DIVISION 11 - EQUIPMENT

11 40 00 FOOD SERVICE EQUIPMENT

A. Design Considerations

1. The A/E shall use the services of a food service equipment specialist in preparation of kitchen areas and other food preparation areas when required in the building. Such areas shall be designed in close coordination with the University food service personnel.

B. Special Documentation Requirements

RESERVED

C. Materials and Methods of Construction

RESERVED

11 53 13 LABORATORY FUME HOODS

A. Design Considerations

1. The A/E shall recommend a list of five (5) proposed fume hood manufacturers to Rutgers whose performance has been validated by the vendor to conform with the requirements of this Standard and which are best suited to the design parameters of the project under consideration. Rutgers will evaluate proposed manufacturers and determine which vendors will be approved for inclusion in project specifications.

2. All significant laboratory projects (new & renovation) shall be reviewed in the early stages by a team comprised of representatives from REHS, The Office of Program Development and Facilities Project Management to review proposed program requirements and determine whether existing infrastructure (i.e. utilities, existing building MEP systems, building area/configuration, etc.) are adequate to support proposed program goals (i.e. number/type of proposed fume hoods, face velocity, diversity, etc.) as developed by the A/E. The A/E shall include a "Fume Hood Schedule" with basis of design on mechanical drawings. The schedule shall clearly indicate hood air flow (CFM) and face velocity (FPM) at both working height and full open sash along with hood

manufacturer, model, type (i.e. constant volume, VAV), static pressure drop and whether the hood is new or existing.

3. All laboratory renovation projects shall meet the following requirements:
    - In all lab renovations and HVAC upgrades (i.e. supply, exhaust, added hoods, etc.), every opportunity should be taken to replace the existing fume hoods with 'high performance' hoods.
    - When replacing multiple 4' or 6' hoods the option should be reviewed with the researchers to replace two 4' hoods or two 6' hoods with a single 8' hood, since an 8’ hood typically requires less air flow.
    - In renovations of existing labs where the existing hood(s) remain, and no other part of the supply or exhaust ventilation system has been altered, these hoods must pass a face velocity test consistent with the original hood design and HVAC system design. At a minimum, all new hoods must pass the ASHRAE 110 test, as installed, at a face velocity of 100 FPM with the sash at working height (18”). In addition, all new hoods must be capable of maintaining a minimum average face velocity of 70 FPM with the sash fully open and no individually measured point below 60 FPM. For a given laboratory, air flow testing shall be conducted with 75% of hood sashes at operating height and 25% of hood sashes fully open to ensure adequate exhaust system capacity is available. The minimum number of hoods for this diversity is four hoods.

4. All new laboratory projects shall meet the following requirements:
    - VAV HVAC systems for new laboratories shall be designed with 75% of hood sashes at operating height and 25% of hood sashes fully open and shall include a 10-20% safety factor to facilitate future installation of additional hoods. The minimum number of hoods for this diversity is four hoods.
    - All fume hoods purchased shall be approved 'high performance' hoods as specified in paragraph A.1 of this standard or as otherwise reviewed/approved on a project by project basis by REHS, The Office of Program Development, Facilities Project Management and the end user.
    - Hoods must pass the ASHRAE 110 test criterion of 4.0 AI 0.05, as installed, at a face velocity of 70 FPM with the sash at working height (18”). In addition, all hoods must be

capable of maintaining a minimum average face velocity of 70 FPM with the sash fully open and no individually measured point below 60 FPM.

5. Minimum hood air flow requirements (i.e. closed sash) shall be based on the greater of the following:
    - 80 FPM at 2" sash opening
    - Minimum required by hood manufacturer to ensure containment
    - Minimum requirement of the latest adopted issue of ANSI/AIHA Standard Z9.5 'Laboratory Ventilation' in keeping with applicable hazard assessment.

6. Minimum laboratory air change rates shall be 12 ACH (occupied) and 6 ACH (unoccupied). Lower air change rates in ancillary laboratory support spaces (i.e. instrument rooms, etc.) may be acceptable subject to Rutger's approval. Design requirements for occupied/unoccupied control of fume hoods and laboratories shall be in accordance with Section 23 09 00 'HVAC Instrumentation and Controls' of the Rutgers Design Standards.

7. Fume Hood type, configuration (i.e. sash arrangement, bypass mechanism, appurtenances, etc) and manufacturer shall be as specified in paragraph A.1 of this standard or as otherwise reviewed/approved on a project by project basis by REHS, The Office of the University Architect, Facilities Project Management and the end user. Fume hoods that rely on integral "moving baffles" or other moving components and associated control devices incorporated by the hood manufacturer to achieve specified performance are not acceptable unless approved for a specific project.

