SECTION 12.0a

CONSTRUCTION SYSTEMS AND ASSEMBLIES STANDARDS AND GUIDELINES

ADDENDUM A: LABORATORY BUILDINGS

INTRODUCTION

Laboratory buildings call for special guidelines and standards in addition to those that apply to all buildings. These guidelines are presented in the format of an addendum to the fundamental SECTION 12.0, so the written structure mirrors the UniFormat style of SECTION 12.0. As in Section 12.0, the UniFormat structure is shown even if, at present, there is no information in some elements and sections.

FACILITY PERFORMANCE

A Basic Function, Research Labs:

1 Design basic modular lab plans or generic labs which, over time, permit accommodation of a wide variety of research functions.

2 Design all research modules as generic labs with generic services; then minimally modify a specific lab to support that user’s unique requirements. FP&C with the design consultant will determine the requirements for the generic module.

3 Design the lab module for flexibility or adaptability to accommodate future changes in research functions with a minimum of remodeling and renovation expense.

4 Future remodeling of a lab should have minimal effect on adjacent labs and adjacent research programs.

5 Provide functional relationships among principle activities, work space, offices, core support and services which support the research program.

6 Provide material management and movement that support the research program while protecting the adjacent research programs.

7 Provide waste management, holding, movement and disposal that support the research while protecting the public.

8 Provide zones within the design for special environmental requirements such as vibration, radiation, EMF, shielding, clean rooms and microwave. Provide communities or pods of faculty offices distributed throughout the lab facilities.

9 Group spaces with the most intense requirements for mechanical, electrical, and plumbing to reduce construction as well as operational costs.

10 Consider ceiling supplied services with no floor penetrations.

B Basic function, Teaching Labs:

1 Design teaching labs that facilitate flexible scheduling by supporting a variety of academic disciplines and teaching styles. Confirm with FP&C the facility parameters needed to match the intended educational program. In the interim, use the following guidelines for preliminary design.

2 Design for 20 to 32 student workstations for introductory courses and 20 to 24 student workstations for advanced courses.

3 Provide standing height benches for chemistry; consider sitting height benches for biology.

4 Provide each student with 3 to 4 linear feet of bench; two students will share a 5 or 6 foot hood and 4 students will share a sink.

5 Provide one network connection on the bench for every two students.

6 Design lab for student working groups of 2 or 4. Lab bench arrangement and spacing should encourage both student and faculty movement and interaction.

7 Provide each Lab with 10 to 20 linear feet of wall storage, plus support equipment required for that discipline; refrigerators, incubators, ovens, demonstration apparatus.

8 Shared instrumentation benches or shared instrumentation rooms between labs are appropriate.

9 Design the lab to allow gathering space for the students near the demonstration table. The bench layout should encourage interaction and informal conversation between instructor and students.

10 Provide good sightlines throughout teaching labs particularly for hoods. Visual control by faculty within the labs is required.

11 Close proximity between hood and benches increases student safety.

12 Consider shared pre-lab lecture rooms or discussion rooms adjacent to labs. Consider interference with lecturer from hood noise.

13 Determine FP&C expectations of durability balanced with cost in the selection of lab bench materials.

14 Countertops of lighter colors increase illumination.

15 Location of research labs adjacent or contiguous to teaching labs provides ability to share instrument rooms, equipment rooms, prep rooms, storage rooms, animal facilities, electron microscopes, and tissue culture.

16 Provide each teaching lab with network connections, ceiling mounted projectors and projection screens; consider CRT or LCD monitors suspended above workstations.

C Health and Safety:

1 Laboratory design must be approved by UH Department of Public Safety and Department of Environmental Health and Risk Management.

2 All labs that house more than two people will have two exits.

3 With the concurrence of the UH Department of Public Safety and Department of Environmental Health and Risk Management, provide quick-connect/disconnect outlets for emergency breathing air, or self-contained backpacks, at strategic locations throughout laboratory work areas.

4 Provide emergency eye or combination eye and face washers in each lab, preferably at each major sink (cup sinks excluded). Minimum flow pressure at 20 psi, maximum static pressure at 125 psi, water temperature range at 60 deg. to 95 deg. F, and flow rate between 2.5 and 12 gpm. Provide alarm system when emergency washer is activated.

