



UNIVERSITY SYSTEM OF GEORGIA

DESIGN CRITERIA

FOR

LABORATORY FURNITURE AND FUME HOODS

Effective: November, 2000

Supersedes: November, 1998

LABORATORY FURNITURE AND FUME HOOD DESIGN CRITERIA

TABLE OF CONTENTS

<u>Section</u>	<u>Page Number</u>
I. SCOPE, PURPOSE, AND GENERAL REQUIREMENTS	1
II. REQUIREMENTS FOR SELECTION, PLACEMENT, AND USE OF EQUIPMENT	
A. General	2
B. Casework	2
C. Counter Tops	3
D. Service Fixtures	4
E. Fume Hood Selection	5
F. Work to be Specified in Other Sections	8
G. Safety Equipment	9
III. WORKING DRAWING REQUIREMENTS	9
IV. SPECIFICATION REQUIREMENTS	10
A. General	10
B. Specification Criteria	10
C. Work to be Specified in Other Divisions	10
D. Quality Assurance	10
E. Submittals	11
F. Product Handling	11
G. Installation	11
H. Laboratory HVAC & Fume Hood System Testing & Balancing	13
V. REQUIREMENTS FOR LABORATORY FURNITURE & FUME HOOD SPECIFICATIONS	14
A. General	14
B. Equipment	14
C. Approved Manufacturers	15
D. Counter Tops	15
E. Service Fixtures	16
F. Sinks	17
G. Fume Hoods	18
APPENDIX A - Chemical Resistance of Laboratory Fume Hood Ductwork Materials	28
APPENDIX B - Flanged Connection Drawing	31
APPENDIX C - Organizations/Standards/References	33
APPENDIX "D" - Manifolded Fume Hood Exhaust Checklist	36
INDEX	38

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LABORATORY FURNITURE AND FUME HOODS**I. SCOPE, PURPOSE, AND GENERAL REQUIREMENTS**

- A. These design criteria (DC) are minimum design standards which shall be used on all new construction and renovation projects involving laboratory furniture and/or laboratory fume hoods in University System of Georgia (USG) facilities. Individual institutions may have more stringent requirements. Designers shall adhere to the requirements outlined in the most recent version of the Board of Regents' publication titled: "Building Project Procedures".
- B. The primary design references for these DC are the latest versions of the National Fire Protection Association (NFPA 45) Standard on Fire Protection for Laboratories Using Chemicals, NFPA 30 Flammable and Combustible Liquids Code, and the American National Standard for Laboratory Ventilation, ANSI/AIHA Z9.5, ASHRAE standard 55 "Thermal Environment Conditions for Human Occupancy," ASHRAE 110-R and the Americans With Disabilities Act.
- C. The purpose of these DC is to establish minimum design requirements for laboratory furniture and fume hoods, to maintain sufficient airflow in laboratory facilities, and to prevent undesirable exposures to chemical contaminants among students, faculty, and staff in USG laboratories.
- D. Laboratory fume hoods shall be considered an integral part of the overall building HVAC system and shall be part of the laboratory mechanical system testing and balancing prior to building acceptance.
- E. Project design documents shall not proceed beyond preliminary design until they have been reviewed and accepted by the institution's Facilities/Engineering Department, Physical Plant, Environmental Safety, the involved academic unit and the Board of Regents Office of Facilities.
- F. Variance requests shall be submitted as early as possible during schematic or preliminary design and shall be in writing to the Board of Regents Vice Chancellor for Facilities. Such requests shall include detailed discussion of the logic for the variance, appropriate justification, verification of the institution's support for the proposed variance and details of the proposed design. Approved variances shall be in writing, by the Board of Regents Vice Chancellor for Facilities.
- G. University System of Georgia institutions shall incorporate chemical use reduction strategies such as micro-scale and virtual (computer-simulated) experiments in chemistry labs to the maximum extent feasible to minimize the overall number of fume hoods necessary in laboratories.

II. REQUIREMENTS FOR SELECTION, PLACEMENT, AND USE OF EQUIPMENT

A. General:

1. Floor space shall be planned for all new, as well as existing and anticipated equipment. Drawings shall show existing and anticipated equipment with broken lines, cross-hatches for anticipated equipment, and shaded areas for existing equipment.
2. Clear Aisle Space
 - For opposite facing benches
 - Preferred - 5'
 - Minimum - 4'
 - For single faced benches
 - Preferred - 4'
 - Minimum - 3' 8"
3. Wall space of at least 2' shall be provided inside the room on the lock side of doorways, for location of light switches, telephone, thermostats, and fire extinguisher.
4. Fume Hoods shall be located per the requirements of ANSI/AIHA Z9.5 (most recent version) and shall be located in a manner which prevents excessive air changes and/or cross-drafts in the laboratory in accordance with sound engineering principles.
5. Doorways into science laboratories having fume hoods and/or other large equipment shall open in the direction of egress and shall have an active leaf 36" wide, and an inactive leaf 12" wide, permitting an opening of 48". Vented laboratory doors (to all egress/access corridors) shall be prohibited.
6. Rooms intended for the storage of hazardous chemicals shall have an independent mechanical ventilation system.

B. Casework:

1. Type: Standard, floor mounted, closed-base type (may have access doors), shall be used in all laboratories.
2. Materials: Metal or Hardwood (such as oak or other approved equivalent) - shall be used in:
 - a. General research and teaching laboratories where humidity and temperature will be normal (standard for occupied rooms), where casework maintenance is not a compelling factor, and where flammable, corrosive, or toxic substances will not be absorbed into the surface.

3. Plastic Laminate - Shall be used in:
 - a. Miscellaneous storage and workrooms requiring base or wall storage facilities, and where the infusion of appropriate colors may be architecturally desirable.
 - b. Only non-combustible and non-reactive laminates may be used where flammable or corrosive chemicals are to be stored or used.
4. Millwork - Shall not be considered for new construction. Variances may be considered on renovation projects on a case-by-case basis.

C. Counter Tops:

1. Chemical Reaction and Abuse Resistance - for chemical resistance work surfaces, either of the following shall be used:
 - a. Type 1 - Composition Stone -- with a chemical resistant resin finish.
 - b. Type 2 - Natural Quarry Stone -- with a chemical resistant finish .
 - c. Type 3 - Solid Resin -- for chemical resistant surfaces and in the bottom of general purpose fume hoods.
2. General Purpose - Areas where neither chemical nor physical abuse is expected and where no liquid services are to be used, such as 30" high desk and writing surfaces, instrument support surfaces, or storage areas shall use either of the following:
 - a. Type 4 - Wood Core -- A wood fiber or wood particleboard core with chemical resistant finish on all exposed surfaces.
 - b. Type 5 - Plastic Laminate -- Plastic Laminate surface with a wood particle core; may be self-edged or post-formed.
3. Radiation and Other Special Uses – areas where radioactive materials or other special uses are approved shall use the following:
 - a. Type 6 - Stainless Steel -- Type 316 polished stainless steel counter top surfaces may be approved on a case-by-case basis.
4. Physical Abuse Resistance - areas where abrasive physical abuse is expected; Physics, Earth Sciences, Geology, or Paleontology laboratories shall use:
 - a. Type 3 - Solid Resin -- with a chemical resistant surface, or
 - b. Type 7 - Composition Stone -- with a low gloss vinyl sealer.
5. Fume Hood Work Surfaces -- shall be selected as follows:
 - a. General Purpose Hoods - Type 3, Solid Resin (chemical resistant)

- b. Radiation Hoods - Type 6 - (Type 316 Stainless Steel).
- c. Perchloric Acid Hoods - Type 6 - (Type 316 Stainless Steel).
- d. Special Purpose Hoods - Type 3, Solid Resin (chemical resistant)

D. Service Fixtures:

1. Gas, air and vacuum service fixtures shall be positioned in that sequence, left to right when facing the services, at all times. An exception may be that of open, double-face reagent racks with services on both sides, and a side outlet tee is used; in this case, an ascending sequence of gas, air, and vacuum shall be maintained, with cold water service below and electric service above.

