DIVISION 15 – MECHANICAL

15000 GENERAL

A. Design Considerations:

1. Supply Air Requirements: At a minimum, outside air must be supplied to occupied spaces in accordance with the latest issue of ASHRAE Standard 62, Ventilation for Acceptable Indoor Air Quality. All laboratories, shops and studios where hazardous materials are used must be maintained under negative pressure with respect to areas of lower hazard (e.g. corridors, offices). Exhaust air from these areas of higher hazard must not be recirculated, and must be exhausted directly to the outdoors. Minimum occupied laboratory air change rate shall be 12 air changes per hour. Minimum unoccupied laboratory air change rate shall be 6 air changes per hour. Higher occupied and unoccupied air flow rates are discouraged unless dictated by cooling load requirements, safety considerations or inability of HVAC system to operate in a reduced flow unoccupied mode. University Facilities and REHS shall review and approve minimum occupied and minimum unoccupied laboratory air change rates on a project by project basis.

2. Ventilation intakes and discharges must be located so that exhaust air is not entrained into the building. Exhaust air discharges are to be roof mounted and air intakes must be located at ground level unless otherwise approved by University Facilities and REHS. Air intakes must be located in areas where they will not introduce air pollutants into the building (e.g. away from loading docks, high traffic areas, exhaust discharges from other buildings, etc.)

3. Building hot water for heating shall be 180^{o} F with a 40 degree temperature difference. Use 150# AISI design standards.

4. Campus high temperature water systems may be designed at 400^{o} F and 400 psig, depending on campus. The Engineer-of-Record shall verify actual design parameters for HTW systems with Rutgers Department of Utilities (in writing) prior to commencing design. Use 300# AISI design standards.

5. Campus chilled water systems may be designed at 45^{o} F with a 12^{o}F temperature difference. The Engineer-of-Record shall verify actual design parameters for campus chilled water systems with Rutgers Department of Utilities (in writing) prior to commencing design.

6. Dual temperature systems shall be designed for 180 ^{o} F (with a 40 degree temperature difference), winter and 45^{o} F (with a 12 degree temperature difference), summer. Where chilled water is being supplied from the campus chilled water system, the Engineer-of-Record shall verify actual design parameters for campus chilled water with Rutgers Department of Utilities (in writing) prior to commencing design.

7. 4-pipe systems are preferable.

8. Hot water is preferred heating medium.

9. Steam system shall be designed for low pressure (15 psig or less) unless otherwise approved by Rutgers. When steam is obtained from a HTW steam generator, it is especially important to realize that pressures of 30 psig or greater are difficult to justify because they use an enormous flow of primary HTW. All kitchen equipment (dishwasher, steam tables, etc.) should be operated at less than this pressure. Autoclaves, sterilizers and cage washers should be capable of operating at less than 30 psig steam. If this is not possible, the use of an electrically driven steam generator that can be separately metered (electrically) can be considered.

10. HVAC - Temperature Design Standards:

    a. The following inside design conditions shall apply unless otherwise approved by Rutgers:

       Winter:
       Non-critical areas such as offices, classrooms, etc.: 70^{o} F +2^{o} F with no humidity added.

       In critical areas as much as 30% relative humidity +5% may be added. Coordinate wall and glass insulation "U" factor to avoid condensation.

Summer:
Non-critical areas: $77^{o\ F}$ +2^{o} F, 50% relative humidity +5%.

Critical areas may be designed to 72^{o} F when approved by the Project Manager.

Recreation Center Fitness Areas:
All Recreation Center fitness areas shall maintain a temperature of 58 to 72 degrees Fahrenheit with a minimum air circulation rate of 12 air changes per hour on a year round basis.

Note that the usual range of accuracy for temperature is +2^{o} F and usual range of accuracy for relative humidity is +5%. Both ranges are as measured at the location of the controlling instruments.

b. Outdoor design conditions should follow ASHRAE Fundamentals, 1985 edition for Newark, New Brunswick, and Philadelphia (for Camden campus).

c. For ordinary spaces, including offices, classrooms, and residence rooms, there are the 2-1/2% and 97-1/2% values in the ASHRAE guide:

	Winter	Summer	Range
Newark	14^{o} F DB	91^{o} F DB/73^{o} F WB	20^{o} F
New Bruns.	10^{o} F DB	89^{o} F DB/73^{o} F WB	19^{o} F
Camden	14^{o} F DB	90^{o} F DB/74^{o} F WB	21^{o} F

d. For critical laboratory spaces use the following values:

	Winter	Summer	Range
Newark	10^{o} F DB	94^{o} F DB/74^{o} F WB	20^{o} F
New Bruns.	6^{o} F DB	92^{o} F DB/74^{o} F WB	19^{o} F
Camden	10^{o} F DB	93^{o} F DB/75^{o} F WB	21^{o} F

e. For cooling towers, use 78^{o} F WB design.

11. HVAC – Acoustic Design Standards

The Engineer of Record shall bear full responsibility for designing all mechanical systems as required to achieve maximum noise levels set forth in the most recent editions of ASHRAE HVAC Applications and the ASHRAE Fundamentals handbooks pertaining to sound and vibration control for the occupancy classification of the individual space served. The University reserves the right to require more stringent acoustic design criteria be used for design on a project by project basis. The University also reserves the right to hire an independent acoustic consultant to review "as installed" noise levels for conformance with the aforementioned acoustic design standards.

12. All designs shall conform to the requirements of the latest issue of ASHRAE/IESNA Standard 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings.

B. Special Documentation Requirements

1. Prior to commencement of design, the Engineer-of-Record shall contact Rutgers Utilities Department to verify (in writing) design temperatures, pressures, delta "T"s and maximum available capacities at proposed points of tie-in for all utilities proposed to serve a given facility. Where these values vary seasonally, the most conservative values shall be used for purposes of design. The Engineer-of-Record shall use this information to design Plumbing, HVAC and Fire Protection systems. Design temperatures, pressures and delta "T"s as referenced in these Standards are for information only and are not to be used for final design without obtaining written confirmation from Rutgers Department of Utilities.

2. The Engineer-of-Record shall coordinate with the project architect to ensure that related mechanical and architectural plans and specification sections are properly coordinated. Specifically, fume hood configuration, controls, fixtures & appurtenances must be coordinated between engineering and architectural disciplines. Fume hoods shall be of constant volume (i.e. bypass type) or variable air volume configuration as dictated by HVAC design.

3. The engineer-of-record shall provide calculations, based on simple payback and\or life cycle cost criteria, of proposed mechanical

system design(s) (and for alternate design(s) as may be requested by the University) to the Office of Facilities Project Administration for review and approval with the Design Development Submission. Calculations shall be performed using the "Trane" Trace computer program or other methodology subject to Rutgers University approval.

C. Materials and Methods of Construction

RESERVED

15050 BASIC MECHANICAL MATERIALS AND METHODS

A. Design Considerations

RESERVED

B. Special Documentation Requirements

1. For all new construction, renovations and alterations, the Contractor shall mark-up the contract documents to indicate any changes in construction and installation due to field conditions or other deviations from the plans and specifications. The A/E shall take the record drawings and produce the As-Builts on mylar with CAD files.

2. The A/E shall be responsible for preparation and follow-up correspondence with REHS and\or the DEP for all permitting required for fuel burning equipment.

C. Materials and Methods of Construction

1. Access for mechanical devices installation and future maintenance is essential. When access doors are specified, check with the Project Manager for need of locks.

2. All equipment shall be installed with sufficient walk-around room to insure proper maintenance of equipment. Equipment shall be installed such that tube pull, filter replacement, ease of removal and replacement of strainers, ease of draining equipment, convenience for service of parts, etc. can be achieved.

3. No roof top mechanical equipment shall be located closer than 10'-0"to a roof edge or adequate guardrail protection (rail or parapet) must be provided.

4. All non-metallic underground pipes shall have trace wire to facilitate future location. Trace wire type and installation shall be in accordance with the requirements of Rutgers Department of Utilities.

5. Do not use sheet metal sleeves through outside walls. Sleeves shall be pipe conforming to ASTM A 120. At outside walls provide "leak plate" and install "Linkseal".

6. No Contractor shall connect to any hydrant owned and operated by Rutgers without first obtaining authorization from Rutgers Department of Utilities and providing a Series 009 RPZ Hydrant Backflow Preventer as manufactured by Watts at the point of connection.