5 Provide emergency deluge stations in corridors serving several research labs. Provide deluge stations near the entry to all teaching labs. Floor drains shall not be provided. See Section 12. CONSTRUCTION SYSTEMS AND ASSEMBLIES STANDARDS AND GUIDELINES D2010.90 for additional emergency shower requirements.

6 Provide fire suppression appropriate to the anticipated activities. All labs and chemical storage will be fire sprinklered. Provide smoke and flame detectors connected to the building alarm system. Provide portable alarm, warning, and monitoring systems if hazard warrants (e.g., hydrogen or hydrogen sulfide). Provide fire extinguishers (ABC class, dry and liquid) in all labs and storage rooms. Provide fire blanket at exit door from each lab and fire cover storage cabinets if advised by FP&C.

7 Provide on each floor, or within each fire zone of each floor, first-aid supply cabinets and emergency equipment carts if advised by FP&C.

8 Provide gas cylinder brackets, retainers, holders, stands, and manifold distribution systems for locations identified by FP&C.

9 Provide battery-powered, trickle-charged emergency stair and corridor lighting units in addition to lighting that may be on the emergency power generator system.

10 Label all pipes, conduits, ducts, etc., with industry standard graphics to identify the contents and direction of flow.

11 Provide access panels, cleanout panels, or inspection panels that contain a small view port to permit a visual check before opening.

12 Consult with UH Department of Environmental Health and Risk Management (EHLS) regarding appropriate signage and provisions for hazardous waste.

13 Provide storage space for chemical spill response containment materials and cleanup requirements, including tools, utensils, and spill-response materials and equipment carts.

14 Consult with EHLS regarding requirements for gas mask storage cabinets in laboratory work areas that may generate organic vapors, dusts, fumes, smoke, and mists from chlorine, acid gases, hydrogen cyanide, ethylene oxide, ammonia, etc. EHLS will advise the design consultant on appropriate required storage and locations.

15 Consult with EHLS regarding requirements for protective suits and clothing, coveralls, foot and head gear, boots, hard hats, gloves, soiled protective gear, and contaminated protective gear. EHLS will advise the design consultant on appropriate required storage and locations.

16 Vented Storage Cabinets.

a. Vented safety storage cabinets for acids and corrosives can be in the base cabinet for the fume hoods in laboratory work areas. Vents for the cabinets may be into the fume hood or into the exhaust duct directly.

b. Solvents and flammable liquids should be stored in vented and fire-rated cabinets (but not in hood base cabinets) and vented directly into exhaust ducts.

c. Hazardous waste storage cabinets, drums, and other containers, and safety containers for storage and disposal of reagents and hazardous waste must be vented into the exhaust duct directly.

d. Large volumes of flammables may be stored outdoors in approved storage units if protected and secured.

e. No more than three cabinets may be located in a single fire area. NFPA 30, Section 4-3-1. No more than 60 gal may be class I and class II liquids, nor more than 120 gal of Class III liquids be stored in a storage cabinet.

f. Metal safety cabinet will comply with: OSHA 29 CFR 1910.106(d)(3) and NFPA 30, Chapter 4, Sections 4-3.2 and 4-3.2.1. The Uniform Fire Code 79.202 requires the same as OSHA 29 CFR 1910.106 and NFPA 30.

g. Bench cabinets are available to store small amounts of flammables and corrosives under the laboratory work bench. Mobile safety cabinets are also available in compliance with OSHA 29 CFR 1910.106 and NFPA 30 regulations.

h. Type I and Type II safety cans must comply with Department of Transportation (DOT) 19L and Un 1A1/Y/100/92 requirements for storage and use of hazardous and flammable liquids in the laboratory.

Liquid Flammables and Combustibles Classifications

Class	Flash Point (°F)		Boiling Point (°F)
Flammables	IA	<73	< 100
IB	<73		> 100
IC		>73 and < 100	
Combustibles	II		> 100 and < 140
IIIA		> 140 and < 200	
IIIB		> 200	

Maximum Storage Quantities for Cabinets

Liquid Classification	Maximum Storage Capacity (gal)
Flammable, class I	60
Combustible, class II	60
Combustible, class III	120
Combination of classes	120[a]

D Physical Security:

1 Partitions enclosing chemical storage rooms and hazardous areas will run to structure and be sealed at top and bottom. Fire-rating of construction will be adequate to protect for the hazard per code or as directed by FP&C. Large chemical storage rooms inside the building will be reinforced CMU.

2 All doors in chemical storage rooms, preparation rooms and hazardous areas will be self-closing and locking with door position switches.