This ascending sequence also applies to fume hood services with the exception of electrical services and the addition of control switches.

Wall and on-line installation of gas, air and vacuum service and fixtures for reagent rack use shall be positioned down at 45°.

2. Hot and Cold Water Service
 - a. Hot and cold water service fixtures shall be provided only at major sink units; use mixing faucets with gooseneck or swing spout furnished with an anti-hose type aerator.
 - b. Cold water service, gooseneck fixtures, provided for use with cup sinks shall be located at the right of the cup sink, when facing the service, and be furnished with vacuum breaker and serrated hose end.
3. Special Water Service - (1) Distilled, (2) deionized, (3) demineralized or (4) filtered water service fixtures, as well as service lines, shall be located at one central position in the laboratory at a major sink and shall be manufactured of unpigmented polypropylene to maintain water purity and to prevent leaching of polymers. Polyvinyl chloride (PVC) shall not be used .
4. Steam Service - shall be accompanied by direct drainage facilities, such as a cup sink.
5. Plumbing Fixtures
 - a. Major sinks: Single sink bowls shall be sized according to the size of cabinet.
 - b. Cup sinks shall accompany any liquid service fixture not accompanied by a major sink. Cup sinks shall be 3" x 6" oval, along wall assemblies and 6" diameter, hemispherical on double-faced island or peninsular assemblies.
 - c. Drain troughs are prohibited on new laboratory construction or renovation

projects.

- d. Floor drains are prohibited in newly constructed laboratory facilities.
6. Electrical Service Fixtures
- a. Electrical service shall be provided through ground fault circuit interrupter (GFCI) devices where circuits are within six (6) feet of water supplies.
 - b. Basic electrical service shall be provided by a GFCI-protected, 120 volt, single phase, three wire system.
 - c. Special electrical service - 208 volt and others - shall be provided for present and anticipated requirements.

E. Fume Hood Selection:

- 1. Laboratory Fume Hood Definition: A box-like structure enclosing a source of potential air contamination with one open or partially open side into which air is moved for the purpose of containing and exhausting air contaminants.
- 2. Laboratory Fume Hood Types:

Laboratory Fume Hoods shall be either Standard By-Pass, Constant Volume or Variable Air Volume -VAV NOTE: VAV fume hoods shall not be permitted for radioisotope or perchloric acid activities.

Auxiliary-air fume hoods (those that provide additional make-up air for fume hoods in laboratories with insufficient supply air) may also be selected for certain specific applications on renovation projects only as referenced below.

The specific types of fume hoods which shall be available for selection include:

- a. *General Purpose* - may be used for removal of vapors, particulates, fumes, or gases generated by chemical reactions in teaching and research laboratories involving cold acids, organic solvents, and radioactive materials within U.S. Nuclear Regulatory Commission (NRC) guidelines. Excluded operations from this type of fume hood include reactions involving perchloric acid; highly toxic materials; unstable explosive materials, and radioisotopes exceeding NRC guidelines. NOTE: General Purpose, Auxiliary-Air Fume Hoods may be considered (on a case-by-case basis) for installation on renovation projects only (NO NEW CONSTRUCTION).
- b. *Radiation* - may be used where radioisotope operations are in progress (as per NRC guidelines). Excluded operations include perchloric acid, highly toxic materials and unstable explosive materials. Radiation, Auxiliary-Air Fume Hoods are prohibited.

- c. *Perchloric Acid* - may be used for laboratory experimentation with any perchloric acid compounds, to the exclusion of sulfuric acid, acetic acid, organic solvents, or any combustible or water-reactive materials. Perchloric, Auxiliary-Air Fume Hoods are prohibited.
- d. *Special Purpose* - a fume hood, not otherwise classified, which may be used for a special laboratory purpose such as enclosing analytical instrumentation or uniquely configured experimental equipment. Special purpose hoods may also be used for uniquely hazardous (i.e. highly toxic, unstable/explosive, corrosive or reactive) materials provided they are constructed of materials compatible with the intended use ***and provided that appropriate filtration and/or other control measures are in place***. For example, work with hot sulfuric acid could be done in a special purpose fume hood with solid (plastic) resinous work surfaces. Excluded operations from this type of fume hood include reactions involving perchloric acid and radioisotopes exceeding NRC guidelines. NOTE: Special Purpose, Auxiliary-Air Fume Hoods may be considered (on a case-by-case basis) for installation on renovation projects only (NO NEW CONSTRUCTION).

NOTE: Biological safety cabinets (BSC) and/or glove boxes require separate design and installation criteria which shall be in conformance with the requirements outlined in National Sanitation Foundation NSF International Standard #49 (most current version), Class II (Laminar Flow) Biohazard Cabinetry and "Biosafety in Microbiological and Biomedical Laboratories" (U.S. Department of Health and Human Services, publication no. CDC 93-8395). BSCs and glove boxes are not addressed in this DC document.

- 3. Size
 - a. Fume hood sizes shall be selected according to their intended use and available space.
 - b. Four-foot long fume hoods shall be used where the fume hood is expected to have limited utilization, when only one person is expected to use the fume hood at any given time, and when large apparatus set ups are not anticipated.
 - c. Five-foot long fume hoods shall be used where the fume hood is expected to have regular utilization, when one or two persons are expected to use the fume hood at any given time, and when large apparatus is expected to be set up some of the time. Fume hoods greater than 5 feet in length shall not be used for any radiation or hot perchloric acid (including nitric acid) activities in laboratories.
 - d. Six-foot long General Purpose fume hoods shall be used where the fume hood is expected to have regular utilization, when two persons are expected to use the fume hood, in teaching laboratories, or when unusually large apparatus is

expected to be set up a majority of the time.

- e. No fume hoods longer than 6 feet are permitted for installation in any laboratory. NOTE: Variances to this requirement may be considered on a case-by-case basis. Written variance requests (with appropriate justification) shall be submitted to the Board of Regents Vice Chancellor for Facilities prior to beginning the project.