15055 MOTORS

RESERVED

15060 HANGERS AND SUPPORTS

A. Design Considerations

RESERVED

B. Special Documentation Requirements

1. Provide calculations for pipe line flexibility justifying pipe routing and anchor locations. Conform to ASME Code for allowable stresses. Furnish calculations for spring hangers. Calculations must address seismic considerations as required.

C. Materials and Methods of Construction

1. All piping with insulation shall be supplied with saddles and rigid insulation at pipe hanger locations.

2. Hanger spacing for copper pipe shall be as follows:

Pipe Size	Hanger Spacing
1"	6 ft.
1-1/2"	8 ft.
2"	9 ft.
3"	10 ft.
4"	12 ft.

15071 MECHANICAL VIBRATION AND SEISMIC CONTROLS

A. Design Considerations

1. Flexible connection shall be installed at pumps only when directed by Rutgers or when acoustic consultant recommendations are accepted by Rutgers.

2. Vibration control is usually not needed when pumps are mounted on basement slab. All vibration controls need to be carefully examined. Pads, isolated from the slab may be acceptable. Inertia blocks need to be considered when the pump room is in proximity to an acoustically important room.

B. Special Documentation Requirements

1. Seismic calculations shall be provided by a licensed New Jersey professional engineer as required to conform with applicable code requirements. Rutgers may require acoustic calculations be provided by a licensed New Jersey professional engineer for noise and\or vibration sensitive applications or to verify conformance with requirements referenced in these standards.

C. Materials and Methods of Construction

RESERVED

15075 MECHANICAL IDENTIFICATION

A. Design Considerations

RESERVED

B. Special Documentation Requirements

RESERVED

C. Materials and Methods of Construction

1. Provide strap-on markers for pipe. Pressure-sensitive type markers are not acceptable.

2. Conform with ANSI 13.1.

3. All underground piping runs, both mechanical and plumbing shall be protected with buried pipeline marker. Marker to be 6 mil thick, 3" wide, fluorescent yellow polyethylene. Tape to be "metalicized" and imprinted to read "Caution- buried pipe below". Before excavation is started, call (1-800-272-1000) for utility markouts.

4. Tape to be placed 1'-0" directly above top of pipe, over entire length of run.

5. Tape to be placed on top of 4" deep x 6" wide layer of clean white sand.

6. Any existing tape which is encountered, removed or disturbed during excavation shall be replaced in conformance with items 1-3 above and to the approval of Rutgers, prior to backfilling.

15081 DUCT INSULATION

A. Design Considerations

1. Interior insulation on ductwork is prohibited unless approved by REHS. Use external duct insulation for thermal purposes.

2. Where duct borne noise is a concern, utilize approved duct-mounted sound attenuators and\or double wall insulated duct (with perforated metal inner liner) as required to achieve acoustic design criteria.

B. Special Documentation Requirements

1. Insulation specification shall describe what systems and services are to be insulated.

C. Material and Methods of Construction

1. All insulation shall conform to Energy Code.

2. Staples are not acceptable for insulation installation.

3. All "raw" ends of insulation shall be sealed.

15082 EQUIPMENT INSULATION

A. Design Considerations

RESERVED

B. Special Documentation Requirements

1. Insulation specification shall describe what systems and services are to be insulated.

C. Materials and Methods of Construction

1. All insulation shall conform to Energy Code.

2. Staples are not acceptable for insulation installation.
3. All "raw" ends of insulation shall be sealed.

4. Mineral wool and calcium silicate may be considered for high temperature (greater than 300^{o} F.) service insulation.

15083 PIPE INSULATION

A. Design Considerations

RESERVED

B. Special Documentation Requirements

1. Insulation specification shall describe what systems and services are to be insulated.

C. Materials and Methods of Construction

1. All insulation shall conform to Energy Code.

2. Staples are not acceptable for insulation installation.

3. All "raw" ends of insulation shall be sealed.

4. Mineral wool and calcium silicate may be considered for high temperature (greater than 300^{o} F.) service insulation.

5. High temperature hot water insulation for new piping below grade shall consist of Multi-Therm 500 Perma-Pipe System. Foamglass insulation with Pittwrap jacket shall be used for repair/replacement of insulation on existing below grade piping.

15110 VALVES

A. Design Considerations

RESERVED

B. Special Documentation Requirements

RESERVED

C. Materials and Methods of Construction

1. Chain-wheel operators for valves shall be located in a place where they will not interfere with normal access and shall be restrained at wall or column if necessary.

2. Butterfly valves shall be Lug type, with memory stop and shall have EPDM (or better) seats. Do not use butterfly valves for balancing steam or hydronic systems.

3. Triple duty valves are acceptable.

4. Adjust class of safety valves for pressure and temperature used in each system.

5. Sizing of pressure reducing valves shall be clearly shown on the Drawings for all equipment.

6. Valves for High Temperature Water Service:

    a. 3" and Larger: Shall be of the ASA 300 pound class, cast steel body, 13% Cr. stainless steel trim, flanged at connections to equipment, butt-weld at other than equipment connections, bored to match outside diameter of pipe.

    b. 2" and Smaller: Shall be of ASA 600 pound class, cast steel or forged carbon steel, socket weld pattern, 13% Cr. stainless steel trim, bored to match inside diameter of pipe.

    c. Gate Valves: Shall be solid wedge with stainless steel wedge or wedge faces, stainless steel seat rings. Stainless steel bonnet bushings and beveled collar on valve stem for back seating. Provide braided, teflon impregnated backing rings in a large, deep stuffing box suitable for high temperature water service. Insert at bottom of stuffing box, to serve as base for packing. Packing glands shall be non corrosive and shall have bolted gland flange with minimum of 2 eye bolts. Valves, with their bypasses, need to be installed for proper operating access.

        (1) Gate Valves 1-1/2" and Smaller: Provide with a minimum of 4 packing rings.

        (2) Gate Valves 2" and Larger: Provide with a minimum of 6 packing rings.

        (3) Gate Valves 6" and Larger: Provide with a minimum of 6 packing rings. Provide forged steel,

globe valve bypass, minimum 3/4". Provide with tapered roller or ball bearing yokes and button type grease gun fittings and adapters to allow charging a reservoir with valve lubricant.

(4) Gate Valves 8" and Larger: Provide with a minimum of 6 packing rings. Provide forged steel, globe valve bypass, minimum 3/4". Provide with tapered roller or ball bearing yokes, Provide with bevel gear operators, clockwise rotation to close, lamented lubricating fittings and approved grease seals.

(5) Acceptable manufacturers: Crane, Jenkins, Vogt.

d. Globe and Angle Valves: Shall be of the cast plug disc with bevel seat, separately screwed or pressed in disc and seat rings, long disc locknut, port opening full pipe diameter. Provide stainless steel seat ring and disc: stainless steel bonnet bushing and beveled collar for back seating. Provide braided, teflon impregnated packing rings in a large, deep stuffing box suitable for high temperature water service. Insert a bottom of stuffing box to serve as base for packing. Packing glands shall be non-corrosive and shall have bolted gland flange with minimum of 2 eye bolts. Valves with their bypasses shall be installed for proper operating access.

(1) Globe & Angle Valves 1-1/2" and Smaller: Shall have minimum of 4 packing rings.

(2) Globe & Angle Valves 2" and Larger: Shall have minimum of 6 packing rings.

(3) Globe & Angle Valves 6" and Larger: Shall have minimum of 6 packing rings. Valves shall have forged steel, glove valve bypass; button-type grease gun fittings and adapters to allow charging a reservoir with valve lubricant tapered roller or ball bearing yokes.

(4) Globe & Angle Valves 8" and Larger: Shall have minimum of 6 packing rings. Valves shall have forged steel, globe valve bypass; button-type grease

gun fittings and adapters to allow charging a reservoir with valve lubricant; and tapered roller or ball bearing yokes. Shall be equipped with impactor or hammer-blow hand wheel.

