

SECTION 15050
BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Motors.
2. Starters.
3. Variable Speed Drives.
4. Manual Valves.
5. Gages and Thermometers.
6. Temperature and Pressure Test Plugs.
7. Pipe Hangers, Supports and Guides.
8. Dielectric Pipe Fittings and Isolators.

B. Related Sections:

1. Section 15010 - Basic Mechanical Requirements.
2. Section 15190 - Mechanical Identification.
3. Section 15240 - Mechanical Sound and Vibration Control.
4. Section 01045 - Cutting and Patching.
5. Section 02200 - Earthwork.
6. Section 08305 - Access Doors.
7. Section 15950 - Temperature Controls
8. Section 09900 - Painting

1.02 REFERENCES

- A. American National Standards Institute (ANSI).
- B. American Society of Mechanical Engineers (ASME).

- C. National Electric Code (NEC).
- D. National Electrical Manufacturer's Association (NEMA).
- E. ASHRAE
- F. ASTM
- G. NFPA
- H. UL

1.03 SYSTEM DESCRIPTION

A. Design Requirements:

1. Motors:

a. General:

1. Size for the operating conditions of each specific item of equipment.
2. Motors 1/2 hp and smaller single phase.

b. Altitude Deration:

1. Motors must be selected to operate within name plate horsepower at 6400 feet elevation and shall not operate on the service factor.

c. Starting Capability:

1. Select motors capable of making starts as frequently as indicated by the automatic control system requirements for energy conservation or other multiple starts.

d. Energy Efficiency:

1. All motors rated greater than 1000 watts shall have a Power Factor of not less than 85 percent under rated load conditions.
2. Specify high efficiency motors

e. Bearings:

1. Ball or roller bearings.
2. Regreasable except permanently sealed where motor is normally inaccessible for regular maintenance.
3. Sleeve-type acceptable for fractional horsepower light-duty motorized equipment.

f. Acoustical:

1. Motors shall not exceed 80 db rating when running their full speed and power range.

g. Specify that all belt-drive motors over 5 HP shall have dual push-pull adjustment screws for the motor mounts. For retrofits, require that the motor mounts be replaced if not of this type.

h. VFD Use:

1. Motors have insulation rated 1600 volts or greater. All motors driven by VFD shall not run in the service factor and shall have phase emulation and appropriate temperature rating for service.
 - i. Insulation:
 1. Motors shall be NEMA Design B with Class F insulation or higher as appropriate.
 - j. Sealant:
 1. Conduit penetrating through exterior walls are to be sealed and supported by Link Seal or approved equal. Size and type of Link Seal to be selected based on type of conduit and application.
2. Starters:
 - a. General:
 1. Specify starters necessary to operate Division 15 Motors.
 2. Consult with Electrical Engineer and determine which motors, if any, require reduced-voltage or reduced inrush starters. Conditions of starting must be considered. For example, large vane axial fans have low starting torque requirements because they are controlled to start with fan blades unloaded which usually allow across-the-line starting to be accomplished within University requirements, with advantages of shorter manufacturer's delivery schedules, lowest cost, least complex and requiring the least maintenance.
 3. Specify starters for chillers and packaged equipment in their respective Sections.
 - b. Motor Control Centers:
 1. Where a large group of starters can be centrally located, it will be beneficial to have these assembled in a motor control center (MCC) and specified in Division 16.
 2. Where starters are to be specified in a MCC in Division 16, close coordination is required with the Electrical Consultant to make sure starters match specific motor requirements for part winding start, auto transformer type starting, wye/star-delta closed transition type or where two speed motors have been specified.
 3. Provide adequate space in design for installation of field panels to contain relays and point cards for remote start-stop and status indication in conjunction with EMCS requirements.
 - c. Starter Configuration:
 1. Comply with full NEMA Standards and NEC. Refer to 16480.
 2. Specify Type 1 general purpose enclosures with/ padlock ears.
 - d. Manual Control:
 1. Specify maintained-contact push buttons with pilot lights for single-speed or multi-speed operation.
 - e. Automatic Control:
 1. Specify magnetic starters for motors 1/2 horsepower and larger and for smaller motors where interlock or automatic operation is required.
 2. Specify auxiliary contacts if needed. Specify space for future.
 3. "Hand-Off-Automatic" switches in starter cover.