4. Fume Hood Air Requirements

- a. Laboratory fume hoods are to be considered an integral part of the overall building HVAC system. In addition to ensuring the safety of all students, faculty, and staff, laboratory fume hoods shall also contribute to overall building energy efficiency efforts. Designers shall conduct a pre-project analysis of potential fume hood safety and energy conservation strategies and shall present their recommendations during the initial project planning phase. Strategies to be analyzed shall include, but shall not be limited to, occupied vs. unoccupied modes of operation, heat recovery loops, built-in permanent sash stops, airflow alarms, and the use of horizontal-sliding sashes. New buildings, or buildings undergoing renovations, must receive a laboratory HVAC system test and balance report, verifying that all laboratories and fume hoods operate in accordance with this criteria, before the building will be accepted.
- b. Standard By-Pass, Constant Volume Type Fume Hoods shall be provided for General Purpose, Special Purpose, Radiation, and Perchloric acid activities that maintain the required face velocity or 100 fpm $\pm 10\%$ with the sash at 18". Factory installed, permanent sash stops (to be coordinated with an alarm mechanism as detailed in section V.G.2 on pages 19-20 of this document) shall be incorporated into all new laboratory fume hoods at 18" from the working surface.
- c. Non-By-Pass Constant Volume Type fume hoods are prohibited.
- d. Variable-Air-Volume(VAV) Type Fume Hoods shall be an available selection for general purpose and special purpose fume hood applications only. VAV hoods shall be capable maintaining the required fume hood minimum face velocity of 100 fpm $\pm 10\%$ with the sash set at 18". Factory installed, permanent sash stops (to be coordinated with an alarm mechanism as detailed in section V.G.2 on page 20 of this document) shall be incorporated into all new laboratory fume hoods at 18" from the working surface.
- e. Auxiliary Air Hoods are not permitted for installation on new laboratory construction or major renovation projects. Auxiliary air hoods may be considered for laboratory renovation projects on a case-by-case basis for general purpose and special use activities only. Where approved for use,

auxiliary air hoods shall introduce make-up air in a uniformly distributed fashion at the top of the fume hood opening and in an amount no greater than seventy (70) percent of total exhaust volume.

- f. Recirculation of any laboratory fume hood exhaust air is prohibited.
- g. Ductless fume hoods are prohibited

F. Work to be Specified in Other Sections, to be Performed by the Contractor:

- 1. Casework
 - a. Rigid molding (such as metal) shall be furnished and installed along the backs of toe spaces, exposed ends of casework and around open knee spaces.
- 2. Service Fixtures
 - a. Tailpieces, traps, drain lines, and couplings shall be furnished, installed, and connected to the sink waste outlet.
 - b. Laboratory plumbing service fixtures and service supply lines, including all gas, air, vacuum, hot or cold water, and any special service fixture specified herein or shown on the drawings, including counter top and fume hood mountings, shall be installed and connected.
 - c. All deck mounted service fixtures shall be installed so that the cold water handle turns clockwise in its cylinder and the hot water handle turns counter-clockwise in its cylinder, both to the "ON" position.
 - d. Laboratory electrical service fixtures, and service supply lines, including counter and fume hood mounted fixtures, shall be installed and connected.

NOTE: All plumbing and electrical rough-in locations shall be provided on all bench assemblies within the eight inch (8") "pipe chase" behind the standard base cabinet with a minimum of a 30" wide counter.

- 3. Fume Hoods
 - a. Safety alarm consoles shall be factory tested and furnished with the fume hood.
 - b. Wash-down systems for all Perchloric Acid Fume Hoods shall be furnished, installed, connected and shown to be operational. An isometric drawing showing the pipe installation, including stop and drain valves, shall be provided. Provisions for installation and connection of plumbing to wash-down pipes in Perchloric Acid Fume Hoods shall be made, including connecting the rear-of-baffle wash-down line to the central handle on the right sash post.

- c. The fume hood-duct interface section between the fume hood and exhaust duct and all flanged gaskets shall be installed, braced, and connected.
- d. The exhaust duct (above the duct interface section) and exhaust fan shall be furnished, installed, and connected.
- e. Fluorescent light bulbs, (two each per General Purpose, Special Purpose, and Radiation Fume Hood) and explosion-proof incandescent light bulbs, 300 watts, (one each per Perchloric Acid Fume Hood) shall be furnished and installed.
- f. Airflow requirements of fume hoods shall be verified, according to the laboratory HVAC system test and balance report.

NOTE: The locations for plumbing and electrical connections shall be determined from the supplier's rough-in drawings.

G. Safety Equipment:

1. Plumbed safety showers shall meet the requirements of ANSI Z358.1 (most current version), including providing tepid water, and shall be located near laboratory exit doors (inside the laboratory). Safety showers shall not impede exit door swing or paths of egress. Safety showers shall be located at least six (6) feet from any electrical outlets or circuits. Safety showers shall be activated by a universally reachable bar or handle which shall also have the capacity to be manually deactivated. Other placement of safety showers within a laboratory may be considered on a case-by-case basis, provided that their placement does not result in blockage of the shower by laboratory equipment or create other safety hazards.
2. Plumbed emergency Eye Wash shall meet the requirements of ANSI Z358.1 (most current version), including providing tepid water, and shall be installed near sink locations and shall be universally reachable.
3. Flammable liquid storage cabinets shall be Factory Mutual and Underwriter Laboratories approved, properly grounded, minimum 30 gal. capacity, and shall be installed in all laboratories that contain flammable liquids. Containers of lesser capacity may be approved on a case-by-case basis for placement in smaller laboratories. Approved acid storage cabinets shall also be installed in all laboratories which contain acids.
4. Laboratories intended for the use of health hazard gases (NFPA hazard rank 3 or 4) shall have a mechanically vented storage area for the gases.
5. Laboratories using free-standing gas cylinders shall be constructed to provide areas and equipment to properly secure gas cylinders.

6. Consideration shall be given to installing combination high efficiency air (HEPA) and organic vapor filters in laboratory fume hoods where compliance with the National Emission Standards for Hazardous Air Pollutants (NESHAP) may be an issue.

III. WORKING DRAWING REQUIREMENTS

During the preliminary design phase of the project, the designer shall develop a draft set of working drawings which shall be submitted to the Board of Regents Office of Facilities and the institution's representatives (including the Facilities/Engineering Departments, Physical Plant, Environmental Safety and the involved academic unit) for review and comment. Working drawings shall include floor plans and elevations of all laboratory casework and equipment. After changes have been completed, the designer shall develop a final set of working drawings which shall be submitted in accordance with the Board of Regents "Building Project Procedures" (most current version).

IV. SPECIFICATION REQUIREMENTS

A. General:

1. Specifications for laboratory furniture shall be a section of Division 1100 and specifications for mechanical components, laboratory HVAC, fume hoods and fume hood control systems shall be a section of Division 1500 based on the CSI format.
2. Laboratory equipment such as environmental chambers, glass washers, autoclaves, or stills which are not built into the building (loose equipment) shall not be included as laboratory furniture under Division 1100.

B. Specification Criteria:

Section V of this DC, "Laboratory Furniture and Fume Hood Specifications", shall be followed in preparing the technical specification section for laboratory furniture and fume hoods. The format may be altered to conform to the architect's standard, but the content shall be the same.

C. Work to be Specified in Other Divisions:

Refer to Section II.F. (Page 8) of this document as a reminder of related work which must be specified in other Divisions of the specifications.

D. Quality Assurance:

1. **Manufacturer Qualifications:** Laboratory fume hoods (for integration with laboratory furniture, tops, sinks and service fixtures) with verified compatibility and overall safety effectiveness shall be provided.
2. **Catalog Standards:** Manufacturer's catalog numbers shall be indicated on drawings for convenience in identifying fume hoods. Unless modified by notation on drawings

or otherwise specified, manufacturer's current catalog description for indicated number, together with indicated or specified options or accessories, constitutes requirements for each unit.

NOTE: Use of catalog numbers, and specific requirements indicated on drawings are not intended to preclude use of products by other listed acceptable manufacturers, but are given for purpose of establishing a standard of design and quality for materials, construction and workmanship.

3. General Performance: Fume hoods shall be designed to be an integral part of the building HVAC system so that, when connected to exhaust system which provides the exhaust volume under normal laboratory conditions, fume hoods will operate in a safe, efficient manner, within acceptable airflow tolerances as specified in Section V.G.4 on page 21 of this document (Fume Hood Airflow Requirements). Laboratory size and layout clearances shall be coordinated with the HVAC design to avoid creating dead air pockets and reverse air currents along the surface of hood interiors.