(5) Acceptable manufacturers: Crane, Jenkins, Powell, Vogt.

e. Check Valves: Shall be horizontal swing check, 300 lb. cast steel, with 13% Cr. stainless steel disc, disc face and barrel type seat rings. Provide full port opening. Disc and seat shall be removable without removing valve from line**.** Acceptable manufacturers: Crane, Jenkins, Powell, Vogt.

f. Gage and Instrument Valves: Shut-off valves for pressure gages and instrument isolating valves shall be of the "barstock" construction, with stainless steel body and stainless steel plug type disc integral with stem. Ends shall be I.P.S. screwed. Rating shall be 600 psig at 7500F. Valves shall be 1/2" size, Crane Co. or approved equal.

g. Blowdown Valves: Blowdown valves for cascades, expansion drums, and hot water generators shall be unit-tandem type valves, consisting of one hardseat and one seatless valve in one common steel body to conform to the ASME Boiler Code. Valves shall be rated at 400 psig and suitable for pressures to 665 psig. Valves shall have welding ends and alloy steel trim.

h. Needle Valves: For high temperature water convectors shall be of "barstock" construction with stainless steel body and stainless steel plug type disc integral with stem. Ends shall be I.P.S. screwed. Rating shall be 600 psig at 7500F., Crane Co. or approved equal.

i. Drain and Vent Valves: Drain and vent valves shall be ASA 600-pound class 1 forged steel globe or angle valves, as specified above. Drain valves need to be sized and shown on the Drawings. Unless otherwise required, vent valves shall be 1/2" size.

j. Control Valves: Flanged 300 lb. cast steel, 316 stainless steel trim, Fisher Type ES body with pneumatic 667 actuator. Valves 1-1/2" should not require a positioner; valves larger than 1-1/2" should have a positioner. Use equal percentage contour plug. Preliminary sizing shall be based on 20 psi. pressure differential (verify with Project Manager). Valves shall be capable of closing off against a 100 psi pressure difference.

15121 PIPE EXPANSION FITTINGS AND LOOPS

A. Design Considerations

RESERVED

B. Special Documentation Requirements

1. Calculations for pipe expansion loops shall be provided by a New Jersey licensed professional engineer at Rutgers request.

C. Materials and Methods of Construction

1. Do not use expansion compensators on HTW and MTW. Use expansion bends (calculated) for all pipe flexibility situations.

15122 METERS AND GAGES

A. Design Considerations

1. BTU meters are required for all permanent buildings connected to central utility systems.

B. Special Documentation Requirements

RESERVED

C. Materials and Methods of Construction

1. Use bimetallic temperature indicators in 5" diameter case. Orient gage so that special flexible joint is not needed.

2. Use materials compatible with service for pressure indicators, temperature indicators and flow meters. Use diaphragm where needed.

3. BTU meters for HTW and MTW services shall have temperature range to 400^{o}F.

4. Meters shall have output of 4-20 MA for campus automation and include totalizer.

5. BTU meters shall be manufactured by Controlatron or approved equal, but all BTU meters shall be from the same source (single source responsibility).

15140 DOMESTIC WATER PIPING

RESERVED

15150 SANITARY WASTE AND VENT PIPING

A. Design Considerations

1. All new building sanitary lines shall go to a manhole.

2. For design purposes, all floor drains in spaces other than mechanical equipment rooms shall be considered “infrequent use” in accordance with the National Standard Plumbing Code.

B. Special Documentation Requirements

RESERVED

C. Materials and Methods of Construction

1. Hubless cast iron pipe is acceptable above grade.

15160 STORM DRAINAGE PIPING

A. Design Considerations

RESERVED

B. Special Documentation Requirements

RESERVED

C. Materials and Methods of Construction

1. Provide at least 2 roof drains per section of roof. See Uniform Construction Code for additional requirements.

15181 HYDRONIC PIPING

A. Design Considerations

RESERVED

B. Special Documentation Requirements

RESERVED

C. Materials and Methods

1. "Victaulic" pipe will be allowed for aboveground condenser water and chilled water.

2. Steel and copper pipe can be used for hydronic piping. Do not use plastic piping.

3. Utilize diaphragm-type compression tanks.

15182 STEAM AND CONDENSATE PIPING

A. Design Considerations

RESERVED

B. Special Documentation Requirements

RESERVED

C. Materials and Methods of Construction

1. Use steel pipe conforming to ASTM A 53, Grade B. Use of copper pipe shall be subject to approval by Rutgers. If copper pipe is used, modify fittings accordingly.

2. Steel piping 1" or less for low-pressure steam shall be Schedule 80.

3. Use bimetallic element traps only with Rutgers approval.

4. Pipe discharge from safety valves shall be terminated at a safe height and location to prevent personnel harm.

15183 REFRIGERANT PIPING

RESERVED

15184 HIGH TEMPERATURE HOT WATER PIPING

A. Design Considerations

RESERVED

B. Special Documentation Requirements

RESERVED

C. Materials and Methods of Construction

1. All new H.T.H.W. systems should be the Multi-Therm 500 Perma-Pipe System.

2. Certified welders are required for HTW work or high pressure work.

3. Materials for High Temperature Water Systems:

   a. Pipe:

3" and Larger	Under 3"and Smaller
Schedule 40	Schedule 80
ASTM A 53, Grade B	ASTM A 53, Grade B
Black	Black
Seamless	Electric Resistance Welded

b. Fittings

2" and Larger	Under 2"
Schedule 40	3,000 pound
Seamless	Forged Carbon Steel
Butt-welded type	Socket weld
ASA B 16.9	ASA B 16.11
ASTM A 234 Grade B	ASTM A 105 Grade II

Weld ells shall be long-radius pattern.

c. Flanges (all sizes): 300 pound class, forged steel, welding neck type, ASA B 16.5 ASTM A 181 Grade I.

d. Gaskets (all sizes): Spiral wound, type 304 stainless steel, non-asbestos filled, 3/16" thick with centering guide, 300 pound class, Flexitallic style CG**,** or approved equal.

e. Strainers (all sizes): Y-type; same size as pipe in which they are installed. Strainers shall have cast steel bodies suitable for 425^{o} F temperature and 600 psig pressure, bottoms drilled, directional arrow on body. Strainers shall be equipped with easily removable cover and basket. Basket shall be stainless steel, 3/32" perforations; net free area through back of basket shall be 2-1/2 times the area of connecting pipe. Flow shall be into basket and out through perforations.

f. Unions (normally not to be used on pipe larger than 1"): 3,000-pound class forged steel, socket-welded type, with steel to steel seat, ASTM A 105 Grade II, as manufactured by Henry Vogt Machine Co. or approved equal.

g. Bolts and Studs: Alloy steel studs threaded full length and fitted with two hexagon nuts per stud for all flanged joints. Bolting to conform to ASTM A 193 Grade B-7, threads class 7 fit. Nuts shall be semi-finished hexagonal, ASA B 18.2 ASTM A 194 Grade 2H.

h. All welding of high temperature water systems shall be performed by welders certified in accordance with ASME Boiler and Pressure Vessel Code, for pressure piping, latest edition.

4. Consult with Project Manager regarding piping materials for other services not mentioned in these Design Standards.

15185 HYDRONIC PUMPS

A. Design Considerations

1. Consult with Rutgers about pump selection philosophy. Limit speed to 1750 RPM. Any pumps handling HTW shall be selected with Rutgers input. Industrial pumps may be required. Selection should be made for high efficiency. Consideration of life cycle cost study of variable speed pumping should be made. Use mechanical seals when choice is available. Use cyclone separator type seal waste cleaning device on all pumps that can be equipped with it (generally on all double suction pumps).

B. Special Documentation Requirements

RESERVED

C. Materials and Methods of Construction

1. For small flows and low heads, in-line circulators may be used, this application is limited to zoned residential-type (or similar) systems and may include systems intended to prevent cold freeze-up. Typical limits are 80 GPM at 25 feet TDH.

2. Vertical in-line pumps may be used for systems similar to those described in the paragraph above where a larger system head exists. Typical limits are 3", 7-1/2 HP.

3. Base-mounted close coupled and separately controlled, end suction pumps shall be used when flows are between 100 and 500 GPM. The suction connection should be less than 4". Close coupled pumps should not exceed 10 HP and should not exceed 15 HP for the separately coupled pump. Base mount or separately coupled pumps should be of the back pull-out type.

4. Base-mounted, separately coupled double-suction, horizontal split-case type pumps should be used for connections 4" and larger. B&G VSC may be used. Consider vertical pumps, such as Aurora 413, where space is at a premium.

15186 STEAM CONDENSATE PUMPS

RESERVED

15189 HVAC WATER TREATMENT

A. Design Considerations

1. Water treatment is required for all heating, chilled water and condenser water loops to ensure the longevity of piping and equipment while minimizing maintenance.

B. Special Documentation Requirements

1. Documentation requirements should be discussed with Rutgers.

C. Materials and Methods of Construction

1. Water treatment should be discussed with Rutgers.

2. Water treatment systems shall be by NALCO Company of approved equal. Alternate water treatment manufacturers will require review/approval by Rutgers Department of Facilities Operations and Services.