3 Research Labs will be locked. FP&C will advise the requirements.

4 Teaching Labs will be locked. FP&C will advise the requirements.

E Operation and Maintenance:

1 All labs will be individually circuited, valved, and isolated so that cutting off services to one lab will not affect operations in other labs.

2 All chases which contain vent stacks will be physically accessible with adequate room so inspectors may enter the chase and visually inspect from all sides.

ELEMENT A

SUBSTRUCTURE

There is no special information in ELEMENT A. Refer to SECTION 12.0.

ELEMENT B

STRUCTURE

There is no special information in ELEMENT B. Refer to SECTION 12.0.

ELEMENT C

INTERIORS

C10 INTERIOR CONSTRUCTION

C1000 GENERAL. Refer to SECTION 12.0.

C1010 PARTITIONS

Use any of the following types of partitions:

1 Gyp board with semi gloss paint.

2 Provide partitions to structure between each lab.

3 Reinforced CMU partitions around hazard or chemical storage rooms.

4 CMU with block filler and epoxy paint at green house or animal holding rooms

C1020 INTERIOR DOORS

1 Provide 4’-0” double opening (1’-0” and 3’-0” doors) at all lab entries.

2 Provide a minimum 6 inch by 18 inch vision panel in all doors other than offices and restrooms.

3 All doors to labs and hazardous areas will be self-closing and self-locking.

4 Galvanize all metal doors and frames.

5 All doors serving labs will be plastic laminate.

C1025 INTERIOR DOOR HARDWARE. Refer To SECTION 12.0.

C3010 WALL FINISHES

1 Flooring:

a. Teaching labs floors will be VCT.

b. Research Lab floors for Chemistry, Physics, and Engineering will be VCT.

c. Research lab floors for biology will be seamless flooring.

d. Greenhouse and animal holding floors will be seamless epoxy resin floors

e. Consider sealed concrete for alternate lab and storage area flooring.

2 Walls will be any of the following:

a. Use semi-gloss paint for labs, store rooms, and offices

b. Use epoxy paint for greenhouses and animal holding and biological rooms

c. Consider epoxy paint for other special use labs

3 Ceilings will be one of the following:

a. Use 2x2 vinyl-coated acoustical tile.

b. Use suspended green board drywall ceiling in greenhouse and animal holding areas.

4 Casework:

a. Use wood construction, oak veneer, light finish

b. Use white tops, material appropriate to chemical resistance required by activities

ELEMENT D
SERVICES

D1000 GENERAL

1 Oversize the mechanical rooms, spaces and chases to accommodate initial level of service and allow for future growth and additions.

2 Insure flexibility in the design of building systems and the space allowed for installation and maintenance to permit ease of changing functions, activities, equipment and regulations.

3 Flexibility depends upon the capacity of building systems while changeability depends on the organization and location of the system elements. Optimize the design of systems for optimal balance between these to obtain approval from FP&C.

D20 PLUMBING

D2000 GENERAL

1 Organize piped services in overhead lanes or chases for uniformity of service and ease of access and provide taps and valves located for potential drops to benches and hoods.

2 Consult with EHLS regarding acid waste piping from designated sinks diverted to a neutralizing basin or holding tank for dilution, pH adjustment, and disposal. FP&C will advise on glass vs. plastic piping systems.

3 Consult with EHLS regarding diverting biohazard liquid waste to holding and processing tanks before being released in the sanitary sewer systems or removed for alternative disposal process. A two-tank system may have to be installed (one to process waste and one to hold waste awaiting processing or removal).

4 Consult with EHLS regarding providing carbon dioxide, nitrogen, oxygen, helium, or other special or mixed gases piping systems including manifolds, valves, and regulators and pressure sensors if required by FP&C. Gases may be supplied to individual workstations from portable gas cylinders mounted/restrained in the laboratory work areas, or from central gas cylinder rooms or a service corridor. Design the manifold and distribution system with the lab programmer.

5 Provide lab quality, oil-free central compressed air supplied at pressures between 40 to 150 psi as defined by FP&C with pressure regulators, filters, dryers, as may be required. Confirm with FP&C if a secondary system of lesser quality air may be required in addition.

6 Provide central natural gas system. Sleeve per code any pipe enclosed in unventilated spaces such as walls, chases, or ceilings. Pipe run in return air plenums may be unsleeved.