E. Submittals:

1. Manufacturer's Data: Manufacturer's data and installation instructions shall be submitted for each type of fume hood and ductwork seam connection methods and materials (if not welded).
2. Shop Drawings: Shop drawings shall be submitted for fume hoods showing plans, elevation, ends, cross sections, service run spaces, locations and type of service fixtures with lines thereto; details and location of anchorages and fitting to floors, walls and base; layout of units with relation to surrounding walls, doors, windows, lighting and HVAC fixtures and other building components; connection to hood exhaust system; location of access doors, cut-off valves and junction boxes.
 - a. Shop drawings shall be coordinated with other work involved.
 - b. Rough-in drawings shall be provided for mechanical and electrical services.

F. Product Handling:

1. Delivery of fume hoods shall be coordinated with delivery of laboratory furniture components, and other building HVAC system components.
2. Finished surfaces shall be protected from soiling and damage during handling and installation. Finished surfaces shall be covered with polyethylene film or protective covering until final installation.

G. Installation:

1. All casework (base cabinets, wall cases, storage cases, reagent racks, shelving, pegboards, free-standing tables, and miscellaneous items of equipment, such as knee

space panels, filler panels, and scribes) shall be structurally integral and of neat appearance.

- a. Base cabinets, singly or in assembly, shall be made level so as to provide a firm Foundation for counter tops and shall be, in assembly, screwed together, front and back, the front of the base cabinets being aligned with each other. Doors and drawers shall operate without binding. Appropriate base anchors shall be provided for services. Door catches and drawer stops shall be aligned.
 - b. Wall cases shall be secured to walls (metal stud walls shall be reinforced) with no less than four fasteners per wall case, two each in both the top and bottom of the wall case. Wall cases in the same room shall be made level with each other, whether or not in the same assembly, and all wall cases shall be plumb. Doors shall operate without binding. Wall cases shall be installed at 54" above the finished floor, or as detailed on the drawings.
 - c. Storage cases shall be installed plumb and attached to walls at the top and bottom with no less than two fasteners per storage case. Doors shall operate without binding.
 - d. Reagent racks shall be mounted with the base of the uprights being flush with the counter top, and fastened to prevent moving, with no less than two fasteners per upright.
 - e. Reagent shelving, wall mounted, shall be installed flush with the wall. Each reagent shelf shall have a 1/2 lip. Floor standing reagent racks shall be installed plumb. Reagent shelves shall be secured to walls with no less than four fasteners per reagent rack, two each at the top and bottom.
 - f. Pegboards shall be mounted flush to walls and secured with no less than four corner fasteners.
 - g. Tables shall be assembled and set in place with the specified top secured with fasteners on 12" intervals.
2. Counter tops shall be installed and shall be level, both along the length and width of the surface.
 3. Fume hoods shall be installed in accordance with Section IV.G, paragraphs 1 - 4 (pp. 11-12). In addition, the superstructures shall be secured to the counter tops.
 4. Fume Hood Exhaust Ductwork for all fume hood systems shall be specified by the designer based on good safety and engineering principles. During schematic design, the institution's user group shall provide the designer with a complete list of chemicals anticipated (current and future) to be used in the laboratories to assist in

the selection of appropriate exhaust ductwork material. Exhaust ductwork material shall be selected based on code compliance and compatibility with the types of chemicals/agents to be used (and anticipated for future use) in the labs. The designer shall consult the "Chemical Resistance of Laboratory Fume Hood Ductwork Materials" chart (Appendix A) in this DC when specifying duct materials. Roof penetrations shall be weather-tight and water-proof. In addition, exhaust ductwork seams shall be welded and ground smooth, or otherwise joined using materials and methods which provide equivalent leak-proof containment. If duct seams will not be welded, the contractor shall provide submittals explaining methods and materials as outlined in Section IV E.1. A minimum of five (5) duct diameters of straight ductwork shall be provided in front of the exhaust fan inlet to minimize system effect. The only permissible exceptions to the vertical-up duct requirement are:

- a. For general purpose fume hoods (on renovation projects only – NO NEW CONSTRUCTION), offsets not exceeding 45 degrees from vertical shall be permitted only to avoid building structural members; and
- b. Horizontal ducting with positive drainage (minimum 1/8" per 1' with slope towards hood) and with trap and neutralization components shall only be permitted to connect a general purpose laboratory fume hood to a service corridor or chase, which shall be adjacent. Mitred joints for changes of direction shall not be permitted. If the laboratory configuration requires locating fume hoods on exterior walls, offsets (at smallest angle possible and not to exceed 45 degrees) shall be permitted at roof level to make the connection through the roof curb to the fan or to the manifold on the roof. Sufficient transport velocities in accordance with ASHRAE and ANSI/AIHA standards shall be maintained in the ducts at all times. NOTE: Perchloric, radiation and special purpose fume hood ductwork shall be vertical-up with no offsets. No exceptions.

H. Laboratory HVAC and Fume Hood System Testing and Balancing :

1. The design professional shall be responsible for coordination necessary to ensure the proper installation of laboratory HVAC and fume hood systems.
2. The testing and balancing of laboratory fume hoods and related components shall include the following:
 - a. Each fume hood system component shall undergo a preoperation check to provide verification that each piece of equipment has been installed in accordance with the manufacturer's instructions.
 - b. Each fume hood system, including all system components, shall be placed in operation.
 - c. Each fume hood system shall be tested and balanced to provide the airflow rates (negative and positive pressures) and volumes specified. Final adjustments, where necessary, shall be made to enhance system performance

before occupancy and also shall be tested and balanced six months after date of occupancy. Each fume hood shall have (2) peel and stick-type labels indicating safe operating conditions. . Built-in fume hood sash stops (to be provided at 18" from the fume hood work surface) shall be tested for operational effectiveness and to verify that the alarm console will properly activate if the sash stops are compromised. A copy of the test report shall be provided as part of the final project documentation.

- d. Each sequence of operation shall be verified, including each control device, which is part of the sequence of operation.
- e. Overall fume hood system operational and maintenance instructions shall be provided to the owner.
- f. Any deficiencies noted during laboratory fume hood testing and balancing shall be corrected before occupancy.

V. LABORATORY FURNITURE AND FUME HOOD SPECIFICATIONS

A. General:

All casework, counter tops, utility service fixtures, fume hoods and miscellaneous items of furniture shall be furnished as described in this section of the specifications shown on the drawings, including delivery to the building, unloading, unpacking, setting in place, leveling and securing to walls and floors and removing of all debris. All equipment specified in this section shall be furnished only by manufacturers who have successfully demonstrated fixture compatibility through approved submittals.

1. Casework includes base cabinets, wall cases, storage cases, reagent racks, shelving, pegboards, free-standing tables and miscellaneous items of furniture, knee space panels, filler panels, scribes and base molding.
2. Knee Space Panels shall be used to enclose the rear portions of an area under an apron rail and between two base cabinets to enclose the plumbing space or to shield between opposing assemblies, as in peninsular or island assemblies, and shall be secured with grommets and screws.
3. Scribes shall be used where casework or filler panels abut walls, columns, pilasters or other casework, and shall be secured to both the casework and abutting structures.
4. Filler Panels shall be provided to enclose spaces between casework and abutting surfaces.
5. Counter Tops include all work surfaces, including backsplashes and end curbs.

