be as follows:

a. Winter: 90 degrees F temperature difference between inside and outside conditions (-20 degrees F outside air temperature). Make-up air winter design temperature is -30 degrees F. Indoor conditions shall be 72 degrees F.

b. Summer: ASHRAE Summer 1%. but 100 degrees F db and 59 degrees F wb outside conditions if air-intake is above a roof, and 95/59 for systems with high make-up air intake. 76 degrees F db, 63 degrees F wb inside conditions.

c. Special areas, such as computer rooms, animal areas, etc., will have temperature and humidity requirements will be provided to the Consultant by the University representative or Laboratory Consultant.

3. The University utilizes central Direct Digital Control Systems (DDC) for central control of certain HVAC functions and terminal DDC for space control.

4. Occupied-unoccupied programming of systems should be initiated to shut-off ventilation air, exhaust air, fan system, pumps, etc., wherever possible. Where shut-down of systems cannot be accomplished during unoccupied hours, energy recovery systems should be considered. Each application should be examined independently to determine any special sources for obtaining recovery of usable energy. Life cycle cost analysis by the Consulting Engineer will be required to determine the feasibility of energy recovery systems.

5. Fan coil units and radiation may be required in specific areas to facilitate shut-down of major fan units. Where necessary, the control of these units shall be coordinated with the controls of the air handling units.

6. All air conditioning systems shall have air-economizer cycles where feasible.

7. In order to take advantage of economizer cooling to the highest temperature possible, return air (RA) should be minimized. Therefore, RA dampers should be specified to be of outdoor sealing quality for all units.

8. All air conditioning, heating, ventilating and exhaust systems shall be matched to the maximum required performance. If appropriate, the use of variable volume supply and exhaust air systems is encouraged to compensate for diversities in loads and to reduce equipment sizes. VAV boxes and supply diffusers and grills shall be designed to ensure proper space ventilation effectiveness.
9. Interior spaces requiring cooling the year around should be handled independently from perimeter areas requiring heating during the winter and cooling during summer. Interior areas with a variable volume cooling system utilizing an air economizer cycle. The perimeter systems should utilize economizer cycles when cooling is required and minimum ventilation rates when heating is required. VAV terminal units shall be able to provide full shut-off.
10. Provide for two-stage filtration (30% / MERV 7 and 60% / MERV 11) upstream of all air handling coils. Heat-recovery coils shall have 60% (MERV 11) filters.

LEED: Filtration shall be 30% (MERV 7) and 85% (MERV 13).

11. All coils shall have access for cleaning, including re-heat coils in, for example, VAV terminals.
12. Elevator shaft venting: In order to minimize drafts, heat loss and elevator door "whistling", it is necessary to install a motorized damper for elevator shaft venting, interlocked to the fire-alarm and control system.

The damper shall be operated as indicated in "Control Sequence of Operation" of the control section
13. Outside air ventilation shall be per latest approved version of ASHRAE Standard 62, during the time the spaces are occupied. Where appropriate the use of CO₂ sensors should be considered.
14. Pressure gages are required across all AHU coils and filters banks (filter and pre-filter combined).
15. See Section 1.05, Submittals, for fan requirements

G. Criteria for Selection of Equipment:

1. The following criteria shall be employed in the selection of equipment:
 - a. Indirect-direct evaporative cooling should be considered. Stainless steel sumps, hardware and housings are required for the direct-evaporation sections. Indirect evaporative cooling with "mechanical air-chilling coil" to complement the indirect evaporative cooling coil should be considered.
 - b. Fans selected for operation above 6" total static pressure must be approved by the responsible University Engineer.
 - c. Compressors for electrically-driven chillers and refrigeration units, of over 100 ton capacity, shall have electrical power consumption not to exceed (set a number with tools) kW/ton between 30 percent and 90 percent of chiller capacity.

- d. Refer to ASHRAE 90 for minimum Energy Efficiency Ratios (EER) allowable for all other compressors.
- e. Water-cooled or evaporative condensers are acceptable depending upon job requirements and necessities. Water-type cooling towers are preferred, to conserve energy, and shall generally be considered on systems 80 tons and larger. On units below 80 tons, an economic evaluation, including cost of maintenance should be made to determine if the condensing unit will be air cooled or water cooled. Cooling tower fan motor loads shall not exceed 0.06 H.P./ton of chiller capacity. Reduced condenser water temperatures should be utilized when possible to reduce the chiller electrical consumption.
- f. Air-cooled condensers shall be capable of operating at 95F ambient temperature with 30F temperature difference between air entering and leaving the condenser. Air-cooled condensers on roofs shall be capable of operating at 105F ambient temperature.
- g. Small water-cooled DX Units or research equipment which utilize tap water for condensing, after which the water is disposed of in the drain, will not be permitted. In every instance, review by UCCS staff is required.
- h. Variable-speed controllers (VSC) are acceptable. Electrical by-pass switches are not required. See section 15050 for VSC minimum requirements.