7 Breathing-quality air may be required at selected locations throughout the laboratory work areas for safety and emergency rescue protocols. Comply with any codes or as directed by FP&C and coordinate with the fire department's rescue practices.

8 If desired by FP&C, provide a central vacuum system operating at 18" to 22" (ordinary) to 28.5" (high) of mercury. Locate fixtures as directed by FP&C, but initial planning should anticipate outlets at each hood and one per bench face. Vacuum to be filtered when installed in high-hazard laboratories.

9 If cup sinks are preferred on benches (generally allows more unimpeded surface for equipment), locate one per 8-10 feet of countertop. Provide single rigid or vacuum-breaker gooseneck faucet for cold water with straight serrated hose connector.

10 Where drain troughs are preferred (perhaps in teaching labs), provide troughs min. 6" wide x 4" sloping to 8" deep (function of length) and composed of acid-resistant composite material.

11 Provide an emergency deluge shower head and eye wash in all laboratory areas with chemical fume hoods. Locate near the primary exit.

12 Provide hot (120 to 140 deg. F) and cold water at each laboratory utility sink with a mixing type rigid or vacuum-breaker gooseneck faucet with straight serrated hose connector. Faucets actuated by arm handles, wrist blades, knee action, or foot controls or automatic devices.

13 Confirm requirements for distilled or de-ionized water at the utility sink(s), in fume hoods, in preparation areas, etc., and use special plastic fixtures and piping to meet purity requirements.

14 Provide at a minimum one single-tub utility sink of acid-resistant composite materials per laboratory module.

D3040 HEATING VENTILATING & AIR CONDITIONING

1 In general, all laboratory work areas will be maintained at negative pressure relative to corridors and adjacent spaces. Special laboratory environments may require an equal or positive-pressure environment.

2 Provide individual thermostat controls for all laboratory work areas.

3 Maintain a minimum of 6 air changes per hour for all laboratory work areas, but confirm with FP&C any higher levels that may be required by specific environments. See also ***Section 12.0 A.01 Laboratory Design Guide, 1.1.C.8.***

4 Confirm with FP&C any requirements for air filtration in specific laboratory areas that exceed capabilities of normal "dust only" filters in air handling units.

5 Design the HVAC system to permit supplemental cooling by fan coil units in laboratory modules that contain special equipment, develop high heat loads, etc.

6 All laboratory work areas, service and support spaces, and animal facilities will be served with 100% outside air supply and 100% exhaust.

7 Location of fresh air intakes relative to the exhaust stacks is a critical item. Consider air flow and turbulence studies to verify intake locations and exhaust diffusion effectiveness. Consider other sources of air contamination such as truck exhausts at loading docks, downwind of exhaust streams from nearby facilities (e.g., labs and kitchens).

D40 FIRE SUPPRESSION SYSTEMS

D4000 GENERAL

1 Provide wet-pipe fire sprinkler systems throughout the entire building.

2 Work with the UH Department of Public Safety, EHLS and users to identify locations for life safety and emergency systems, fire and smoke containment, spill containment, eyewash and showers, supplemental breathing apparatus, etc.

D50 ELECTRICAL

D5000 GENERAL

1 Provide clean “normal” power and emergency power sources for each lab and equipment area. Consider with FP&C whether to provide a central UPS or provisions for local systems in each lab and equipment area versus installing local devices on each piece of equipment.

2 Consider combination direct and indirect pendant fluorescent light fixtures to provide 70 to 100 fc (based on activity) at standing work counter height (36”) supplemented with task lighting. Verify actual lighting requirements in each lab with users.

3 As a beginning point, assume connected load design capacity between 60 and 100 VA/nsf in laboratory work areas only. Service levels may be considerably higher (several hundred VA/nsf) in electronics and production laboratory work areas. Equivalent of 50 W/nsf minimum in laboratory work areas only.

4 Provide in each laboratory work area an accessible electrical panel to distribute electrical power. Locate panel either in the corridor by each door or just inside the door. Also, consider emergency cut off switches (red “mushroom” buttons) at the exit doors from each lab. Standard electrical service should be a bus duct system, 120v/208v panel-board, single and three phase, four-wire, 60-hertz current, with 25-35% excess capacity minimum.

5 Provide explosion-proof light fixtures, switches, and receptacles in laboratories and fume hoods using highly reactive, volatile, or explosive substances. Confirm locations, quantities, and types with FP&C.