6. Service Fixtures include all liquid, gaseous, and electrical terminal outlets, including tank nipples and lock nuts, laboratory sink bowls, cup sinks, drain troughs and overflows.
7. Sink Waste Outlets may be an integral part of the sink, and shall be furnished with couplings to connect to the drainage system.
8. Fume Hoods shall include base cabinet, counter top, and superstructure complete with service fixtures, warning signs, and safety alarm console.
9. Shop Drawings: Provide rough-in, installation and shop drawings to the architect. NOTE TO DESIGNER : Specify number of copies and any special requirements. Also, any deviation between design drawings and submittals shall be resolved by the primary project designer.
10. Samples: All prospective bidders shall, upon request, submit samples.

B. Equipment:

1. Casework shall be constructed with a flush-lipped overlap on all four sides of doors and drawers. All joints shall be squared, glued and screwed in place.
 - a. Casework shall be furnished in accordance with the construction documents.
 - b. Base Cabinets shall be in accordance with the plans and elevation drawings as to size, location and door and drawer configuration.
 - c. Wall Cases shall have wood-framed glass sliding doors and shall be in accordance with the plans and elevation drawings as to size and location. Bypass stops shall be included on all sliding doors.
 - d. Storage Cases shall have doors and shall be in accordance with the plans and elevation drawings, as to size and location. Sliding doors shall include a bypass stop.
 - e. Reagent Racks shall be constructed of the manufacturer's standard materials for Reagent Racks, coated with a chemical-resistant finish, and of the size, configuration and location per contract documents.
 - f. Reagent Shelving shall be constructed of the manufacturer's standard materials for Reagent Shelving, shall have a 1/2" lip, shall be approximately shoulder height, coated with a chemical-resistant finish, and of the size and location as per construction documents.
 - g. Pegboards shall be constructed of 1 1/4" thick polypropylene or composition stone, coated with a chemical-resistant finish, and of the size and location as shown on the plans or elevation drawings. Pegs shall be polypropylene.

- h. Tables shall be constructed of solid hardwood with tops as specified herein. Tables that are 36" high shall be provided with leg stretchers, and tables whose frames are longer than four feet shall be provided with a stretcher-connecting rail.

C. Approved Manufacturers:

Approved fume hood manufacturers shall be those who have or may demonstrate through written, approved submittals and performance data (including the ASHRAE 110 test) that their fume hoods are capable of maintaining a sustained safe working environment for laboratory students, faculty, and staff while also maintaining maximum energy efficiency and adequate air flow throughout the laboratory.

Laboratory furniture and fume hoods shall be integrated to ensure adequate safety and space utilization.

D. Counter Tops:

1. General

Counter tops shall be the various work surfaces as described in these specifications or as shown on the drawings. Counter tops shall be of the greatest length practicable, based on a 72" or 96" module, except for shorter assemblies or portions of assemblies. All counter sections shall be one piece, 30" wide (minimum front to back), except for 24" wide assemblies. Counter tops, as well as joints between counter tops and backsplashes and curbs, shall be secured with screws and chemical-resistant adhesive compound. Counter tops shall be 1" thick (minimum) and shall have a drip groove along the under side of exposed edges. Counter top, backsplashes and curbs shall have a 1/4" radius on all exposed corners. Backsplashes and curbs shall be 4" high, 3/4" thick (minimum) and provided along the backs of counter tops, abutting walls and taller furniture and where columns and pilasters abut the counter top. End curbs installed on a 30" high counter top shall extend to the bottom side of any adjacent 36" high counter top. All counter tops shall have an overhang of 1" on all exposed edges and shall have cutouts for all specified service fixtures. Approved types are:

- a. Type 1 - Composition Stone - with a chemical resistant finish.
- b. Type 2 - Natural Quarry Stone - with a chemical resistant finish.
- c. Type 3 - Solid Resin - Shall be compounded solid resin throughout.
- d. Type 4 - Wood Core - Shall be constructed of multi-ply of wood particles or tempered welded fiber board, laminated with moisture resistant glue. Exposed surfaces shall have black, chemical resistant, high bake resin, enamel finish.

- e. Type 5 - Plastic Laminate. Shall be constructed of a black, high pressure, thermosetting, phenolic resin plastic sheet, 1/16" thick, bonded to a core of high density wood particle board, with a phenolic balance sheet bonded to the under-surface. Exposed edges shall be edged with plastic laminate.
- f. Type 6 - Stainless Steel. Polished Type 316, 16-gauge, reinforced by three, 10-gauge steel channels. Exposed edges of tops shall be formed into a channel shape extended over a formed hardwood perimeter with a 1" return under the frame; backsplashes and curbs shall be a full channel formation with no edges. All welds shall be ground smooth and polished to a uniform No. 4 finish. Soldering shall not be permitted. Field Joints shall be mechanically bolted and aligned with steel reinforcements, providing a hairline seam with a flat level surface. Joints shall be made waterproof at time of joining. After fabrication and polishing, surfaces shall have applied a removable plastic coating. Under sides of tops shall be coated with a thick plastic sound deadener. Standard products of approved laboratory furniture manufacturers are approved.
- g. Type 7 - Composition Stone - with a low gloss vinyl sealer.

E. Service Fixtures:

- 1. Utility Service Fixtures shall be furnished for plumbing and electrical outlets as described in this section of these specifications or shown on the drawings.
- 2. Plumbing Service Fixtures shall be laboratory grade and handles shall be color-coded by type of service in accordance with the following schedule:

Gas	-	Blue
Air	-	Orange
Vacuum	-	Yellow
Hot Water	-	Red
Cold Water	-	Green
Hot & Cold Mixing	-	Red for Hot and Green for Cold
Steam	-	Black

- 3. Cold Water Service Fixtures shall be provided with an integral vacuum breaker and a ten-serration hose connection end. Hot and cold mixing water service fixtures shall be provided with an anti-splash spout. **NOTE:** All deck mounted water service fixtures shall be furnished such that the cold water handle turns clockwise in its cylinder and the hot water handle turns counter-clockwise in its cylinder, both to the "ON" position. Deck-mounted hot, cold and hot and cold mixing water service fixtures shall be fixed 6" gooseneck type.
- 4. Gas, Air and Vacuum Service Fixtures shall be ground key type, with wing type

handles.

5. Special Water Service Fixtures for Distilled, Demineralized, Deionized or Filtered Water Service shall be polypropylene and shall be the self-closing type.
6. Electrical Service Fixtures shall be the type specified or shown on the drawings. Flush plates shall be stainless steel. Unless otherwise specified in this section, the following electrical services shall be furnished:

120 volts, single phase, 3-wire polarized, GFCI-protected receptacles, duplex type, single or double face, 208 volts, 3 or 4-wire, single or three-phase, polarized GFCI-protected receptacle, (where within six (6) feet of a water supply) and as specified in this and other sections or shown on the drawing(s).

F. Sinks:

1. Sinks, Cup Sinks, Sink Outlets, Strainers and Overflows shall be of the sizes shown on the drawings.
2. Sink Bowls shall be furnished with sink outlets, strainers and overflow, 2" shorter than the inside top of the sink bowl. Outlet shall be 1 1/2" N.P.S. Sink Counter cut-out shall overlap interior dimensions of sink by 1/2" (minimum) on all four sides.
3. Cup Sinks shall be 6" inside diameter, hemispherical at double faced island and peninsular assemblies, and 3" x 6" oval along wall assemblies, and provided with strainer and locknut.
4. Drain Troughs shall not be installed in any newly constructed laboratory within the University System of Georgia.