H. Design Documents:

1. Drawings:

- a. Computer-aided drawing is required. Final CAD drawings shall be updated with as-built conditions and equipment data before delivery to University. CAD disks shall be provided as well.
- b. They shall include date of issue, versions, University job number and indication on each sheet of number of sheets issued (e.g., Sheet ___ of ___). Drawings shall follow AIA CAD requirements.
- c. All equipment designations, schedules and equipment parameters descriptions shall be indicated on the Drawings. The Specifications may be used to clarify and complement or to describe minimum performance standards and operating instructions be listed on the Drawings, in table form (schedule), whenever possible. Single, distinct equipment may be described in non-table form. Include two columns indicating what the equipment is used for (e.g. Exhaust Hood, Room 258, Supply Air, First Floor) and room number where located.
- d. Plumbing isometrics shall be included.
- e. Components shall be labeled per the list in Appendix 1 of this section.

2. Specifications:

- a. We require the standard long-form of specification. Our experience with the short

form has been unsatisfactory.

- b. We require the Specifications be set up in specific CSI Sections, with each Section having the pages numbered for that section only.

3. Consultant Submittal Requirements

a. Schematic Design

1. Narrative

- a. Narrative description of the proposed mechanical systems

2. Plumbing & Piping

- a. Restroom locations and fixtures (quantity and type)
- b. Piping risers
- c. Location of water, sanitary sewer, storm sewer and sprinkler services to the building
- d. Tentative fixture schedule
- e. Location, sizes and types of water heaters, heat exchangers, and flues if required
- f. Provide a fixture-count calculation sheet
- g. Meter/submeter/RP backflow designs per CSU standards

3. HVAC

- a. HVAC load calculations
- b. Equipment schedules with tentative sizes, capacities, features, etc.
- c. Mechanical-room drawings, showing locations and sizes of fans, and if possible, pumps, compressors, heat-exchangers, etc.
- d. Shaft locations and sizes.
- e. Size all equipment for 6,400 feet above sea level.

b. Design Development

1. Narrative

- a. Updated narrative from the one included in the Schematic Design documents

2. Plumbing & Piping

- a. Plans of each floor, noting fixture locations and types. Indicate routing of main distribution lines with tentative sizes.
- b. General arrangement of all piping systems (piping, heating and cooling, and FP).
- c. Location of water, sanitary sewer, storm sewer and sprinkler services to the building.
- d. Tentative fixture schedule.
- e. Location, sizes and types of water heaters, heat exchangers, and flues if required.
- f. Provide a fixture-count calculation sheet.

3. HVAC

- a. Plans of each floor, showing single-line duct layouts (as a minimum), equipment location, and typical heating and cooling

devices (e.g., a VAV-box and branches with diffusers, BBR, CUHs and UHs).

b. Equipment schedules with tentative sizes, capacities, features, etc.

c. Mechanical-room drawings, showing locations and sizes of fans, pumps, compressors, heat exchangers, etc.. Show elevations or cross-sections to ascertain that equipment fits vertically.

d. HVAC load calculations.

4. Specifications

a. Outline specifications are not required. It is expected that the mechanical consultant will provide an informal review set of drawings and specifications at the 70% level of mechanical design.

c. Partial CD's (~70%)

1. Provide drawings for informal review at 70% of mechanical design.

2. Outline specifications are not required. Provide "best effort" full specifications.

d. Full CD's

1. If not totally completed, provide documents with a list of lacking or pending items (i.e., 100% with exceptions).

2. Control schematics shall be included, as well as points list and control sequences.

e. Drawings

1. Drawings at all stages of design shall have room numbers corresponding to those in architectural drawings.

f. Commissioning

1. Include appropriate commissioning checklists in the specifications (See UCCS Standards Section 01740).

I. Codes:

1. The latest Edition of the International Mechanical Code, Plumbing Code and the Fire Code shall apply to the Project Design except where University Standards are more stringent.

J. Coordinate with the Architect to provide a curbed floor area for storage of on-site water-treatment chemicals, following water-treatment consultant's recommendations.