6 Provide a bus grounding bar connected to a special building ground grid system in each laboratory module for instruments and equipment requiring an absolute ground. Provide testing reports for each lab.

7 For initial planning, assume a minimum of one emergency electrical power outlet on each side of the laboratory work area module line or partition centerline, 1200 to 1500 W capacity.

8 Provide smoke and flame detectors in each laboratory work area and in service and support areas. Confirm with FP&C the need for special sensors for hazardous materials.

9 Anticipate one 208-V single-phase three-wire polarized grounded outlet per bench face and at each hood.

10 Anticipate at a minimum one 120-V three-wire polarized grounding duplex outlet per 3 feet of counter. Confirm with UH the need for all outlets to be GFCI, but at a minimum provide these in the vicinity of any sinks or equipment using liquids.

D5030 TELECOMMUNICATIONS

1 See other sections for telecommunications wiring and outlet requirements. But at a minimum anticipate one data network connection per bench face and a voice/data outlet at each researcher workstation.

ELEMENT E
EQUIPMENT AND FURNISHINGS

E10 FUME HOODS

E1000 GENERAL

1 Locate fume hoods away from circulation without dead end configurations.

2 All Laboratory hoods shall meet the requirements of the National Fire Codes, NFPA 45, Fire Protection for Laboratories Using Chemicals. Hoods handling radioactive material shall also meet the requirements of NFPA 801, Recommended Fire Protection Practice for Facilities Handling Radioactive Materials.

3 Hoods shall be variable volume and an integral part of the HVAC system design.

4 Hood lighting should be vapor or explosion proof; light bulbs will be changeable from outside of the hood.

5 Hood liner materials should be matched to the anticipated substances and procedures.

6 Airflow distribution within a hood is better attained with adjustable type slots. Movable panels or baffle plates are not recommended.

7 The working surface of a hood should include a raised front lip for spill control.

8 Perchloric acid hoods require a “wash down” feature in which water spray is used to remove acid crystals from the exhaust fan, ductwork, and hood plenum after each use.

9 Consult with EHLS regarding radioisotope hoods installations. These air stream systems require special construction to permit easy cleaning. Filtration requirements of the exhaust air and fume hood construction shall be determined on a case by case basis in consultation with FP&C.

10 Biological safety cabinets (BSC's) shall meet NIH 03-112C Performance Specifications and shall be in accordance with National Sanitation Foundation Standard NSF49 and be listed by N.S.F. For application guidelines and filtration requirements use HHS Publication No. (CDC) 93-8395 "Biosafety in Microbiological and Biomedical Laboratories". Unit shall be of coated steel or stainless steel construction; interior shall be stainless steel with coved corners. All seams and welds to be ground smooth and polished. Sliding view window shall be ¼" safety or tempered glass. Supply and exhaust HEPA filters shall be front loading and shall be 99.99% efficient for 0.3 micron sized particles. Unit shall be listed by UL or CSA for electrical services to be provided per the end user. Unit shall include fluorescent light and an ultraviolet (germicidal) light. Certification of unit after installation is required and must be performed by an approved certification company.

11 Hood sash will have a positive stop at approximately 60% open and required exhaust air volume and velocity shall be determined at this position. Provide an alarm and/or flashing red light to be activated whenever this stop is bypassed.

12 Average face velocity for all hoods with sash 60% open will be 100 fpm and minimum at any point 80 fpm (standard specifications allow a 20% variance at any one spot as along as no eddying or backflow occurs).

13 Exhausts from fume hoods may be designed with either an independent duct system for each hood or a manifold system. Consider a variable volume manifolded system where mixing of the exhaust is not a problem. *[See Section 12.0 Addendum A.01 for additional ducting restrictions]*

14 A high transport velocity (1500-2000 feet per minute) is needed so that dust and aerosol-size materials are not deposited in the joints, cracks, or corners in the duct system.

15 Exhaust ducts will be constructed of Type 316L Stainless Steel with all-welded or mechanically fastened joints sealed with mineral impregnated woven fiber tape which is further impregnated with an activator/adhesive of the polyvinyl acetate type such as manufactured by Hardcast, Inc. or equal. Ducts shall be routed vertically with minimum number of returns. All hood exhaust outlets shall be flanged and furnished with a companion flange for welding to the exhaust duct.