G. Fume Hoods:

1. General
 - a. Base Cabinets shall be at least as long as the fume hood superstructure or counter top, whichever is greater. Base cabinets shall be compatible with and capable of supporting the counter top the fume hood superstructure.
 - b. Counter Tops shall be compatible with and as long as the base cabinet or the fume hood superstructure, whichever is greater, and shall support the fume hood superstructure. Counter tops shall be provided with a raised edge around the interior periphery of the fume hood.
 - c. Service Fixtures shall be provided as described in this section of these specifications or as shown on the drawings. All plumbing service fixtures shall be located no more than 12" from the inside of the sash, and shall be on a common vertical center line. Plumbing and electrical service fixtures shall

be provided in the following ascending order.

- 1) Two Cup Sinks shall be provided, mounted in the counter top.
- 2) Electrical Service Fixtures shall be combination type, mounted on the lowest portion of each sash post as follows:
 - a) Two 120v A.C., GFCI-protected outlets.
 - b) One 240v (or more-based on owner requirements) A.C., GFCI-protected outlet.
- 3) Two Vertical Discharge Cold Water Service Fixtures with vacuum breakers, each fixture directly above and draining directly into the cup sink below.
- 4) Two gas service fixtures. (Lower position)
- 5) Two air service fixtures. (Middle position)
- 6) Two vacuum service fixtures. (Higher position)

NOTE: 3), 4), 5) and 6) are to be sash-post mounted and have four-arm remote control handles.

- 7) One light fixture toggle switch mounted on the left sash post.
 - 8) A punchout for one exhaust fan switch and box on the left sash post.
 - 9) A light fixture shall be provided for each fume hood; General Purpose and Radiation Fume Hoods shall be provided with a two-bulb fluorescent fixture; Perchloric Acid Fume Hoods and Special Purpose Fume Hoods shall have an explosion proof incandescent fixture. Lamp/ballast combinations shall be recommended by the institution's engineering and/or maintenance department.
 - 10) Fume hood fans, blowers and drive mechanisms shall be located on the exterior (rooftop) of the building and shall be designed and located so they are readily accessible for visual inspection and maintenance. Exhaust discharge velocities shall be maintained in the range of 3500-4000fpm and shall be located in a manner to prevent re-entrainment of contaminants back into building. Rain caps and other fixtures which may impede exhaust stack airflow are prohibited.
2. A Safety Alarm Console shall be provided to signal unsafe operating conditions whenever fume hood face velocity falls below 90% of the baseline value and whenever fume hood sash stops are overridden. The one-unit alarm console shall consist of the following:

Standard By-Pass, Constant Volume Type Fume Hoods:

- a. An audible alarm with a minimum intensity of 60 decibels and a red warning light to both audibly and visibly indicate an unsafe operating condition.
- b. A silencer switch for the audible alarm; the red warning light shall remain "ON" until the unsafe condition is corrected and the alarm device is manually reset.
- c. A push-button circuit tester to verify the operation of the audible and visible alarm.
- d. A secure means of disabling the alarm device to permit controlled shutdown shall be provided. Upon correction of the alarm condition, the alarm device shall be reactivated.
- e. Air velocity sensors (through the wall or face velocity sensors) as provided by the fume hood manufacturer, in conjunction with the laboratory control system contractor, which are capable of measuring air velocities over the potential range of fume hood operation.
- f. The Safety Alarm Console shall be furnished complete with all internal wiring and stainless steel exhaust duct sensors (where duct sensors are required).
- g. A contact closure or local area network device capable of indicating a low airflow condition shall be provided as a means to interface with the building airflow control system.
- h. A six-second delay circuit shall be provided to prevent false alarms when the blower is reactivated.
- i. After the laboratory air handling system has been balanced, the "low-limit" of the air velocity and/or static pressure sensors shall be adjusted and set to activate the alarm whenever the face velocity of any fume hood falls 10% or more from its baseline average face velocity with the sash at 18".
- j. The Safety Alarm Console shall be factory mounted and tested and shall be on the right side of the fume hood, flush with the face of the fume hood superstructure facing to the front.
- k. Unit shall be provided with an instructions plate mounted on the exposed side of the housing. Instructions shall describe fume hood operating procedures, alarm functioning, and re-set features.
- l. A selectable digital device shall be installed to indicate the average fume hood face velocity (fpm).

- m. An alphanumeric display device shall be installed to indicate the type of alarm or emergency condition (e.g. LOW face velocity, SASH stops overridden, or EMERGENCY). A diagnostic message shall also be provided to notify the hood operator of control function failure.
- n. Where there is an existing or new building energy management system, the fume hood safety alarm shall be integrated with and monitored by the energy management system alarm function. Also, for fume hoods having on/off switches or a set-back mode, the alarm shall not activate when the switch is turned off intentionally or during the set-back mode.

Variable Air Volume (VAV) Type Fume Hoods:

- a. To provide for the safety of students, faculty, and staff, the face velocity of each VAV fume hood shall be maintained at 100 fpm. This airflow rate shall be factored into the laboratory airflow control system to maintain proper laboratory pressurization.
 - b. The one-unit alarm console for VAV fume hood systems shall also include each of the elements in specified V.G.2 (a-n) in the previous section .
3. Fume hood signs or nameplates shall be secured to the center of the lintel, as shown on the drawings, immediately above the sash opening. The signs shall be of white lettering, 1/4" high, with red facing; fume hood "type" lettering to be 1/2" high; reading as follows:
- a. "GENERAL PURPOSE FUME HOOD
Reactions with radioactive material exceeding NRC guidelines, perchloric acid, highly toxic or unstable explosive materials are not permitted in this fume hood. Check with the Radiation Safety Officer for limits on isotope use."
 - b. "RADIATION FUME HOOD
Reactions with radioactive materials within NRC guidelines and other general purpose reactions are permitted in this fume hood. Reactions involving hot perchloric acid, other concentrated acids, or unstable explosive materials are not permitted in this fume hood. Check with the Radiation Safety Officer for limits on isotope use."
 - c. "PERCHLORIC ACID FUME HOOD
Only reactions with perchloric acid are permitted in this fume hood."
 - d. "SPECIAL PURPOSE FUME HOOD
Only approved equipment and chemicals to be used in this fume hood. Check with the Lab Safety Officer for approved activities."
4. Fume Hood Airflow Requirements
- a. Fume hood manufacturer documentation shall be provided to the owner certifying that a quality assurance program is in place to verify that the unit

will successfully complete the ASHRAE 110-R performance test (with a minimum rating of 4.0 AM 0.05). The quality assurance program and test shall indicate that hood performance is adequate for the intended use.

- b. Upon installation in the laboratory, a fume hood safety certification test, (such as the SEFA protocol), including face velocity measurements and smoke capture tests, shall be completed. Certification of successful fume hood safety tests shall be submitted prior to building acceptance.
- c. Each fume hood shall be designed and installed to operate at an average face velocity of 100 fpm with the vertical sash set at 18" above the work surface (for constant volume and VAV fume hoods) or with the horizontal sliding sash set with sliding sections open to the maximum, with no single face velocity measurement exceeding plus or minus 10%.
- d. Positive pressure ventilation shall not be introduced into any fume hood behind the plane of the hood sash.
- e. The motor(s) and fan(s) for each fume hood system shall be designed to accommodate a minimum of ten (10) % extra capacity to compensate for normal system loss. Fan motors shall not operate at design capacity exceeding 90% of motor nameplate horsepower.