4. Interlocks, pneumatic switches and similar devices as required for coordination with the control requirements specified in Section 15950 - Controls and Section 15985- Control Sequence of Operation.
5. Built-in 120 volt control circuit transformer, fused from line side, where service exceeds 240 volts.
6. Trip-free thermal overload relays, each phase.
7. Externally operated manual reset.

3. Variable-Speed Drives (VFD)

a. General:

The characteristics listed below are the minimum requirements for UCCS applications.

1. The VFD shall be of sufficient capacity and provide a quality of output wave form so as to achieve full rated output of the motors. The VFD shall be capable of operating any standard NEMA Design B squirrel cage induction motor (3 phase, 60 Hz), with full-load amp rating between 10 percent and 100 percent of the drive full load current capability, without requiring any modifications to the motor or drive.
2. The audible dB sound level of the complete system (motor & VFD) when operated over the full speed range shall be not more than 10 percent above the sound level of the motor operated in the bypass mode (60 Hz building power). This test will be performed during initial start-up. Corrections needed to achieve this requirement shall be made by the VFD supplier at no cost to the University.
3. 3 year warranty.

b. Construction:

1. VFD's shall have good power factor, good turn down rates and not reflect noise into the power distribution systems.

c. Basic Features

1. Control:

- a. With the "H-O-A" switch in the 'HAND' position, the drive shall be controlled by the manual mode on the drive door.
- b. With the "H-O-A" switch in 'AUTOMATIC', the drive shall start, and its speed shall be controlled by a 4 to 20 MA input speed signal.
- c. With the "H-O-A" switch in the "OFF" position, the run circuit will be open and the VFD will not operate.
- d. The VFD shall be arranged to provide automatic restart after a trip condition resulting from over-voltage or under-voltage. For safety, the drive shall shut down and require manual reset and restart if the automatic reset/restart function is not successful within a maximum of five attempts.
- e. A separately housed bypass shall be provided to allow complete by-pass and removal of VFD controller. Only on pumps, cooling towers, and a case by case on air handling units.

2. Field Adjustments:

- a. Independent acceleration/deceleration rates: 0.5 - 120 seconds. Regeneration or dynamic braking will not be required for deceleration.

3. Line Noise Protection:

- a. VFDs shall be equipped with factory installed reactors or separate isolating transformer as called for on the plans to minimize the effects of harmonics and "line notching" on the building distribution system. Manufacturer shall optimize the impedance of reactors or transformer and provide calculations to the owner certifying that the installed system is within IEEE-519 standards. Care should be taken in specifying transformer impedance so the transformer can support across-the-line starting of the driven motor in a standby mode.

4. Factory Tests:

- a. The VFD shall be tested with the system logic and given complete factory tests including simulated operation

4. Manual Valves:

- a. Specify valves which meet these standards as a minimum. They shall be pressure-rated type valves.
- b. Specify that all valves shall comply with the applicable MSS (Manufacturer Standardization Society) standards, and shall state so in submittals.
- c. Locate valves in accessible locations with adequate clearance around hand wheels or levers for easy operation.
- d. Specify and clearly indicate service valves for all equipment, risers, branches and zones on Drawings.
- e. Specify valves according to proper duty and operating characteristics.
- f. Size valves properly for required control range.