15191 FUEL OIL PIPING

RESERVED

15194 FUEL GAS PIPING

A. Design Considerations

RESERVED

B. Special Documentation Requirements

1. Documentation demonstrating conformance with Factory Mutual requirements must be submitted to FM for review\approval as required.

C. Materials and Methods of Construction

1. All natural gas systems shall be installed and utilize materials in full accordance with the latest edition of NFPA 54.

15211 GENERAL-SERVICES COMPRESSED AIR PIPING

RESERVED

15212 LABORATORY AIR AND VACUUM PIPING

RESERVED

15213 MEDICAL GAS PIPING

RESERVED

15221 CHEMICAL-WASTE PIPING

RESERVED

15222 PROCESSED-WATER PIPING

RESERVED

15251 GENERAL-SERVICE COMPRESSED AIR EQUIPMENT

RESERVED

15252 LABORATORY AIR AND VACUUM EQUIPMENT

RESERVED

15410 PLUMBING FIXTURES

A. Design Considerations

RESERVED

B. Special Documentation Requirements

RESERVED

C. Materials and Methods of Construction

1. Shower control valves shall be pressure balance type, solid brass construction.

2. All plumbing fixtures shall have water saving type controls.

3. All plumbing fixtures must be tight fitting to walls and be neatly sealed at joint with silicone sealant.

4. All piping penetrating walls shall be covered with escutcheon plates.

5. Plumbing fixtures and fittings for laboratory furniture shall be provided by the laboratory furniture manufacturer.

6. Provide freezeless wall hydrants every 50' on exteriors of new buildings. Model B65 series as made by Woodford Manufacturing, Inc. or approved equal.

7. All ADA water closets, urinals, sinks and hand dryers shall be automatic flushing and turn on/off. Automatic fixtures shall be battery operated type as manufactured by Sloan, Zurn or Chicago Faucets. Model/configuration of automatic operator specified shall be as approved by the University Compliance Officer.

15412 EMERGENCY PLUMBING FIXTURES

A. Design Considerations

RESERVED

B. Special Documentation Requirements

RESERVED

C. Materials and Methods of Construction

1. Eyewash units shall be installed at or near sinks within the hazardous operations space. Such spaces include wet laboratories, areas where dust is generated, darkrooms, mechanical rooms and other areas where liquid chemicals are used or handled. Handheld hose type units providing a soft spray of 3-7 gpm tempered water at a pressure of 30 pounds per square inch are recommended. These may be bench mounted or on the side of the bench or wall, and should be readily accessible and located in a high visibility area near the main door. Wall-mounted units, pedestal-mounted units, eye\face wash units, combination safety shower\eyewash units must be provided with a soft spray of 3-7 gpm at 30 pounds per square inch of pressure.

2. All eyewash units must flush both eyes simultaneously, the flow must remain on without the use of the operator's hands, the unit must remain activated until intentionally cut off and the nozzles must be protected from airborne contaminants.

3. A sign must be posted to identify the location of the eyewash unit and the area behind or around the eyewash unit must be painted with a bright color. Eyewash units for non-ADA compliant units should be installed between 2'-9" and 3'-9" from the floor. For ADA compliant stations, for dimensions ICC ANSI A117.1 standards for drinking fountains shall be followed. However, the appliances shall be eyewash units.

4. Safety showers are to be installed in a conspicuous location, such as a well-traveled aisle, doorway or corridor. They must be within the room or space they serve or within 25 feet of the main room door. Safety showers in corridors can serve several laboratories or rooms. Safety showers must be installed in locations that are accessible at all times.

5. Safety showers are to be installed so that the center of the shower head is at least 25" from the nearest wall, bench or furnishing and at a safe distance away from electrical equipment or outlets. The base of the shower must be between 6'-10" and 8' above the floor. The shower head should be a deluge-type head, and should be made of plated brass or plastic. The safety shower unit should be capable of providing a flow of 30-50 gallons of water per minute at 30 pounds per square inch of pressure.

6. Safety shower activating valves are to be operated by pulling either a chain, a cord attached to die valve lever, an 8" diameter ring or a triangle connected by a chain or a cord to the lever. The lowest portion of the ring, triangle or cord should be located no more than 48" from the floor for frontal approach and no more than 54" from the floor for a side approach, and should be run within 1"-2" of a wall or bench. Safety shower activating valves are to be quick-opening, self-closing globe valves. A shut-off valve accessible from a 6 foot ladder is to be installed for each shower head.

7. A sign must be posted to identify the location of the safety shower, and the area behind or around the safety shower must be painted with a bright color. Exterior safety shower and water supply lines must be protected from freezing.

8. Installation and operation of safety shower and eyewash units must comply with the most recent edition of ANSI Z358.1-standard.

9. The contractor must test each emergency eyewash and safety shower unit prior to building occupancy to confirm compliance with these paragraphs. The test results shall be posted on tags affixed to each unit that includes: the test date, the flow rate, the initials of the person conducting the testing, and whether or not the unit meets these design criteria (pass or fail). In addition, the contractor shall provide the building owner with a list that identifies the type and location of all emergency plumbing fixtures installed in the building.

15415 DRINKING FOUNTAINS AND WATER COOLERS

A. Design Considerations

RESERVED

B. Special Documentation Requirements

1. Provide "lead free" materials certification from drinking fountain manufacturer prior to installation.

C. Materials and Methods of Construction

1. Drinking fountains and water coolers shall be as manufactured by Elkay or approved equal.

15430 PLUMBING SPECIALTIES

A. Design Considerations

1. To facilitate landscape and other maintenance operations, exterior hose bibs shall be provided at 50 foot intervals along building perimeters, including near principal building entrances and exits. Each building face shall have at least one hose bib.

B. Special Documentation Requirements

RESERVED

C. Materials and Methods of Construction

1. All hose bibs shall be of the non-freeze, recessed lockable wall box type, and shall be mounted flush to the wall.

15441 DOMESTIC WATER PUMPS

RESERVED

15444 PACKAGED BOOSTER PUMPS

RESERVED

15445 SEWAGE PUMPS

RESERVED

15446 SUMP PUMPS

RESERVED

15450 POTABLE WATER STORAGE TANKS

RESERVED

15469 WATER SOFTENERS

RESERVED

15471 WATER FILTRATION EQUIPMENT

RESERVED

15485 ELECTRIC WATER HEATERS

A. <u>Design Considerations</u>

1. Electric water heaters are permitted as an alternative to direct or indirect-fired hot water heaters to serve local low flow hot water requirements.

B. Special Documentation Requirements

RESERVED

C. Materials and Methods of Construction

1. Electric hot water heaters shall be as manufactured by A.O. Smith or approved equal.

15486 FUEL-FIRED WATER HEATERS

A. Design Considerations

1. Oil fired water heaters may be required where significant hot water requirements must be met and gas service or indirect water heating is not available. Oil fired water heaters shall be used only with Rutger's approval.

B. Special Documentation Requirements

1. Fuel burning equipment must be registered with REHS by the Engineer-of-Record (care of the project team leader) during design. Fuel burning equipment with a maximum rated fuel input of 1,000,000 BTU/hr or greater will require an air permit, prior to installation. REHS will submit all air permit applications. Engineer-of-Record is responsible to supply equipment information to REHS with adequate lead-time to obtain permit (180 days prior to intended installation date.) All documentation demonstrating conformance with Factory Mutual requirements must be submitted to FM for review\approval as required.

C. Materials and Methods of Construction

1. Oil fired water heater manufacturers shall be as approved by Rutgers.

15487 HEAT EXCHANGERS

A. Design Considerations

RESERVED

B. Special Documentation Requirements

RESERVED

C. Materials and Methods of Construction

1. Domestic water generally should be heated with HTW when central heating system is available. Check with Rutgers for specific requirements. Use 2-way, cast steel control valves as approved by Rutgers.

2. All heat exchangers shall comply with ASME Boiler and Pressure Vessel Code and shall be stamped with appropriate code symbols.

15510 HEATING BOILERS AND ACCESSORIES

A. Design Considerations

1. Boiler design and sizing of boilers shall conform to the requirements of the current "Boiler Pressure Vessel and Refrigeration Code" as issued by the NJ Department of Labor; Office of Pressure Vessel Compliance. Stand alone boilers shall be designed such that a licensed operator is not required to monitor boiler plant operation. Cast iron sectional boilers or approved non-condensing high efficiency boilers are the preferred boiler for remote locations and relatively small boiler plants. Boilers shall operate at 15 psig or less unless otherwise approved by Rutgers. Use hot water generators when possible.