5. Sash Requirements

- a. The front face of the hood shall be provided with one or more transparent movable sashes capable of closing the entire front face and shall be constructed of flame-resistant, shatterproof material.
- b. All newly installed laboratory fume hoods shall have factory installed, sash stops (at least one spring-loaded) at 18" above the fume hood work surface to maintain adequate face velocity and operator safety. The alarm console shall produce an alarm signal if sash stops are overridden.
- c. Sashes may move vertically or horizontally, depending on personnel safety, airflow balance and accessibility requirements.
- d. All vertically moving sashes shall be movable throughout their travel by application of no more than (5) pounds of force and must remain stationary when force is removed.
- e. All horizontally moving sashes shall consist of at least (2) separate panels movable throughout their travel by application of no more than (5) pounds of force and shall remain stationary when force is removed.
- f. All combination sashes (horizontal panels in a vertically moving frame) shall meet the requirements of items (d) and (e) above.

6. The Fume Hood Exhaust Outlet Flanges shall be constructed at the size necessary to maintain required air flow, and shall be constructed of materials deemed appropriate from a safety and engineering standpoint and in accordance with Appendix A of this document. Flanges shall be pre-drilled for bolting to duct flange.
7. Connections for exhaust ducts shall be provided in the walls or roof of the hood behind adjustable baffles on the top of the fume hood. These connections shall have a flow cross-section sized for a velocity of 2000 fpm (maximum) at the rated volume flow of the hood at the specified sash height and must be located to allow uniform face velocity. The fume hood duct interface shall be furnished as an extension above the outlet, and shall be constructed of appropriate material in accordance with Appendix A of this document. The static pressure sensors (if used), from the fume hood safety alarm console shall be pre-set into the duct interface. All joints shall be smooth.
8. Fume Hood Types
 - a. Constant Volume Fume Hoods
 - 1)
 - a) General Purpose Fume Hoods shall be air foil, by-pass type with sash.
 - b) General Purpose, Auxiliary-Air Fume Hoods (if approved on a case-by-case basis) shall be air-foil, by-pass type, with sash, designed to furnish other than room air as a portion of the exhaust air requirements. (Note: This type of hood will only be considered on renovation projects. No new construction.)
 - 2)
 - a) Special Purpose Fume Hoods may be uniquely configured; however, general construction shall be air foil, by-pass type with sash.
 - b) Special Purpose Auxiliary-Air Fume Hoods (if approved on a case-by-case basis) shall be air foil by-pass type with sash designed to furnish other than room air as a portion of the exhaust air requirements. (Note: This type of hood will only be considered on renovation projects. No new construction.)
 - 3)
 - a) Radiation Fume Hoods shall be air-foil by-pass type with sash and stainless steel interior.
 - b) Radiation, Auxiliary-Air Fume Hoods are prohibited.
 - 4)
 - a) Perchloric Fume Hoods shall be air-foil by-pass type with sash and corrosion resistant interior. (See Appendix A).

b) Perchloric, Auxiliary-Air Fume Hoods are prohibited.

b. Variable Air Volume (VAV) Fume Hoods

1) General Purpose VAV Fume Hoods shall be capable of varying the exhaust air volume in proportion to the hood face opening by either changing the speed of the exhaust blower or by adjusting a damper in the exhaust duct for general laboratory fume hood operations.

2) Special Purpose VAV Fume Hoods shall be capable of varying the exhaust air volume in proportion to the hood face opening by either changing the speed of the exhaust blower or by adjusting a damper in the exhaust duct for fume hoods containing approved equipment or apparatus on a permanent basis.

Note: VAV fume hoods are not permitted for radiation and perchloric acid activities.

3) General VAV Fume Hood Control System Requirements

a) Airflow sensors and quick response (three seconds or less) pressure independent valves shall be installed in each exhaust duct, desirably at roof level, to maintain face velocity and to prevent backflow or air volume fluctuations.

b) Exhaust volume shall be directly measured (and face velocity appropriately varied) using closed-loop feedback control.

c) Documentation certifying the performance of the control valve technology shall be included as part of the preliminary design documents.

d) The control technology selected for VAV fume hoods shall use a proven successful technology with a demonstrated track record of three or more years.

e) Laboratories using VAV fume hoods shall incorporate temperature compensation to avoid undesirable temperature variations.

c. Fume Hood Construction

1) All fume hood superstructures shall be provided with radiused air-foil section at the bottom of the fume hood sash opening. Double-wall end panel construction shall be provided, with the end panel terminating flush with the interior lining.

The bottom air-foil shall be fastened to the superstructure, mounted one inch above the counter top, and shall be extended under the sash

so as to function as a stop for the sash, preventing complete closure of the opening.

- 2) All Fume Hoods shall be provided with closure panels (constructed of the same material as the fume hood) to enclose the space between the top of the fume hood and the ceiling (if a ceiling is present).

- 3) Baffles shall be provided in all hoods - adjustable in General, Special Use, and Radiation hoods, fixed in Perchloric Acid hoods, and shall be full width and provided with adjustable openings, (except for Perchloric Acid Fume Hoods), one at the top of the fume hood chamber and one immediately above the counter top. Baffle openings shall be provided with a stop to maintain a minimum opening of 1" for the top and bottom baffle openings. Materials for baffles and interior linings shall be as specified in this section. Hood baffles shall be configured so as to prevent operators from leaning into the fume hood to make adjustments. Hood baffles shall be adjustable with one hand, or control shall be from the corner post of the fume hood. Slab baffles with turn knobs are prohibited.

d. Fume Hood Exhaust Discharge

- 1) Fume hood exhaust discharges shall be directed to the outside atmosphere and shall comply with applicable federal, state or local air emission standards. Fume hood exhaust shall be discharged in a manner and location to avoid reentry into the laboratory building or adjacent buildings.
- 2) Fume hood exhaust discharges from stacks shall be in a vertical-up direction at a minimum of 10 feet above the adjacent roof line. Exhaust stacks shall be located such that rooftop features (e.g. parapets, mechanical equipment, etc.) Will not adversely effect exhaust airflow. Rain caps and other fixtures which may impede exhaust stack airflow are prohibited.

Note: Aesthetic considerations concerning external or internal appearance of the building shall not be grounds for variances from this requirement. Consideration shall be given to additional architectural structures to mask the unwanted appearance of the stack (provided the stack is at least one stack diameter or more taller than the masking structure) or treatment of the discharge vapors, fumes, gas or particulates which might allow for shorter or alternative stacks.

- 3) Fume hood exhaust stacks (for both constant volume and VAV) shall have discharge velocities which meet the requirements of ANSI/AIHA Z9.5 (most current version).
- 4) All fume hood ducts and fans (inside and outside of buildings) shall be clearly labeled for maintenance purposes.

e. Manifolding of Laboratory Fume Hood Exhaust Ducts

- 1) The dedicated single fume hood/single exhaust fan per stack design methodology has been preferred for facilities projects within the University System of Georgia because it represents a "tried and true"

strategy premised on the highest standards for health and safety and because University System of Georgia institutions generally possess a sufficient level of in-house capability to properly maintain these systems. However, as technology has advanced in this area, the University System recognizes that other fume hood exhaust systems which incorporate design features such as manifolds may also provide equivalent levels of safety and maintainability.