5. Gages and Thermometers:

- a. Review with University during design development where stationary gages and thermometers will be required, in addition to sensors and instrumentation specified in Section 15950-Controls, to avoid unnecessary redundancy. Gages with dual units (Standard and S.I.) are required.
- b. Stationary locations to confirm, and clearly indicate, on primary pieces of equipment specified in other Sections of these Design Standards include the following:
 - PRV Stations
 - Heat Exchangers
 - Domestic Water Heaters
 - Condensate Coolers
 - HVAC Pumps
 - Chillers
 - Condensers
 - Boilers

6. Temperature and Pressure Test Plugs:

- a. Specify for all other locations of equipment or piping where periodic temperature and/or pressure indication is required to test performance of equipment or systems include the following:

Water Coils
Zone Loops
Booster Pumps

- b. Determine and specify minimum number of portable thermometers and gages that will be required for test plugs to monitor any one set of conditions.

7. Pipe Hangers, Supports and Guides:

- a. Hangers in contact with steel, iron, cast or ductile iron shall be plated.
- b. Hangers in contact with copper piping shall be copper clad or have a suitable lining to prevent electrolysis.
- c. Hangers for cold insulated pipe shall be around the outside of the insulation supply 180 degree cal-sil with metal shield or wood blocks with 180 degree metal shield.
- d. Specify galvanized metal shields and heavy density insulation inserts at these hangers and roller support points to prevent insulation damage.
- e. Plastic piping shall be supported on continuous galvanized steel trough with clevis hanger spacings as indicated for metallic piping, or as recommended by supplier.
- f. Pipes that run parallel and have similar grade or pitch may be supported on trapeze hangers with spacing determined by the smallest pipe.
- g. Special pipe hanger and support provisions required for control of pipe expansion, vibration, and sound transmission shall be in accordance with Section 15240-Mechanical Sound and Vibration Control and good sound attenuation practice.
- h. Pipe guides and anchors shall be detailed and locations shown on drawings.
- i. Pipes on roofs shall be supported by roller supports of adjustable height. Wood blocks and straps are not acceptable for lengths greater than six feet.

8. Dielectric Pipe Fittings and Isolators:

- a. Provide Dielectric Waterways at all connections between dissimilar metals in water systems to control corrosion potential caused by galvanic or electrolytic action. Dielectric unions are not acceptable.
- b. Typical locations are:
 1. Water heaters.
 2. Storage and pressure tanks.
 3. Water conditioning equipment.
 4. Changes in service piping materials.
 5. Make-up connections to boilers.
 6. Make-up connections to chilled water systems.
 7. And the like where materials of different electrode potential are joined.

9. Unions:

- a. Unions and isolation valves are required wherever any components need to be removed for repair or replacement.

10. Metering:

- a. Consultant shall check with owner for metering requirements.
- b. Regardless of presence of metering, provide proper upstream and downstream straight-lengths requirements and flanged sections for meter installations.

1.04 QUALITY ASSURANCE

- A. Welder Qualifications: Welding shall be performed by ASME Certified Welders with current certificate in accordance with ANSI B31.1 for shop and project site welding of piping work.

PART 2 - PRODUCTS

2.01 MOTORS

A. Manufacturers:

ABB
AO Smith
Baldor
General Electric
Gould
Lincoln
Louis Allis
Reliance
Toshiba
Westinghouse

- B. Motor performance and ratings certified in accordance with latest NEMA standards.

2.02 STARTERS

A. Manufacturers:

Allen Bradley
General Electric
Siemens
Westinghouse
SQ "B", Cutler-Hammer

- B. Starters certified in conformance with latest NEMA Standards and NEC requirements.

2.03 VARIABLE SPEED DRIVES

A. Manufacturers:

ABB
Toshiba
Yaskawa
CutlerHammer

2.04 VALVES (For any value used in steam service, refer to Section 15521)

A. Manufacturers:

1. General: Valves, manufacturers and catalog numbers are shown only to establish type and quality of valves required. Other equal valves may be selected from the following lists of acceptable manufacturers. All valves shall be pressurerated type.

a. Ball Valves (Bronze body, tunnel balls), (Comply with MSSSP110):

Apollo
Dynaquip
Hammond
Jamesbury
Jomar
Milwaukee
Nibco
Watts
Worcester

b. Butterfly Valves (Comply with MSSSP67):