8. New fume hoods may be constant volume or VAV as required to suit the application, and shall be "high performance" type, certified by the manufacturer to conform to the requirements of the latest adopted issue of ANSI\ASHRAE Standard 110 "as manufactured" at a nominal face velocity of 60 FPM at both full open sash and operating height (i.e. 18") and as follows:

    - Constant Volume fume hoods shall be certified by the manufacturer to conform to the requirements of the latest adopted issue of ANSI\ASHRAE Standard 110 "as manufactured" at a nominal face velocity of 70 FPM at full open sash and at all other sash positions at an air flow (CFM) corresponding to 70 FPM at full open sash.

- VAV fume hoods shall be certified by the manufacturer to conform to the requirements of the latest adopted issue of ANSI\ASHRAE Standard 110 “as manufactured” at a nominal face velocity of 80 FPM at all sash positions.

9. All new hoods shall meet testing criteria established by the latest adopted issue of ANSI\ASHRAE Standard 110, "Method of Testing Performance of Laboratory Fume Hoods" as may be modified by requirements of Rutgers Design Standards. All hoods, bench, distillation, or walk-in types, shall have proper aerodynamic design to minimize eddy currents and assure against air movement from the hood into the laboratory. This is accomplished by airfoil sides and an aerodynamically designed sill with a one-inch air gap between it and the hood floor. An "air by-pass" shall be present on all constant volume hoods to control the range of the face velocity as the hood sash is raised and lowered. The face velocity at any sash position should never exceed 1.5 (one and one half) times the "open face" velocity. It is necessary to keep the air velocities within this range to reduce eddy currents around the edges of the hood face. Hoods used in conjunction with variable air volume HVAC systems shall be designed for this application.

10. Location: All new fume hoods shall be an integral part of the laboratory design and all laboratory renovations shall also rectify improper hood locations. Fume hoods shall be located in a room so that air currents generated in the room will not interfere with the hood's ability to capture and eliminate vapors, mists, and airborne particles. Therefore, hoods shall be located as far away as possible from:

    Doors
    Supply air diffusers
    Windows which can be opened
    Heavy traffic areas
    Other local exhaust ventilation devices

    a. Room air current velocities at the face of the hood should not exceed twenty linear feet per minute (LFM) from any source and should be as close to zero as practicable.

11. Commissioning/Testing: See Division I, ‘General Commissioning Requirements’ of these standards for additional commissioning/testing requirements for laboratory fume hoods.

B. Special Documentation Requirements

RESERVED

C. Materials and Methods of Construction

1. Hood Design and Construction: In general, all fume hoods should be constructed and contain materials that will permit their planned use to be carried out safely; therefore, their intended use must be known.

    a. Sides: Hood sidewalls shall be 3 1/2 - 6 1/2 inches wide, and shall be properly formed to present a smooth airfoil to the inflowing air. The hood interior lining shall be flush with the sides. These features shall, over the range of the hood's designed air face velocity, prevent significant eddy currents from circulating air from inside the hood through the plane of the face of the hood.

    b. Sill: A radiused painted sill is required unless otherwise required to suit application. It shall be installed at the bottom of the hood opening and extend back under the sash. An open area of approximately one inch shall be present under the sill to direct air across the work surface at all sash positions.

    c. Sash: Vertically tracked sashes are preferred. Combination sashes (vertically and horizontally tracked) are acceptable when requested by the user and approved by the Office of of the University Architect. Combination sashes shall drop to the fully closed position unless manually locked in the full open position for set-up purposes. Removal of the sash only is possible with special tools or keys. Glass used in the sash shall be at least 7/32" thick combination sheet. The sash shall be securely enclosed in a complete frame, welded and ground smooth at the corners. Stainless steel or a baked on epoxy coat is to be used for the sash frame. Vertical sashes shall be counter-balanced with sash weights, suspended from each side of the sash and shall be easily operated. Vertical sashes shall drop to the University standard 18 inch operating height unless manually locked in the full open position for set-up purposes. The sash frame must be held in a stainless steel track and have plastic guides. Sashes shall be anti-guillotine.

    d. Interior: The interior lining of the hood must be resistant to the materials and chemicals to which it will be exposed. The selection of resistant materials must be made through consultation with the Rutgers Environmental Health and Safety Department (REHS).