16 The exhaust fan assembly shall be located on the roof. The fan will be belt-driven with exhaust directed vertically at a velocity sufficient to clear the building and all other obstructions (min. 2500ft. per minute exit velocity). The open end shall be a minimum of 10'-0" above roof or walking surface or more as directed by local codes or UH. Exhaust fan shall consist of monel wheel and cast iron housing, coated with three coats of air dried "Herzite." Motor shall be outside of the air stream in a galvanized enclosure.

17 Hood exhaust system design must provide for 10% minimum flow through exhaust duct when hood is not in service. The hood exhaust may be used as part or all of the required exhaust from the laboratory room.

18 Avoid pressurized exhaust ducts. Fans blowing into the duct system will not be permitted.

E11 FUME HOOD TESTING

E1100 GENERAL

1 All fume hoods must be tested per requirements of ASHRAE Standard 110-1995. Each hood will be tested at the factory before acceptance for shipping and also after installation before acceptance of the laboratory.

2 Tests at the factory will be conducted by the manufacturer's quality control staff, with complete documentation supplied to FP&C and the design consultant. At a minimum, a selected group of hoods representing each of the types of hoods in the project will be observed in testing at the factory by a representative of FP&C, the design consultant, and the contractor. More observers may be included at the discretion of FP&C and the project team.

3 Each hood will be tested after installation and after the HVAC systems have been balanced. These tests will be conducted by an independent testing agency that is experienced in fume hood performance testing. It is recommended that representatives of FP&C, the design consultant, contractor, mechanical engineer, and manufacturer will observe the tests.

4 Factory testing will include all three component tests described in the ASHRAE standard, including the tracer gas method. Field testing in the laboratory need not include the tracer gas test unless required by FP&C for special hazard conditions.

5 The following is an abbreviated version of ASHRAE 110-1995 provided by Fisher Hamilton, a major manufacturer of fume hoods, as part of its standard specifications. Other manufacturers supply similar standards and all should subscribe to the ASHRAE 100-1995. This document is included as a guideline but the full ASHRAE 110-1995 should govern all tests.

E1110 SOURCE QUALITY CONTROL TESTING OF FUME HOODS

1 Evaluation of manufacturer's standard product shall take place in manufacturer's own test facility, with testing personnel, samples, apparatus, instruments, and test materials supplied by the manufacturer at no cost to the University.

2 Submit test report consisting of the following test parameters and equipment for each hood width and configuration specified.

3 Hood shall achieve a rating of 4.0 AM 0.1 P.P.M. or better. Tested to ASHRAE-110-R.

4 front of fume hood. Provide make-up air to replace room air exhausted through fume hood and to obtain a negative 0.2" w.g. room pressure. Introduce make-up air in a manner that minimizes drafts in front of hood to less than 20% of the face velocity. Connect 100 feet per minute air velocity through face of fume hood. Adjustment in blower shall vary face velocity down to 75 feet per minute.

   a. Examine facility to verify conformance to the requirements of this Section.

   b. Test room shall be isolated from all personnel during test procedure.

5 Provide the following for testing of auxiliary air fume hoods:

a. Control room temperature and maintain quantity of auxiliary air sufficient to meet the manufacturer's stated ratio of auxiliary air to exhaust air.

6 Provide the following for testing of Vectrol fume hoods:

a. Maintain temperature of auxiliary air 10 degrees F. above room temperature.

7 Testing equipment:

a. Properly calibrated hot wire thermal anemometer probes equal to Sierra Model 600-02; correlate with computer data acquisition format to provide simultaneous readings at all points.

b. Pitot tube and inclined manometer with graduations no greater than 0.2 inch of water, equal to F.W. Dwyer Model 400. Calibration curves based on 20. Pitot traverse readings and correlated to a digital readout indicator to provide quick and accurate adjustment of air flows.

c. Tracer gas: Sulfur hexa-fluoride supplied from a cylinder at a test flow rate of four liters per minute.

d. Ejector system: Tracer gas ejector equal to IHE No. 525-014. Submit sufficient proof of ejector system calibration.

e. Critical orifice: Sized to provide tracer gas at four liters per minute at an upstream pressure of 30 PSIG.

f. Detection instruments: Ion Track Model 61 Leak Meter II sulfur hexafluoride detector instrument.

g. Recorder with an accuracy better than plus or minus 0.5% of full scale.

h. Three dimensional manikin, overall height 67", clothed in a smock.

i. Titanium tetrachloride glass modules. CAUTION: Titanium tetrachloride is corrosive and irritating; skin contact or inhalation shall be avoided.

j. One dozen 30-second smoke bombs.