B. Special Documentation Requirements

1. Fuel burning equipment must be registered with REHS by the Engineer-of-Record (care of the project manager) during design. Fuel burning equipment with a maximum rated fuel input of 1,000,000 BTU/hr or greater will require an air permit, prior to installation. REHS will submit all air permit applications. Engineer-of-Record is responsible to supply equipment information to REHS with adequate lead-time to obtain permit (180 days prior to intended installation date). All documentation demonstrating conformance with Factory Mutual requirements must be submitted to FM for review\approval as required.

C. Materials and Methods of Construction

1. Refer to section of Standards pertaining to boiler type under consideration.

15512 CAST IRON BOILERS

A. Design Considerations

1. Cast iron boilers, though lower in efficiency than other boiler types, have proven to be reliable and require relatively low maintenance. Refer to Section 15510 *Heating Boilers and Accessories* for additional design considerations.

B. Special Documentation Requirements

1. Refer to Section 15510 *Heating Boilers and Accessories.*

C. Materials and Methods of Construction

1. Approved cast iron boiler manufacturers are Buderus, Utica and Weil-McLain. Buy as a package unit when possible with high-efficiency burners approved by Rutgers.

15513 CONDENSING BOILERS

A. Design Considerations

1. Although capable of high efficiencies, condensing boilers may require more maintenance and have shorter life spans than non-condensing boilers. Condensing boilers shall not be used without Rutgers approval.

B. Special Documentation Requirements

RESERVED

C. Materials and Methods of Construction

RESERVED

15514 FINNED WATER-TUBE BOILERS

A. Design Considerations

1. In keeping with the University's "Green Initiative", high-efficiency non-condensing boilers are acceptable. Non-condensing boilers have proven to offer a good combination of reliability and maintainability as well as higher efficiencies and reduced emissions. The compact size of these boilers allows their use in confined spaces and facilities, replacement of existing boilers without demolition of walls, etc. Refer to Section 15510 *Heating Boilers and Accessories* for additional design considerations.

B. Special Documentation Requirements

1. Refer to Section 15510 *Heating Boilers and Accessories.*

C. Materials and Methods of Construction

1. High-efficiency boilers shall be "P-K Thermific" as manufactured by Patterson-Kelly Co. or approved equal.

15515 WATER-TUBE BOILERS

RESERVED

15518 FIRE-TUBE BOILERS

A. Design Considerations

1. Such boilers may be considered for installations larger than 50 horse power. They should be multi-pass and have an efficiency of greater than 80% at the design point. Consult Rutgers for use of dual-fuel burners for type of burner to use, turn-down desired and type of control to use. Refer to Section 15510 *Heating Boilers and Accessories* for additional design considerations.

B. Special Documentation Requirements

1. Refer to Section 15510 *Heating Boilers and Accessories.*

C. Materials and Methods of Construction

1. Selection of fire-tube boilers shall be subject to Rutgers approval.

15519 ELECTRIC BOILERS

A. Design Considerations

1. Do not use electric boilers except for small outputs which serve a special piece of equipment (5 HP or less). Electric boilers shall not be used unless approved by Rutgers.

B. Special Documentation Requirements

1. Refer to Section 15510 *Heating Boilers And Accessories.*

C. Materials and Methods of Construction

1. Selection of electric boilers shall be subject to Rutgers approval.

15520 FEEDWATER EQUIPMENT

A. Design Considerations

1. Consult Rutger's engineers concerning feedwater equipment.

B. Special Documentation Requirements

RESERVED

C. Materials and Methods of Construction

1. Feedwater equipment and installation shall be approved by Rutgers.

15525 DEAERATORS

RESERVED

15530 FURNACES

RESERVED

15540 FUEL-FIRED HEATERS

A. Design Considerations

1. Do not use without permission of Rutgers. When permitted, use gas-fired (not oil-fired) units with electronic ignition and stainless steel heat exchangers.

B. Special Documentation Requirements

1. Fuel burning equipment must be registered with REHS by the Engineer of Record (care of the Project Manager) during design. Fuel burning equipment with a maximum rated fuel input of 1,000,000 BTU/hr or greater will require an air permit, prior to installation. REHS will submit all air permit applications. Engineer of Record is responsible to supply equipment information to REHS with adequate lead-time to obtain permit (180 days prior to intended installation date). All documentation demonstrating conformance with Factory Mutual requirements must be submitted to FM for review\approval as required.

C. Materials and Methods of Construction

1. Refer to section of Standards pertaining to fuel-fired heater type under consideration.

15541 FUEL-FIRED DUCT HEATERS

RESERVED

15542 FUEL-FIRED RADIANT HEATERS

RESERVED

15543 FUEL-FIRED UNIT HEATERS

RESERVED

15550 BREECHINGS, CHIMNEYS, AND STACKS

A. Design Considerations

1. The MASTERSPEC version of this specification can be used for relatively small, isolated boiler plants. For larger plants, consult Rutgers. Terminations of chimneys shall be "open" (without weathercap) so that an upward velocity is possible, without sideward flue gas movement. Design so that gases will not be drawn into adjacent outdoor air intakes, windows or otherwise create a nuisance or hazard. A mechanical draft control device may be necessary at the outlet of the stack as dictated by design constraints.

B. Special Documentation Requirements

RESERVED

C. Materials and Methods of Construction

1. Materials and methods shall be in full conformance with the latest issue of the International Mechanical Code and applicable NFPA requirements.

15555 DRAFT CONTROL DEVICES

RESERVED

15560 FUEL-FIRED H&V UNITS

RESERVED

15561 DIRECT-FIRED H&V UNITS

RESERVED

15562 INDIRECT-FIRED H&V UNITS

RESERVED

15620 PACKAGED WATER CHILLERS

RESERVED

15621 INDIRECT-FIRED ABSORPTION WATER CHILLERS

RESERVED

15622 DIRECT-FIRED ABSORPTION WATER CHILLERS

RESERVED

15625 CENTRIFUGAL WATER CHILLERS

A. Design Considerations

1. In many cases, Rutgers will pre-purchase centrifugal chillers. Rutgers requires as efficient a unit as possible. Centrifugal chillers

shall use either R-123 or R-134A. Centrifugal chillers shall not be located outside of the building. A/E shall route pipe rupture disk discharge to a safe point.

B. Special Documentation Requirements

1. If the unit is pre-purchased, the A/E shall obtain pre-purchase specifications from Rutgers. Bidding contractors shall provide Rutgers with requested performance and efficiency documentation at time of bid to facilitate bid evaluation.

C. Materials and Methods of Construction

1. Acceptable manufacturers are Trane, York and Carrier.

15626 ROTARY-SCREW CHILLERS

RESERVED

15628 RECIPROCATING/SCROLL WATER CHILLERS

A. Design Considerations

1. Use only on very small projects, with Rutgers permission. Water-cooled units may be considered for special applications such as back-up refrigeration. Air-cooled units must be justified by life-cycle analysis at the request of Rutgers. Heat recovery units will require an economic evaluation including life-cycle analysis. Refrigerant type must be approved by Rutgers. Scroll type chillers are preferred to reciprocating type.

B. Special Documentation Requirements

RESERVED

C. Materials and Methods of Construction

1. Acceptable manufacturers are Trane, York, Carrier and as otherwise approved by Rutgers.

15635 REFRIGERANT MONITORING AND SAFETY EQUIPMENT

RESERVED

15641 OPEN-CIRCUIT, MECHANICAL-DRAFT COOLING TOWERS

A. Design Considerations

RESERVED

B. Special Documentation Requirements

RESERVED

C. Materials and Methods of Construction

1. Cooling towers shall be packaged, stainless steel, cross-flow (induced-draft) cooling towers with propeller fan, gear box, plastic fill (plastic shall be fire retardant and Factory Mutual approved in a stainless steel casing and pan**),** 2-speed or variable speed high-efficiency fan motors, controlled and sequenced to obtain the condenser water temperatures needed.

2. Provide handrail, ladder and cage for access.

3. Provide flow control valves for all outlets. Provide all needed screens and protective devices. Discharge hoods and sound control measures shall be provided to attain noise levels acceptable to local conditions and ordinances.

4. Water level may use float switch. Water level control may also utilize a conductivity type level sensor wired to a controller located in the mechanical room. Controller should activate EP-pneumatic or slow closing solenoid valve, blow down solenoid valve and chemical feed pump. EP, BD and chemical pump should have H-O-A- selection switch.