Crane
DeZurik
Fisher
Hammond
Jamesbury
Keystone
Milwaukee
Nibco
PosiSeal
Victaulic

c. NonLubricated

Eccentric Plug Valves:

DeZurik
Keystone
Milliken

d. Lubricated Plug Valves:

Nordstrom
Powell
Walworth

e. Gas Cocks (AGA, CGA, UL):

Crane
Hammond
Peter Healy
Alternate: Milwaukee "Butterball" valves
Jomar Ball values

f. U.L., F.M. Approved or Listed Valves:

Demco
GEM
Grinnell
Jomar
Kennedy
Keystone
Mission
Mueller
Nibco
Pratt
Victaulic

g. Stop and Drain Valves:

Hammond
Prier
United Brass

h. Bronze Pressure-rated Valves (Comply with MSS-SP-80):

Crane
Hammond
Milwaukee
Nibco
Powell
Stockham

i. Iron Body Pressure-rated Valves (Comply with MSS-SP-70):

Crane
Kennedy
Lunkenheimer
Milwaukee
Mueller
Powell
Stockham
Walworth

j. Gate Valves (Steam only. See Section 15521.)

k. Balancing Valves:

See Section 15511 (Hydronic Piping).

B. Valve Schedule:

1. Ball Valves:

a. Pressure-rated

- b. Blowout-proof stem with packing nut
- c. Full ball port with Teflon seals and seat, as specified.
- d. Solid, bored-hole, stainless-steel ball and trim.
NOTE: For all bronze valves, specify the following:
Body = ASTM B61, B62 or B584 Bronze

e. Example Schedule:

Plan Code: B.V.
Service: Balancing
Pressure: 150 SWP/600 WOG
Sizes/Inches: 1/4 through 3"
Make: Apollo 77-200
Actuator: Lever
Port: Full

f. Three-piece ball valve if 2-1/2" or greater.

2. Butterfly Valves:

a. Example Schedule: standard 150 psig with 150 psig ANSI companion flanges for use where system pressures cannot exceed 200 psig shut off (static) pressure.

Plan Code: BFV
Style: Fully-lugged body. Shall be capable of dead-end shut-off and full-rated pressure without the need for downstream blind flange.

Pressure Rating:

ANSI Class: 125/150 minimum

Body: Cast Iron or Ductile Iron

Disc: Aluminum Bronze

Stem: 416 stainless steel

Seat: EPDM (-40 deg. F to 250 deg. F)

Actuator: 2" through 5" Infinite position lever with memory stop. 6" through 20" Self locking worm gear with adjustable limit stops, and position indicator. Provide chain wheel and chain where indicated by contract documents.

Make: Keystone

Size: 2"-12" 14"-24"

Model: 222 129

3. Balancing Cock

a. Example Schedule:

Plan Code:	Flow Indicating	Ecc. Plug Valve
Pressure:	175 lb. WOG	175 lb. WOG
Size/Inches:	1/2 through 2 1/2	3 through 12
Make:	T & A	DeZurik
Model:	Bal. Valve	100 w/gage tap

Actuator: w/Memory Stop 159 w/Memory Stop
 Ends: Threaded or Sweat Flanged

4. Gas Valves:

- a. Gas cock and lubricated plug or AGA-approved Ball or Butterball TM valves.
- b. Example Schedule:

Plan Code:	G.C.	L.P.V.	L.P.V.
Size/Inches:	1/2 through 1		
Pressure:	100 PSIG Air	200 lb. WOG 1/2 through 3	200 lb. WOG 4 through 12
Make:	Peter Healy 1500-F	Walworth 1700	Walworth 1707-F
Actuator:	UL and FM Approved	E-2	Wrench
Valve Type:	None Required	Threaded	Flanged

- a. Gate, check and butterfly.
- b. Sizes all.
- c. Example Schedule:

Plan Code:	OS&Y	C.V.	W.C.V.	BF.V	D.V.
Valve Type:	Gate	Swing	Wafer	BTFY	Drain
Make:					
Straight Flanged:	68				
	Kennedy	GEM	GEM	Demco	Milwaukee
Straight Threaded:	67	-----	----	----	Butterball
		F-250	-----	----	----
Wafer:	-----	-----	F-512	NE-H	----