8 Preliminary Test and Data:

a. Provide sketch of room indicating room layout, location of significant equipment, including test hood and other hoods. Provide sketch of air supply system indicating type of supply fixtures.

b. Reverse air flows and dead space:

i. Swab strip of titanium tetrachloride along both walls and floor of hood in a line 6" behind and parallel to the hood face, and along the top of the face opening. Swab an 8" diameter circle on the back of the hood. All smoke should be carried to the back of the hood and exhausted.

ii. Test the operation of the bottom air bypass air foil by running the cotton swab under the air foil.

iii. If visible fumes flow out of the front of the hood, the hood fails the test and receives no rating.

c. Face velocity measurements: Face velocity shall be determined by averaging minimum of four and maximum of eight readings at the hood face. Take readings at center of a grid made up of sections of equal area across the top half of the face and sections of equal area across the bottom half of the face. Take simultaneous readings at each point with a series of calibrated hot wire anemometers over a one minute period of time. Probes shall be correlated to a computer data acquisition package, which will provide an average of each reading over that one minute period and also an overall average. During the one minute monitoring period, all velocities must automatically update average at a maximum of four second intervals.

9 Test Procedure:

a. Check sash operation by moving sash through its full travel. Verify that sash operation is smooth and easy, and that vertical rising sash shall hold at any height without creeping up or down. Position sash in the full open position.

b. Measure exhaust air flow with the baffles' position to give maximum air flow. Measure exhaust air volume with baffles' position to give minimum air flow. Verify that the air volume at minimum air flow is not less than 95% of the exhaust air volume at maximum air flow. Hoods exceeding this fail the test and receive no rating.

c. Take a static pressure reading, using methods assuring an accurate reading, in an area of the ductwork no more than three feet nor less than one foot above the exhaust collar. Static pressure loss shall not exceed values given under Design Requirements in Part 1 of this Section.

d. Install ejector in test positions. For a typical bench-type hood, three positions are required: left, center and right as seen looking into the hood. In the left position the ejector center line is 12" from the left inside wall of the hood; center position is equal distance from the inside sidewalls; and the right position is 12" from the right inside wall. The ejector body is 6" in from the hood face in all positions. Location of ejector may require modification for hoods of unusual dimensions.

e. Install manikin positioned in front of the hood, centered on the ejector.

f. Fix detector probe in the region of the nose and mouth of the manikin. Take care that method of attachment of the probe does not interfere with the flow patterns around the manikin. Locate nose of manikin 9" in front of ejector (3" in front of sash).

g. Open tracer gas block valve. Correlate readings with a computer data acquisition package, which is capable of monitoring and visually recording a minimum of one reading per second for a minimal three minute time period at each of the three positions.

h. The control level rating of the hood shall be the maximum of the three average values for the three test positions.

i. Record performance rating of the fume hood as XXAMyyy, where XX equals the release rate in liters per minute (4.0) and AM represents the as manufactured test sequence and yyy equals the control level in parts per million.

j. All data on the above test conditions including instrumentation and equipment, test conditions, preliminary test and data information shall be provided on a one page report, including a printout of the average face velocities, and a separate graph-type performance curve on all three tracer gas positions.

10 Constant Volume/Bypass and VAV/Conventional Fume Hoods:

a. Conduct test as outlined above with the sash open.

b. Ignite a smoke bomb within the fume hood work area to verify that the fumes are quickly and efficiently carried away. Move the lighted bomb about the fume hood work area, checking near fume hood ends and work surface to verify that there is no reverse flow of air at these locations.

11 Air flow in fume hoods with auxiliary air:

a. When the specified velocity has been determined, the volume of exhaust air should be verified by multiplying the average face velocity by the square foot area of the fume hood opening. The volume of exhaust air may be determined by other recognized procedures. In accordance with industry standards, the auxiliary air blower shall be turned off during face velocity grid readings.

b. Following grid readings, turn on the auxiliary air blower, adjust to give the proper quantity of auxiliary air, and continue with other steps outlined in Test Procedures above. The quantity of auxiliary air should be determined by the use of a 20 point Pitot tube traverse of the duct and be correlated to an indicator to provide easy adjustment for varying volumes. The quantity of auxiliary air may be determined by other recognized procedures. The temperature of the auxiliary air shall be adjusted to 10 degrees F. above the room temperature.