        1) Use of perchloric acid, hydrofluoric acid, and radioisotopes require special consideration as detailed in those sections.

e. Exterior: Cold rolled steel shall be used for the hood exterior. All parts shall be joined together as required to allow for dismantling and access for service. After fabrication and before final assembly, all component parts shall be given an acid, alkali and solvent resistant finish on both exterior and interior surfaces.

f. Frame: The exterior and interior walls of the hood shall be rigidly supported by a full frame.

g. Working Surface: The hood working surface shall be molded epoxy or stainless steel. It shall be recessed not less than 1/4" deep and have a raised area on all sides. The raised area across the front of the hood shall be at least three inches wide.

h. Hood Fixtures and Services: All hood services shall be specified by the user. All electric service shall be located on the exterior of the hood. Plumbing services shall be brass, chrome-plated, or acid and organic vapor resistant plastic. All fixtures shall have color coded end caps. All controls for plumbing services shall be located on the hood exterior.

i. Lighting: Sufficient lighting shall be provided by either fluorescent or incandescent light fixtures at the top exterior of the hoods. The light fixture shall be easily accessible from the outside of the hood, shall be shielded from the hood interior by a laminated or tempered glass panel, and shall be vapor sealed.

j. Air By-Pass Mechanism: All constant volume hoods shall be factory equipped with an air by-pass mechanism located above the hood face opening. It shall provide an effective sight-tight barrier between the user and the hood interior. By-pass louvers shall be directed upward away from the front of the hood and provide an effective barrier and deflector for flying debris from inside the hood. The by-pass shall control the face velocity as the sash is lowered. The velocity of the air at any sash position shall never exceed 1.5 (one and one half) times the open face velocity. The air by-pass shall begin to operate when the sash is one-third to one-half closed.

k. Plenum and Slot Arrangement: A plenum shall be located in the rear of all fume hoods. It must have at least two but no more than three slots. The lower slot shall be furnished at the working surface level and be locked at 2 to 2 1/2 inches or have the baffle removed entirely. The upper slot shall be located in the upper section of the hood. The opening shall be set at 3/8 to 1/2 inch maximum. A middle slot, if furnished, shall is to be fixed and have an opening no greater than 2 inches.

l. Exhaust Fans and Ductwork: See Division 23

m. Face Velocity Alarm Monitor & Control System: Face velocity alarm monitor and control systems shall be of type and configuration as listed in Section 23 09 00 'HVAC Instrumentation and Controls' of these standards. Each fume hood shall be equipped with a face velocity alarm monitor compatible with specified laboratory HVAC control system. At a minimum, the monitor shall have a digital display of the hood face velocity and adjustable low flow/caution alarm points with audible alarm. Low flow alarm must have dual setpoint capability to avoid nuisance alarms where reduced face velocities are maintained 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. Combination sash hoods shall be equipped with a stationary sash limit switch that closes a pair of contacts when the bottom of the vertical sash is less than 2 inches from the fully closed position. Provision of control components (i.e. field versus factory furnishing, mounting and wiring) shall be coordinated with Section 23 09 00. All alarms and controls shall be calibrated and commissioned in accordance with Division 1, Section 01815 'HVAC Commissioning Requirements' of these standards.

2. Special Hoods:

a. **Perchloric Acid Hood:** To safely contain perchloric acid, work requirements in addition to the standard design for fume hoods are specified under this section.

1) Construction: Materials of construction for the hood and ductwork shall be nonreactive, acid resistant and relatively impervious. Type 316 stainless steel, with welded joints, is preferred. Unplasticized polyvinyl chloride or an inorganic ceramic coating such as porcelain are acceptable. All interior surfaces of the hood and ductwork shall be smooth and seamless, and constructed for easy cleaning. The work surface shall be smooth and watertight with a minimum of 1/2" dished front and sides and an integral trough at the rear to collect wash-down water. The hood shall be designed to allow easy visual inspection of all interior surfaces.

See Division 23 for ductwork and exhaust fans.

b. **Hydrofluoric Acid Hoods:** Hydrofluoric acid is a highly corrosive agent. Consequently, materials resistant to hydrofluoric acid attack shall be substituted for standard laboratory fume hood construction materials. For

hydrofluoric acid, use the standard design specified for fume hoods, supplemented by the following specifications on construction and materials:

1) Construction: The hood and ductwork shall be constructed of nonreactive materials that are resistant to hydrofluoric acid attack and are relatively impervious. A Portland cement hood interior or other suitable material is recommended. The hood shall be constructed to allow easy visual inspection of all interior surfaces. A transparent plastic sash and PVC ductwork are required.

   See division 23 for ductwork and exhaust fans.

c. **Radioisotope Hoods:** In addition to meeting the standard design specifications for fume hoods, the interior of all radioisotope hoods shall be stainless steel or molded epoxy resin and must form a smooth integral unit. All interior screws shall be countersunk and joints sealed and smooth for ease of decontamination.