5. Winterizing requirements shall be discussed with Rutgers. The appropriate design shall be reviewed prior to such application.

6. All cooling tower drains and chemical bleed lines should be piped to a suitably sized sanitary drain.

7. Water treatment shall be specified and included in the design.

8. Centrifugal fan, forced draft towers shall not be used unless approved by Rutgers.

9. Cooling towers shall be as manufactured by Marley or approved equal.

15642 CLOSED-CIRCUIT, MECHANICAL-DRAFT COOLING TOWERS

RESERVED

15663 EVAPORATIVE CONDENSERS

RESERVED

15671 CONDENSING UNITS

A. Design Considerations

1. Use only on very small projects, with Rutgers permission. Water-cooled units may be considered for special applications such as back-up refrigeration.

B. Special Documentation Requirements

RESERVED

C. Materials and Methods of Construction

1. Acceptable manufacturers are Trane, York, Carrier, AAON, Liebert and as otherwise approved by Rutgers.

15672 AIR-COOLED CONDENSERS

A. Design Considerations

1. Limit air-cooled condensers to very small systems or for equipment such as constant temperature rooms or computer room equipment unless otherwise approved by Rutgers.

2. Where air-cooled condensers are used, they shall be designed for low ambient temperature operation.

B. Special Documentation Requirements

RESERVED

C. Materials and Methods of Construction

1. Acceptable manufacturers are Trane, York, Carrier, Liebert and as otherwise approved by Rutgers.

15710 HYDRONIC AND STEAM HEAT EXCHANGERS

A. Design Considerations

1. Design steam pressure shall be 15 psig or less (low pressure) unless otherwise approved by Rutgers.

B. Specials Documentation Requirements

RESERVED

C. Materials and Methods of Construction

1. Selection and specifications for liquid-to-liquid, steam-to-liquid, air-to-air, etc. shall be reviewed with Rutgers.

2. HTW heat exchangers shall be shell and tube type. HTW shall be in tubes. Tubes shall be 90-10 copper-nickel. Heads shall be forged steel. In water-to-water exchangers, the water flow shall be upward. In water-to-steam generators, the controls shall be similar to those used for fired steam generators, excluding low water cutoff. Provide separate over- temperature control on

leaving hot water. Provide required level controls, relief and/or safety valves on water or steam generators. Provide increased tube pitch on steam generators. Shell flow shall be designed for 100% of system flow.

3. 35% propylene glycol solution should provide adequate freeze protection where freezing is a consideration. Consult with Rutgers if it is felt that a greater percentage is required.

4. Provide units with a fouling factor of 0.0005 for water or as approved by Rutgers.

5. HTW-to-water heat exchangers shall have the operating and high limit temperature sensing elements located in the shell near the outlet nozzle or immediately adjacent to outlet nozzle.

6. Heat Exchangers shall be manufactured by Cemline, Yula, Bell & Gossett or approved equal.

15725 MODULAR INDOOR AIR-HANDLING UNITS

A. Design Considerations

RESERVED

B. Special Documentation Requirements

RESERVED

C. Materials and Methods of Construction

1. Hot water and Chilled water coils shall have no more than 120 fins per foot of tube length, where possible. All coils shall be completely drainable at each row. Drainage of coil shall be accomplished by removing the drain and vent plugs; no other means shall be required. Copper tubes with aluminum fins are satisfactory.

2. Use of factory mounted\wired automatic temperature controls may be considered subject to compatibility with campus building automation system and approval of Rutgers Department of

Utilities. Where factory mounted\wired controls are utilized, the method of integration with the campus building automation system requires the review\approval of Rutgers Department of Utilities.

3. Do not use electric heat without specific permission of Rutgers.

4. Provide a properly sized pumped water protective system for all coils when glycol is not utilized and the possibility of freezing exists at any coil (i.e. due to high percentages [30% or greater] of outdoor air). Face and bypass dampers are preferred to pumped water protective systems for 100% outdoor air systems. Face and bypass dampers shall be integral type unless otherwise approved by Rutgers. Glycol shall not be used without Rutgers permission.

5. Humidifiers should be used only with Rutgers approval.

6. 30% Filters shall be installed in manufactured filter frames. Precede higher efficiency filters with roughing filters. Use HEPA or other approved high efficiency filters when required or directed. Provide pressure differential gage to monitor filter performance on all major air handling units.

7. Modular indoor air-handling equipment shall be as manufactured by Trane, McQuay, York, Miller-Picking, Air Enterprises, Marcraft, Webco, Pace or approved equal.

15731 PACKAGED TERMINAL AIR CONDITIONERS

A. Design Considerations

1. Window air conditioning units shall be permitted where central air conditioning systems are not available or are not feasible.

B. Special Documentation Requirements

RESERVED

C. Materials and Methods of Construction

1. Window air conditioning units shall be equipped with a timer which can be programmed to shut off when the space is not

occupied. The timer can be part of the unit, or at the panel as appropriate.

2. Window air conditioning unit manufacturers shall be approved by Rutgers.

15732 ROOFTOP AIR CONDITIONERS

A. Design Considerations

1. Utilization of rooftop air-conditioning equipment requires Rutgers approval.

2. When rooftop equipment is suggested for the project, the access to the roof shall be as a minimum a stair tower meeting applicable codes extended full-size to the roof. In addition, an available elevator may be required to extend to the roof.

3. As an alternative, the equipment may be located on an approved ground slab.

B. Special Documentation Requirements

RESERVED

C. Materials and Methods of Construction

1. Coils shall be fully drainable and fin spacing shall not exceed 120 fins per foot as specified for coils in air handling units.

2. Heating and cooling should be from external sources of hot water (or glycol mixture) or chilled water; do not use gas fired exchangers or air cooled refrigerant (DX) systems without Rutgers approval.

3. Rooftop air-conditioning equipment shall be as manufactured by Trane, McQuay, Aaon, Governair, York, Miller-Picking, Air Enterprises, Marcraft, Webco, Pace or approved equal.

15733 ROOFTOP REPLACEMENT-AIR UNITS

RESERVED

15734 COMPUTER-ROOM AIR-CONDITIONING UNITS

RESERVED

15736 SELF-CONTAINED AIR-CONDITIONING UNITS (15 TONS AND SMALLER)

A. Design Considerations

1. Use only on very small projects, with Rutgers permission. Water-cooled units may be considered for special applications such as back-up refrigeration.

B. Special Documentation Requirements

RESERVED

C. Materials and Methods of Construction

1. Acceptable manufacturers are Trane, York, Carrier, AAON, Liebert and as otherwise approved by Rutgers.

15737 SELF-CONTAINED AIR-CONDITIONING UNITS (LARGER THAN 15 TONS)

A. Design Considerations

1. Use only on small projects, with Rutgers permission. Water-cooled units may be considered for special applications such as back-up refrigeration.

B. Special Documentation Requirements

RESERVED

C. Materials and Methods of Construction

1. Acceptable manufacturers are Trane, York, Carrier, AAON, Liebert and as otherwise approved by Rutgers.

15738 SPLIT-SYSTEM AIR-CONDITIONING UNITS

RESERVED

15745 WATER-SOURCE HEAT PUMPS

A. Design Considerations

1. Water-source heat pumps shall be used only after detailed life cycle cost analysis and approval of Rutgers.

B. Special Documentation Requirements

RESERVED

C. Materials and Methods of Construction

1. Water-source heat pumps shall be as manufactured by Trane, York, Carrier or approved equal.

15752 HUMIDIFIERS

A. Design Considerations

RESERVED

B. Special Documentation Requirements

RESERVED

C. Materials and Methods of Construction

1. Steam for user-required humidification should be generated by gas or electric unitary humidifiers, approved by Rutgers, as manufactured by Armstrong, Sarco, Carnes, Herr, Nortec or approved equal.