6. Specialty Valves:

- a. Petcock, stop and drain, drain, needle.
- b. Example Schedule:

Plan Code:	PTK	S&D.V.	D.V.	N.V
Type:	Petcock	Ball	Gate	Needle
Pressure:	250 SWP	Water 150 LB.	Water 125 LB.	200 SWP/
Size/Inches:	1/8	1/2 and 3/4	3/4	1/8 through 3/4
Make:	Powell	Apollo	Milwaukee	Hammond
Model:	922	Full-Port	148	1B415
Ends:	Threaded	Threaded or	Threaded	Threaded
		Solder, and		
		Hose End		
		Adapter, Hose		
		cap & chain		

7. Standard Bronze Valves - 150 SWP/300 WOG.

- a. Gate, globe and check.

b. Sizes 1/8 through 2 inches.

c. Example Schedule:

Plan Code:	G.V	GL.V.	C.V.	L.C.V.	B.C.V.
Valve Type:	Gate	Globe	Swing	Lift	BTFY
Make:	Hammond	Hammond	Hammond	Crane	----
Straight Threaded:	1B629	1B413T	1B446	366-1/2	----
Angle Threaded:	-----	1B454T	-----	-----	----

8. Standard Iron Body Valves - 250 SWP/500 WOG

a. Gate, globe and check.

b. Sizes 2 through 12 inches.

c. Example Schedule:

Plan Code:	G.V.	OS&Y.	GL.VC.	C.V.	N.S.C.V.
Valve Type:	Gate	Gate	Globe	Swing	Non Slam
Make:	Milwaukee	Milwaukee	Milwaukee	Mueller	Crane (Chapman)
Straight Threaded:	T-2897	T-2894	-----	-----	-----
Straight Flanged:	F-2897	F-2894	F-2983	F-2600-6	223

2.05 STATIONARY PRESSURE GAGES

A. Manufacturers:

Crosby
Dwyer
Trerice
U.S. Gauge
Weksler

B. Example Schedule:

Dial	Service	Dia.	Range	Make	Model	Accessories
Water	4"	Appropriate for Application	Trerice	600C	#870-1-865-1	
Air	4"	0 to 300 psig	Trerice	600C	#870-1-865-1	
Vacuum	4"	30"Hg to 30 psig	Trerice	600C	#870-1-735-2	

2.06 STATIONARY THERMOMETERS

A. Manufacturers:

Weiss or pre-approved equal

B. Vari-angle Digital Thermometer with light-sensitive electric cells.

2.07 TEMPERATURE AND PRESSURE TEST PLUGS

A. Manufacturers:

Fairfax
Peterson Equipment (Pete's Plug)
Trexco

B. Plugs suitable for vacuum to 600 psig and temperatures of -20 F to 300 F with cap and extension for insulated pipe where required.

C. Pressure gages and thermometers in individual shock-proof cases.

D. Schedule:

Item	Make	Model
Test Plug	Fairfax	N-78-02
Pressure Gage & Adapter	Trexco	0-300 psig #600-3-1/2" Gage 80-02
Thermometer	Trexco	B-81105 0-220 F

2.08 PIPE HANGERS, SUPPORTS AND GUIDES

A. Manufacturers:

B-Line
Grinnell
Michigan
P.H.D.
Tolco

2.09 DIELECTRIC PIPE FITTINGS AND ISOLATORS

A. Manufacturer:

Perfection Corporation: Dielectric Waterway, Flow Design
Available from Keystone and Victaulic distributors

B. Dielectric fittings shall conform to ASA B16.8, plated as applicable a minimum of .0005" and have no flow restriction when assembled.

PART 3 - EXECUTION

3.01 ERECTION, INSTALLATION, APPLICATION

A. Variable Speed Controllers

1. Field Tests

The VSC and bypass shall be tested and started under actual conditions by factory trained personnel. One day of technician's time shall be included in the base bid for checkout/startup.