Based on the particular building site conditions and academic (teaching and/or research) program parameters, design professionals may propose that it is in the University System's best interest to use a manifolded fume hood exhaust system. In such cases, design professionals shall focus on the principal objective of protecting public health and safety. The design professional shall also consider whether the particular institution has the in-house capability to properly maintain such a system.

- 2) Where a manifolded system is proposed for a University System of Georgia facility, *the project's prime design firm shall be required to complete the Board of Regents' "Manifolded Fume Hood Exhaust Checklist" (Appendix D) and submit it with the schematic design documents.* This checklist shall address the following issues:
 - a) How does the proposed manifolded system provide the necessary level of user/occupant/environmental safety?
 - b) Has the institution/user agreed in writing that they support the proposed manifolded system and that they possess adequate in-house capabilities to maintain the system? Has the proposed design been reviewed by the user group and the institutions' Facilities/Engineering, Physical Plant/Maintenance and the Environmental Safety Departments?
 - c) Has the institution/user agreed in writing that they are aware of the manifolded exhaust system limitations (e.g. potential chemical exhaust mixing/in compatibilities)? Has the institution/ user agreed in writing that they are aware that special hazard hoods (such as radiation and perchloric acid) require their own separate dedicated single exhaust fan/stack systems and cannot be combined with the manifolded system?
 - d) Why is it in the University System of Georgia's best interest to install the proposed manifolded system? (Address issues such as system reliability, benefit to the academic/teaching program(s), installation costs, operating costs and short- and long-term maintenance factors.)

- 3) Where manifolded systems are used on University System of Georgia laboratory fume hood projects, critical design parameters shall include:
- a) Redundancy: Manifolded exhaust systems shall maintain continuous negative pressure in lab fume hoods and ducts at all times. The following design strategies shall be used to accomplish this:
 - An installed spare exhaust fan (or fans) that may be put into service rapidly (three seconds or less) by energizing its motor and switching a damper by a current relay switch,
 - A reliable, back-up emergency power source which is linked directly to the manifold system exhaust fans,
 - Airflow sensors and quick response (three seconds or less) pressure sensitive valves or through-the-wall airflow/sash position sensitive valves shall be installed in each fume hood exhaust duct to prevent backflow or significant air volume fluctuations. The airflow sensors and pressure sensitive valves shall be incorporated into an audible and visual alarm device which shall instantaneously notify the operator of any failures or alarm conditions in the manifolded system.
 - b) Clustering: Preference shall be given to clustering or grouping identical labs/operations using low-hazard chemicals into common manifolds. Lab fume hoods using dissimilar or incompatible chemicals or other agents shall not be manifolded together in a common plenum. The number of fume hoods connected to any one manifold and the number and length of horizontal duct runs shall be minimized.
 - c) Extra Capacity: The motor(s) and fan(s) for the manifolded system shall be designed to accommodate a minimum of 10% extra capacity to compensate for normal system loss (and possible future system expansion). Fan motors shall not operate at design exceeding 90% of motor nameplate horsepower.

APPENDIX A

Chemical Resistance of Laboratory Fume Hood Ductwork Materials

APPENDIX B

Flanged Connection Drawing

APPENDIX C

ORGANIZATIONS TO CONTACT FOR STANDARDS AND REFERENCE MATERIALS

ORGANIZATIONS TO CONTACT FOR STANDARDS AND REFERENCE MATERIALS

1. American Industrial Hygiene Association (AIHA)
2700 Prosperity Avenue
Suite 250
Fairfax, VA 22031
phone: (703)849-8888
fax: (703)207-3561

2. American National Standards Institute (ANSI)
655 15th Street, NW
Suite 300
Washington, DC 20005
phone: (202)639-4090
fax: (202)628-1886

3. American Society for Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE)
1791 Tullie Circle, NE
Atlanta, GA 30329
phone: (404)636-8400
fax: (404)321-5478

4. Board of Regents of the University System of Georgia
270 Washington Street, SW
Atlanta, GA 30334
phone: (404)656-2247
fax: (404)657-1479

5. Centers for Disease Control and Prevention
ATTN: Biosafety Branch
Atlanta, GA 30333
phone: (404)329-3883

6. National Sanitation Foundation (NSF) International Standard #49-1992
Class II (Laminar Flow) Biohazard Cabinetry
Ann Arbor, MI
phone: (313)769-0109

7. National Fire Protection Association (NFPA)
P.O. Box 9101
Batterymarch Park
Quincy, MA 02169
phone: (800)344-3555

8. Scientific Equipment and Furniture Association (SEFA)
1028 Duchess Drive
McLean, VA 22102
phone: (703)790-8661
fax: (703)790-9573

APPENDIX D

MANIFOLDED FUME HOOD EXHAUST CHECKLIST

BOARD OF REGENTS of the UNIVERSITY SYSTEM OF GEORGIA

Manifolded Fume Hood Exhaust Checklist

**To be completed by project prime design firm, with sign-offs from different campus departments as indicated, during the schematic design phase of the project.*

1. Why is it in the University/College and University System's best interest to install a manifolded fume hood exhaust system as opposed to a single fan/single exhaust stack system? (Using a separate sheet, please address the following issues: personnel and environmental safety, system reliability, benefit to the academic program, installation costs, operating costs and short and long-term maintenance factors.)
2. Have the institution's Facilities, Physical Plant, Environmental Safety and User (Academic) Departments reviewed the proposed design of the manifolded system(s)?
Yes: _____ No: _____
3. Have the institution's Facilities, Physical Plant, Environmental Safety and User (Academic) Departments verified that they are aware of the manifolded exhaust system limitations and that special hazard fume hoods such as radiation or perchloric acid should not be combined into a manifolded system?
Yes: _____ No: _____
4. Has the project prime design firm obtained a list of the chemicals *anticipated (current and future)* to be used in the manifolded fume hoods from the User (Academic) Departments?
Yes: _____ No: _____
5. Does the institution have adequate in-house capabilities to properly maintain the proposed manifolded exhaust system(s)?
Yes: _____ No: _____
6. In the proposed manifolded exhaust system(s) design, are provisions made for the following factors?
 - a. Redundant Safety Measures:
 - 1) Spare (backup) exhaust fan(s)? Yes:_____No:_____
 - 2) Reliable back-up (emergency) power? Yes:_____No:_____
 - 3) Duct air flow sensors/alarms? Yes:_____No:_____
 - 4) Duct pressure sensitive valves? Yes:_____No:_____
 - 5) Sash position sensors? Yes:_____No:_____

- b. Clustering Similar Operations/Fume Hoods:
 - 1) Only identical labs/operations using low hazard chemicals combined into manifolds? Yes:_____No:_____
 - 2) All dissimilar labs with potentially incompatible chemicals segregated? Yes:_____No:_____

 - c. Minimizing the number of Hoods in Each Manifold:
 - 1) Are the number of hoods combined into any one manifold minimized? Yes:_____No:_____

 - d. Minimizing Horizontal Duct Runs:
 - 1) Are the number and length of horizontal duct runs minimized? Yes:_____No:_____

 - e. Extra Design Capacity:
 - 1) Fan/motor designed with at least 10% extra capacity? Yes:_____No:_____
 - 2) Can minimum hood face velocities be achieved without fan motors operating at maximum capacity? Yes:_____No:_____
-

Signature (project prime design firm): _____ Date: _____

Institution Signatures:

Facilities Department: _____	Date: _____
Physical Plant Department: _____	Date: _____
Environmental Safety Department: _____	Date: _____
User (Academic) Department: _____	Date: _____