K. Vibration Engineering Criteria:

1. Refer to Section 03740 of the Architectural Standards

1.04 PROOF OF PERFORMANCE

- A. Require that all pressurized piping be pressure tested.
- B. Require that all new ductwork in new systems be pressure-tested per SMACNA, from AHUs to upstream of terminal control devices (e.g., VAV boxes).
- C. Include commissioning as described in Section 01740.

1.05 SUBMITTALS

A. Specify Contractor to:

1. Submit Samples, Shop Drawings and Product Data as required by various Sections of Division 15 in accordance with Section 01300 - Submittals.
2. "Submit detailed shop drawings for all fan systems having structural frame supports for the fan housing. These must include solid rotor shaft dimensions, wheel weight, bearing center-to-center distances, bearings, bearing support pedestals and structure, etc. None of the above-cited items are to be considered as being "unavailable" or "proprietary". Relevant sketches giving pertinent details are acceptable. The design resonant speed of the fan system shall be a minimum of 25% above the fan operating speed, considering both wheel mass and inertia. Appropriate engineering calculations must be available to support the design resonant speed value and to insure that the bearing support structure has adequate stiffness in all three directions (lateral, axial, and vertical). The installed, operating fan bearing motions (inboard and outboard) shall not exceed 1.5 mils peak-to-peak in any direction when measured in the "filter out" measurement mode at any operating speed; "filter in" mode measurements are not acceptable. The instrument system used must have a flat response down to 120 RPM. Fan speed shall not exceed 1200 RPM.

Design Resonant Speed is that speed which corresponds to the natural frequency of the spring-mass system consisting of the rotating components, bearing lubrication and housing, and supporting pedestal (supporting floor, foundation, etc., considered to be infinitely rigid)."

3. Prepare and submit two (three for Non-General Fund Buildings) copies of Operation and Maintenance Data for Division 15 in accordance with Section 01700 - Contract Closeout and "Operation and Maintenance Manuals" paragraph in this Section 15010. (Also, see 1.06 below). Also, provide one each of the building monitoring and control systems and the life-safety systems.
4. "Mechanical contractor shall obtain approval in writing from Balancing contractor for type and size of balancing devices."

1.06 OPERATION AND MAINTENANCE INFORMATION

- A. The manuals of Operation and Maintenance data bound in 8-1/2 by 11 inch three-ring side binders with durable hard plastic covers. The University shall receive the quantity of O&M manuals stated in Division 1. They shall include:

1. Warranties.

2. Alphabetical list of all system components including the name, address, and 24-hour phone number of the company responsible for servicing each item during the first year's operation.
 3. Maintenance Instructions, including valves, valve tag and other identified equipment lists, proper lubricants and lubricating instructions for each piece of equipment and necessary cleaning/replacing/adjusting schedules.
 4. Manufacturer's Data on each piece of equipment, including:
 - a. Installation Instructions.
 - b. Drawings and Specifications (reviewed and accepted Shop Drawings).
 - c. Parts Lists.
 - d. Complete Wiring and Temperature Control Diagrams (reviewed and accepted Shop Drawings).
 5. Testing, adjusting and balancing (TAB) report.
 6. Signed-off commissioning checklists.
 7. Appropriate start-up information by factory representative.
 8. On-site dynamic balancing report by independent balancing firms of all labs.
- B. In addition to the "Operation and Maintenance Manual", and keyed to it, the equipment shall be identified and tagged as specified in Section 15190 - Mechanical Identification including the following:
1. Identify all starters, disconnect switches, and manually operated controls, except integral equipment switches with permanently applied, legible markers corresponding to operating instructions in the "Operation and Maintenance Manual". Coordinate with University Preventive Maintenance personnel.
- C. Division 15 Contractor shall be responsible for scheduling instructional meetings for maintenance personnel on the proper operation and maintenance of all mechanical systems, using the "Operation and Maintenance Manual" as a guide.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.01 WATER TAPS

In general, we prefer "hot taps" over "dry taps" because it is so difficult to schedule outages.

3.02 MOUNTING OF EQUIPMENT

Specify that equipment shall be anchored with anchors extending through the housekeeping pad or curb into the floor. This is illustrated in the schematic associated with section 03200 of the UCCS standards.

3.03 JOURNEYMAN-TO-APPRENTICE RATIO

Specify that "The University requires all plumbing work be performed under the direct supervision of licensed plumbers (4-year), with a ratio of not more than two apprentices per journeyman. The requirement also applies to licensed pipefitters."

END OF SECTION