2. Large capacity humidification requirements shall be met by direct or indirect-fired steam generators.

15755 DEHUMIDIFICATION UNITS

RESERVED

15761 AIR COILS

RESERVED

15762 ELECTRIC RADIATORS

RESERVED

15763 FAN-COIL UNITS

A. Design Considerations

RESERVED

B. Special Documentation Requirements

RESERVED

C. Materials and Methods of Construction

1. Fan coil units shall have permanent split capacitor motors.

2. Fan coil units shall be as manufactured by Trane, York or Carrier.

15764 RADIATORS

A. Design Considerations

RESERVED

B. Special Documentation Requirements

RESERVED

C. <u>Materials and Methods of Construction</u>

1. Use 18 gauge front panels on baseboards.

2. Radiators shall be as manufactured by Trane or approved equal.

15766 CABINET UNIT HEATERS

RESERVED

15767 PROPELLER UNIT HEATERS

RESERVED

15768 UNIT VENTILATORS

RESERVED

15769 RADIANT HEATING PANELS

RESERVED

15772 RADIANT HEATING PIPING

RESERVED

15775 ELECTRIC HEATING CABLES

RESERVED

15785 AIR-TO-AIR ENERGY RECOVERY UNITS

RESERVED

15815 METAL DUCTS

A. Design Considerations

1. Hazardous Systems Exhaust:
   Laboratory fume hood exhaust and general exhaust may be combined in a common manifold system subject to applicable code requirements unless otherwise directed by Rutgers. Circular Stainless steel ductwork shall be utilized for all portions of manifold laboratory exhaust systems unless otherwise approved by University Facilities and REHS.

   a. Bio-Safety cabinets shall not be connected to the general exhaust system or the fume hood exhaust system. Bio-Safety cabinets (Class II, Types B1 or B2) shall be connected to a dedicated exhaust system.

   b. The discharge point must be at a proper height above the highest point of the roof or parapet (10-15 ft.) to reduce air streaming effects of the building. Air shall be discharged vertically with at least 3500 feet per minute stack discharge velocity. The discharge stack should be located in the prevailing downwind direction of air intake point.

   c. Deflecting weather caps are prohibited on discharge stacks, as they reduce the effective stack height, reduce air velocity, are not effective rain shields, and increase final cost.

   d. Each perchloric acid hood shall have an individual exhaust system (i.e., individual duct to individual fan). The ductwork shall go straight from the hood to the roof with no horizontal runs or sharp turns. "Wash-down" facilities shall be built into the hood and ductwork.

B. Special Documentation Requirements

RESERVED

C. Materials and Methods of Construction

1. Fume Hood Duct Design and Construction

a. Ducts should be constructed of materials compatible with the chemicals being used in the hood. Circular ductwork shall be used.

b. Ducts are to be constructed of non-reactive stainless steel with welded connections. Sealants are not an acceptable alternative to welded duct connections. Questions about duct composition should be referred to REHS.

c. Ductwork shall take the straightest route to the roof, minimizing bends and horizontal runs. Increased distances and bends create resistance to air flow and require larger exhaust motors. When elbows are necessary, they shall have proper center-line radius (one-and-one-half times the diameter of the ducts) to minimize eddying and resistance to air flow. All elbows shall have removable wear plates when operations will involve heavy dust concentrations. Ductwork shall not enter the blower motor on an elbow.

d. The discharge stack shall be uncapped, straight, and cylindrical. The discharge duct shall overlap the fan ductwork 6" and have a 1" greater diameter, to provide for rain drip discharge.

e. Ductwork serving hydrofluoric acid hoods shall be constructed of nonmetal ducts in accordance with Section 15816 *Nonmetal Ducts.*

15816 NONMETAL DUCTS

A. Design Considerations

RESERVED

B. Special Documentation Requirements

RESERVED

C. Materials and Methods of Construction

1. Ductwork serving hydrofluoric acid hoods shall be constructed of Teflon lined 316 or 304 stainless steel. Horizontal runs and bends in ductwork must be kept to a minimum.

15817 HVAC CASINGS

RESERVED

15820 DUCT ACCESSORIES

RESERVED

15830 FANS

RESERVED

15834 AIR CURTAINS

RESERVED

15836 AXIAL FANS

RESERVED

15837 CENTRIFUGAL FANS

A. Design Considerations

1. Exhaust fans and duct systems for hoods are to be sized and designed to provide an average hood face velocity of 80-100 LFM, as measured at the face, with the sash wide open. Deviations in this value shall not be greater than 20% at any point across the hood face. To assure this standard, the designer must work closely with the duct installer to determine the effects of duct routing on motor sizing.

2. Exhaust fans shall be located on the roof, or properly ventilated fan loft so that a negative pressure will be maintained in the ductwork and prevent escape of toxic material through holes and cracks in

the duct. Exhaust motors shall be located to allow access for maintenance.

3. Manifold exhaust systems shall be equipped with 100% (i.e. n + l) redundancy such that if a single fan fails (or requires maintenance) the other fan(s) will automatically maintain uninterrupted exhaust system operation.

4. Do not use backdraft dampers on laboratory fume hood fans unless specifically approved by Rutgers.

5. Rutgers may require an analysis of effluent plume shape and dispersion by a specialist in air wake analysis. Specialist shall be approved by Rutgers. Such analysis is typical for all discharge stacks such as laboratory fume hood or other laboratory discharges.

6. Perchloric acid hoods shall utilize an air ejector system or an exhaust fan. An air ejector exhaust system eliminates the possibility of acid reaction with fan components and allows for ease of cleaning.

B. Special Documentation Requirements

RESERVED

C. Materials and Methods of Construction

1. Drives for centrifugal fans used for general exhaust (i.e. non-fume hood) applications shall be direct drive or multi-belt. Direct drive is preferred to belt drive where practical. Where belt drives are utilized, generous size pulleys shall be used to reduce the belt bending.

2. Fans shall be provided with all factory options as required to suit application.

3. Blades of fans serving perchloric acid hoods shall be made of acid resistant metal or a metal protected by an inorganic coating. The fan shall be lubricated with fluorocarbon type grease.

4. The motor and blower housing of fans serving hydrofluoric acid hoods shall not have exposed metallic parts.

5. Fume hood exhaust fans shall be direct drive type as manufactured by Strobic Air Corporation, MK Plastics or approved equal. Fans used for general exhaust shall be as manufactured by Penn, Greenheck, Carnes or approved equal.

15838 POWER VENTILATORS

RESERVED

15840 AIR TERMINAL UNITS

RESERVED

15855 DIFFUSERS, REGISTERS, AND GRILLES

RESERVED

15856 INTAKE AND RELIEF VENTS

RESERVED

15861 AIR FILTERS

A. Design Considerations

1. HEPA or charcoal filters are not required for most routine uses of fume hoods. Install a filter or filter housing only if specified by REHS. Where filters are required, the housing shall be located in the fan room or roof before the blower. The filter housing shall be located to allow for easy filter changing by the bag-in bag out technique.

B. Special Documentation Requirements

RESERVED

C. Materials and Methods of Construction

1. Filters shall be as manufactured by Cam-Farr or approved equal.

15870 COMMERCIAL KITCHEN HOODS

RESERVED

15890 AIR DUCT CLEANING

A. Design Considerations

1. Duct cleaning should be scheduled and closely coordinated through Rutgers University Facilities and REHS representative. Where lined ductwork is being cleaned, the condition of the existing lining must be evaluated by REHS and replaced with external duct insulation as required.

B. Special Documentation Requirements

RESERVED

C. Materials and Methods of Construction

1. Duct Cleaning shall be based upon the National Air Duct Cleaners Association (NADCA) specification. Duct cleaning contractors shall be approved by Rutgers.

15900 HVAC INSTRUMENTATION AND CONTROLS

A. Design Considerations

RESERVED

B. Special Documentation Requirements

1. The Engineer of Record shall request direction from Facilities Design prior to developing design documents with regard to how the "Automatic Temperature Controls" portion of the project will be bid. Acceptable Building Automation System (BAS) control system manufacturers, system configurations, and compatibility requirements with existing control systems and components and

coordination of specifications with respect to compatibility of the BAS with factory mounted\wired equipment controls provided by others (i.e. air handling units, chillers, boilers, terminal units, etc.) shall be reviewed and approved by both Rutgers Department of Utilities and Office of Facilities Design prior to developing design documents.

2. Design drawings shall include dedicated automatic temperature control drawing(s) showing control diagrams for all controlled equipment and systems as well as BAS architecture. Point-to-point wiring diagrams are preferred. Refer to Section 15940 Sequence of Operation for additional documentation requirements.