2. Once operational, the unit being controlled by the VSC shall be operated through its full range to determine resonant speeds, and the VSC shall be programmed to skip those speeds.
3. Provide one complete spare set of all fuses used in each VSC supplied.

B. Quiet Operation and Vibration:

1. Specify that all work shall operate in accordance with Section 15240-Mechanical Sound and Vibration Control under all conditions of load.
2. Sound or vibration conditions not in accordance with Section 15240 and considered objectionable by the University shall be corrected in a manner approved by the Project Architect under the Work of Division 15.

C. Access Doors:

1. Coordinate location, installation, furnishing and specification for both standard and fire rated access doors with the Architect.
2. Specify 20" by 20" minimum size or larger as required for service use on mechanical equipment.
3. Locate where required for access to valves, shock absorbers, dampers, controls, mechanical equipment or appurtenances.

D. Sleeves, Plates and Closures:

1. Protection for Insulated Pipes:

- a. When insulated pipes penetrate floors which will be covered with finish flooring, specify that a sheet metal protective covering be installed around the insulation jacket.
- b. Sheet metal shall extend above the pipe sleeve far enough to protect the insulation from bumping by polishing machines and vacuum sweepers.
- c. Space between the pipe sleeve and the sheet metal must be sealed.

2. Floor Sleeve Heights:

- a. Rooms with floor drains-extend 2" above floor (and floor penetration within walls surrounding the rooms).
- b. Kitchens and Mechanical Equipment Rooms-extend 4" above floor.
- c. All other areas where pipes are exposed-extend 1/4" above finished material on floor.
- d. All existing floors that are core drilled need to comply with a, b and c of this spec section.

3. Seals:

- a. Where fire rated separations are penetrated by pipes or ductwork, the annular space around the pipe or ductwork shall be installed to an approved fire rated assembly with appropriate fire rated materials.

E. Excavating and Backfilling:

1. Specify excavation and backfilling for mechanical equipment requirements to be in accordance with Section 02200-Earthwork of these Design Guidelines.

F. Cutting and Patching:

1. Specify cutting and patching requirements for mechanical equipment to be in accordance with Section 01045-Cutting and Patching of these Design Guidelines.

G. Other Installation Requirements:

1. In general, for project specifications, remove "Design Requirements" in Part 1, paragraph 1.03, sub-paragraph A, and expand here on specific requirements of installation for motors, starters, valves, gages, thermometers, test plugs and any other products specified in Part 2 or required for Division 15 work in general.

H. Construction and pre-occupancy Indoor-Air-Quality (IAQ) Management

1. Include in the specifications the items listed. Also require that all on-site equipment and components shall be protected from dust.
 - a. During Construction, meet or exceed the recommended design Approaches of the SMACNA IAQ Guideline for Occupied Buildings under Construction, 1995, Chapter 3.
 - b. Protect stored on-site or installed absorptive materials from moisture damage.
 - c. If AHUs must be used during construction, filtration media with a Minimum Efficiency Reporting Value (MERV) of 8 must be used at each return air grille, as determined by ASHRAE 52.2-1999.

LEED EQc3.1: Construction IAQ Management Plan:

Replace all filtration media immediately prior to occupancy. Filtration media shall have a MERV of 13, as determined by ASHRAE 52.2-1999 for media installed at the end of construction.

LEED EQc3.2: Construction IAQ Management Plan:

Include in the specifications the items listed below regarding to pre-occupancy IAQ.

- a. **After construction and prior to occupancy, conduct a minimum 2-week flush-out with new MERV 13 filtration media at 100% outside air. After the flush-out, replace the filtration media with new MERV 13 filters, except for the filters solely processing outside air.**

-OR-

- b. **Conduct a baseline indoor air quality testing procedure consistent with the U.S. EPA's**

current Protocol for Environmental Requirements, Baseline IAQ and Materials for the Research Triangle Park campus, Section 01445.

END OF SECTION