c. When the proper air volumes and temperatures have been obtained and with the sash in the full open position except as indicated, conduct the following tests:

   i. Ignite a smoke bomb within the fume hood work area to verify that the fumes are quickly and efficiently carried away. Move the lighted bomb about the fume hood work area, checking near fume hood ends and work surface to verify that there is no reverse flow of air at these locations.

   ii. Discharge smoke bomb into the auxiliary air duct ahead the blower to insure that the smoke is thoroughly mixed with the auxiliary air. Observe the flow of air down and into the fume hood face to verify that capture efficiency is 95% minimum.

d. With the sash in a closed position, discharge a smoke bomb in auxiliary air duct and verify that all smoke and air is captured and drawn through the fume hood work area.

E1120 FIELD QUALITY CONTROL TESTING OF FUME HOODS

1 Field testing requirements:

a. Perform tests in field to verify proper operation of the fume hoods before they are put in use, using only qualified personnel.

b. Perform tests after installation is complete, the building ventilation system has been balanced, all connections have been made, and written verification has been submitted that the above conditions have been met.

c. Verify that the building make-up air system is in operation, the doors and windows are in normal operating position, and that all other hoods and exhaust devices are operating at designed conditions.

d. Correct any unsafe conditions disclosed by these tests before request of test procedures.

2 Testing equipment:

a. Properly calibrated hot wire thermal anemometer equal to Alnor Model No. 8500D-1 Compuflow.

b. Supply of 30-second smoke bombs.

c. Supply of titanium tetrachloride.

3 Test procedure - SEFA LF-1-1991:

a. Check room conditions in front of fume hood using a thermal anemometer and a smoke source to verify that the velocity of cross drafts does not exceed 20% of the specified average fume hood face velocity. Eliminate any cross drafts that exceed these values before proceeding.

i. CAUTION: Titanium tetrachloride fumes are toxic and corrosive. Use sparingly; avoid inhalation and exposure to body, clothing and equipment that might be affected by corrosive fumes.

ii. NOTE: No fume hood can operate properly if excessive cross drafts are present.

b. Perform the following test to verify conformance of actual fume hood face velocities to those specified. Turn on the exhaust blower with the sash in full open position. Determine the face velocity by averaging the velocity of six readings taken at the fume hood face: at the centers of a grid made up of three sections of equal area across the top half of the fume hood face and three sections of equal area across the bottom half of the fume hood face.

i. If not in accordance with specifications, refer to manufacturer's Troubleshooting Guide for aid in determining cause of variation in air flow.

ii. Check sash operation by moving sash through its full travel. Verify that sash operation is smooth and easy, and that vertical rising sash shall hold at any height without creeping up or down.

4 Field testing of air flow in fume hoods without auxiliary air:

a. Turn fume hood exhaust blower on. With sash in the open position check air flow into the fume hood using a cotton swab dipped in titanium tetrachloride or other smoke source. Verify that air flow is into the fume hood over the entire face area by a complete traverse of the fume hood 6" inside the face. Reverse flow is evidence of unsafe conditions. Take necessary corrective actions and retest.

b. Move a lighted smoke bomb throughout the fume hood work area directing smoke across the work surface and against the side walls and baffle. Verify that smoke is contained within the fume hood and rapidly exhausted.

5 Field testing of air flow in fume hoods with auxiliary air:

a. Calculate exhaust volume from face velocity data as determined above. Determine face velocity and exhaust volume with the auxiliary air blower off, in accordance with SEFA LF-1.

b. With sash in the open position check air flow into the fume hood using a cotton swab dipped in titanium tetrachloride or other smoke source. Verify that air flow is into the fume hood over the entire face area by a complete traverse of the fume hood 6" inside the face. Reverse flow is evidence of unsafe conditions. Take necessary corrective actions and retest.

c. Ignite smoke bomb at the source of auxiliary air and observe the flow of smoke/air down the face and into the hood. Close sash and observe flow patterns. Verify that operation is safe and proper.

d. Move a lighted smoke bomb throughout the fume hood work area directing smoke across the work surface and against the side walls and baffle. Verify that smoke is contained within the fume hood and rapidly exhausted.

ELEMENT F

SPECIAL CONSTRUCTION AND DEMOLITION

There is no special information in ELEMENT F. Refer to SECTION 12.0.

ELEMENT G

BUILDING SITEWORK

There is no special information in ELEMENT G. Refer to SECTION 12.0.