C. Materials and Methods of Construction

1. Laboratory Controls:

   a. Manifold laboratory exhaust systems shall utilize pressure independent air valves of constant volume, two position or variable air volume (VAV) configuration depending upon the HVAC design under consideration. Where two-position or VAV type exhaust valves are utilized, corresponding supply valves and associated tracking controls must be provided. Exhaust valves, supply valves and associated fume hood & tracking controls shall be manufactured by Phoenix Controls or approved equal. In general, two position control of laboratory HVAC systems is preferred to VAV control.

   b. In those instances where feasible and agreed to by the Office of University Facilities, REHS and the end user, laboratories shall utilize ceiling-mounted occupancy sensors to provide local, independent demand-based occupied\unoccupied control of both lighting and HVAC systems. Occupancy sensors shall be of “dual technology” configuration employing both passive infrared and sound sensitive technologies to detect occupancy, shall “fail safe” (i.e. failure condition defaults to “occupied mode”) and shall have an adjustable “delayed off” feature whereby the occupancy sensor will remain in the “occupied mode” of operation for up to 30 minutes (adjustable) after the laboratory has been vacated. Ceiling mounted occupancy

sensors shall be as manufactured by Watt-Stopper or approved equal.

c. The number, mounting locations and wiring configuration of occupancy sensors and associated controls shall be reviewed and approved by the Office of University Facilities and REHS and shall be in full accordance with the installation recommendations of the occupancy sensor manufacturer. A sufficient number of ceiling-mounted occupancy sensors shall be provided to eliminate potential blind spots caused by building obstructions (i.e. laboratory shelving, columns, etc.). Consideration must also be given to the location of ceiling-mounted occupancy sensors in the vicinity of ceiling diffusers and other sound generating devices that may trigger a false “occupied” condition.

d. Occupancy sensors shall be hard-wired in conjunction with a local wall-mounted override switch (or two three-way wall-mounted override switches as required to suit application) to enable the room lights to be turned off (for purposes of conducting light sensitive experiments) while the HVAC system remains in the occupied mode of operation.

e. All laboratory fume hoods that operate at reduced face velocities (i.e. minimum 60 FPM) when the laboratory is unoccupied, shall be equipped with a "Zone Pressure Sensor" as manufactured by Phoenix Controls or approved equal that will maintain a face velocity of 100 FPM whenever anyone is in proximity to the fume hood. The fume hood "Zone Pressure Sensor(s)" shall be in addition to the ceiling mounted occupancy sensors and shall act as a safety to ensure that the HVAC system is indexed to the "occupied mode" of operation whenever the laboratory is occupied.

f. All ceiling mounted occupancy sensors shall be hard-wired in parallel with all fume hood Zone Presence Sensors such that detection of occupancy by any ceiling sensor or fume hood sensor will index the laboratory to “occupied mode” (“occupied mode” being characterized by a minimum laboratory air change rate of 12 ACH with all hoods maintaining a face velocity of 100 FPM).

g. Occupied\unoccupied control of laboratory HVAC and lighting systems shall be locally hard-wired such that each laboratory operates independently. Computerized lighting control and\or global occupied\unoccupied control of lighting and\or HVAC from the BAS shall not be permitted as a substitute for local hard-wired control as heretofore described unless otherwise approved by the Office of Facilities Project Administration. However, a contact from the BAS shall be wired in parallel with the local hard-wired occupied\unoccupied control circuit of each laboratory to facilitate remote occupied\unoccupied override control of lighting and HVAC for any or all labs (i.e. each laboratory would be capable of having it's own individual occupied\unoccupied occupancy schedule programmed into the BAS).

h. The controls contractor shall program a user defined occupancy schedule for each laboratory into the BAS but shall leave each laboratory under local control when the building is turned over to the Owner upon completion of work.

i. Each fume hood shall be equipped with a face velocity alarm monitor or controller and associated components that are compatible with the specified laboratory HVAC control system and components (i.e. supply & exhaust valves, etc.). At a minimum, the system shall have a visual indicator of the hood face velocity and adjustable low flow/caution alarm points with audible alarm. Low flow alarm must have dual setpoint capability where reduced unoccupied mode face velocities are maintained to avoid nuisance alarms during the unoccupied mode of operation. It is also recommended that each fume hood be equipped with a local high sash alarm activated when the sash height exceeds 19 inches. High sash alarm shall be equipped with a silence button with an adjustable timing device that resets when the sash is lowered.

j. Fume hood controls may be either factory mounted/wired or field mounted/wired at the discretion of the engineer-of-record. Provision and specification of fume hood controls must be coordinated with Section 11610 *Laboratory Fume*

Hoods of these Design Standards. The control system chosen must be approved by REHS and the Office of Facilities Design.

k. Each laboratory shall be equipped with a "room pressure indicator" as manufactured by Airflow Direction Incorporated (www.airflowdirection.com) or approved equal. The room pressure indicator shall be installed in the wall above the doorway to each laboratory (i.e. one indicator required for each lab) and shall visually indicate whether the lab is being maintained at the proper pressure relative to the adjacent space. Each room pressure indicator shall be selected to visually alarm either a positive or negative pressure condition as dictated by the application.

15940 SEQUENCE OF OPERATION

A. Design Considerations:

RESERVED

B. Special Documentation Requirements

1. Design drawings shall include dedicated automatic temperature control drawing(s) showing detailed written sequence of operation adjacent to the corresponding control diagram for all controlled equipment and systems. Sequences of operation should specify all setpoints and deadbands and shall indicate which are adjustable. Refer to Section 15900 *HVAC Instrumentation and Controls* for additional documentation requirements.

C. Materials and Methods of Construction

RESERVED

15950 TESTING, ADJUSTING, AND BALANCING

A. Design Considerations

RESERVED

B. Special Documentation Requirements

1. Rutgers reserves the right to bid "Testing, Adjusting, and Balancing" as a separate contract on any given project with the testing, adjusting, and balancing contractor working directly for Rutgers University. Direction shall be requested from the Office of Facilities Project Administration prior to developing design documents with regard to how the "Testing, Adjusting, and Balancing" portion of any given project will be bid.

C. Materials and Methods of Construction

1. HVAC Testing, Adjusting & Balancing contractors shall be limited to those listed below unless otherwise approved in writing by Rutgers:

   Technical Airflow, Inc. (973-827-2803)

   Effective Air Balance (973-790-6748)

   Dynamic Air Balance, Inc. (973-881-0360)

2. All new and relocated fume hoods shall be commissioned/balanced in accordance with the latest issue of ANSI/ASHRAE 110, “Method of Testing Performance of Laboratory Fume Hoods” both as manufactured and following installation/relocation at both full operating velocity (100 fpm) and reduced operating velocity (60 fpm) for those systems with occupied/unoccupied control systems. ASHRAE testing shall include airflow velocity assessments (sash full open, 18” vertical sash opening, 2 horizontal sashes open), local and large volume smoke study, and tracer gas testing (positional control level at left, center, right position; leakage test, and sash movement effect). For tracer gas testing, the mannequin test height shall be 5 feet 7 inches; however, the mannequin test height shall be adjusted to 5 feet 1 inch for ADA workstations.

3. ASHRAE testing contractors shall be limited to those listed below unless otherwise approved in writing by Rutgers:

   Micro-Clean, Inc. (800-523-9852)

ENV-Services Testing & Certification, Inc. (800-617-3368)

4. Unless otherwise approved by University Facilities and REHS, ASHRAE testing shall be conducted in the normal "occupied" operating mode after all HVAC system components have been properly commissioned and balanced. Fume hoods that maintain containment with an ASHRAE as installed rating of4.0 AI 0.05 are considered acceptable.

See also the following related non-Division 15 sections of these Design Standards:

01815	**HVAC COMMISSIONING REQUIREMENTS**
10200	**LOUVERS AND VENTS (RESERVED)**
10520	**FIRE PROTECTION SPECIALTIES (RESERVED)**
11610	**LABORATORY FUME HOODS**
13900	**FIRE SUPPRESSION SYSTEMS**
13210	**ELEVATED WATER STORAGE TANKS (RESERVED)**
13220	**SURFACE WATER STORAGE TANKS (RESERVED)**
13915	**FIRE-SUPPRESSION PIPING (RESERVED)**
13920	**FIRE PUMPS (RESERVED)**
13921	**ELECTRIC-DRIVE, CENTRIFUGAL FIRE PUMPS (RESERVED)**
13922	**DIESEL-DRIVE, CENTRIFUGAL FIRE PUMPS (RESERVED)**
13926	**ELECTRIC-DRIVE, VERTICAL-TURBINE FIRE PUMPS (RESERVED)**
13927	**DIESEL-DRIVE, VERTICAL-TURBINE FIRE PUMPS (RESERVED)**
13955	**FOAM FIRE-EXTINGUISHING (RESERVED)**
13967	**CLEAN-AGENT EXTINGUISHING SYSTEMS (RESERVED)**