

**DIVISION 11 - EQUIPMENT**

Includes the following sections:

- 11 53 13 Laboratory Fume Hoods
- 11 53 53 Biosafety Cabinets (BSCs)

**DESIGN CRITERIA**

Lab Design shall comply with the UC Lab Safety Design Manual located at:

<http://lsdm.ucop.edu/>.

**LABORATORY FUME HOODS****11 53 00****GENERAL FUME HOOD REQUIREMENTS**

1. Quality Assurance - Published specifications, standards, tests or recommended methods of trade, industry or governmental organizations apply to work in this section.
  - a. NFPA 45 - Standard on fire protection for laboratories using chemicals. Chapter 6: Ventilating System, Chapter 9-2.8: Laboratory Hoods.
  - b. NFPA 56C - Safety standard for laboratories in health-related institutions, Chapter 3-3.5: Fume hoods.
  - c. ASHRAE 110, Method for Testing Performance of Laboratory Fume Hoods.
2. Requirements of Regulatory Agencies
  - a. Prior approval from University of California Santa Cruz Environmental Health & Safety (UCSC EH&S) for any substitution is required.
  - b. Flammable liquid storage cabinets shall conform to NFPA 30.
3. Fume Hood Design Standards
  - a. Scientific Equipment and Furniture Association (SEFA) SEFA 1, latest edition.
  - b. ASHRAE Handbook - HVAC Applications: Chapter 16 - Laboratories: Part 16.3: Fume Hoods - American Society of Heating, Refrigerating, and Air Conditioning Engineers.
  - c. ANSI Z 9.5 Laboratory Ventilation Standard
  - d. National Sanitation Foundation (NSF) Standard 49
  - e. Guidelines for Design and Construction of Health Care Facilities - Facility Guidelines Institute; Part 6 Ventilation of Health Care Facilities - Sections 410: Laboratory Ventilating Systems and Hoods.
4. Submittals
  - a. Only those fume hoods on the University's approved list may be used (see item General Product Requirements below). Fume hood submittals shall be reviewed and approved by UCSC EH&S.
  - b. Fume hoods not on the University's approved list may be added to the approved list only after UCSC EH&S review and approval of manufacturer's specifications.
  - c. Manufacturer's product literature and data sheets, including ASHRAE 110 test results. As-manufactured, under the ASHRAE 110 test method, fume hoods shall meet 4.0AM0.01 (4.0 liters/minute release rate of tracer gas, as-manufactured, less than 0.01 ppm of tracer gas detected by the mannequin) criteria.

- d. Plastic laminate for color selection.
  - e. Submit specifications for size of fume hood, showing dimensions, required clearances, and finishes; and where necessary, size (especially height above floor), and capacity and location of all mechanical and electrical services required.
  - f. Certificates: Certify compliance with UCSCFPB requirements for under hood flammable liquid storage cabinets.
5. Testing (refer to Division 23 09 10 for additional testing details).
- a. Balance, test, and certify each fume hood in accordance with the latest edition of ASHRAE 110 Testing Requirements. Fume hood field tests shall be performed by a qualified independent testing company on each hood to determine face velocity, containment, response time (for hoods installed on a VAV lab airflow control system), cross drafts, and air flow patterns.
  - b. Fume hood face velocity to be maintained at between 100-120 fpm at all times during normal operation.
  - c. As installed, under the ASHRAE 110 test method, fume hoods shall meet the testing criteria 4.0A10.05 as specified in the Industrial Ventilation Handbook (4.0 liters/minute release rate of tracer gas, as-installed, less than 0.05 ppm of tracer gas detected by the mannequin).
  - d. There shall be no visible smoke flow out of the fume hood during the flow visualization test.
  - e. Response time shall be less than 10 seconds for face velocity re-stabilization for VAV installations.
  - f. Cross drafts measured at the fume hood face in the horizontal and vertical direction should be less than 20% of the face velocity. This is not pass/fail criteria but is used to diagnose potential problems in lab airflow control systems.
  - g. Balance, test, and certify each glove box in accordance with the latest edition of NSF 49 Testing Requirements. Glove box field tests shall be performed by a qualified independent testing company on each glove box to determine proper containment. Glove boxes to be maintained at a negative air pressure of at least 0.50 inches w.g.
  - h. Test results shall be submitted to the University's Representative to be reviewed and approved by UCSC EH&S.
6. General Design Issues
- a. Fume hoods are to be operated 24 hours a day. No user controlled shut-off switch is allowed.
  - b. Fume hood ducts may be ganged onto exhaust plenum w/ multiple fans, with the exception of hot-acid, radioactive, or other special use hood.
  - c. Except for specialized applications, limit hood width to 5' due to the very high energy costs associated with larger hoods.
  - d. For many existing buildings "constant volume, bypass type" fume hoods are required in order to be compatible with the existing building fume exhaust system.
  - e. For new buildings provide variable volume fume hoods.
  - f. Due to the costs involved, however, we normally only pipe the utilities which are required by the user. Commonly these are: DI Water (Lab Grade 3), Industrial Cold Water, Industrial Hot Water, Air, Vacuum, & Gas.
  - g. The hood may either be direct purchased or furnished as part of a remodel contract.

- Furnishing the hood as part of a remodel contract offers the following advantages; a.) Less coordination risk b.) Competitive bidding of the hood for a better price. Equivalent hoods by: Hamilton, Kewahnee, or St.Charles are all acceptable.
- h. Hood should be specified with optional electronic safety alarm with face velocity indicator. (Relative velocity LED read out OK in lieu of analog velocity gauge).
  - i. Hood electrical outlets, light, and switch configuration should be verified.
  - j. Air balancing should be included in the project scope. The system will need to be adjusted for proper air flow after the new hood is installed. For retrofit installations, sufficient fume exhaust / make-up air capacity to accommodate the selected hood should be verified by the consultants. This should be accomplished by making reasonable inferences from as-built drawings of the original building. The consultants should inform UCSC should they conclude that capacity is marginal. In such cases, air flow measurement may need to be taken prior to completing the design.
  - k. Air volume through the lab should be determined by the most critical of the following requirements; 1.) Hood air volume based on a velocity of 100 FPM with the vertical sash set at 18" open. 2.) 6 air changes / hour.
  - l. Full by-pass fume hoods shall be used for constant volume applications. Variable air volume (VAV) hoods (partial by-pass) shall be used in conjunction with a VAV general ventilation system (i.e., Phoenix Controls, or equal).
  - m. Ductless or auxiliary air hoods are not acceptable.
  - n. Provide removable baffles with three fixed horizontal slots or perforated baffles only. If slots are to be provided, they shall be continuous across the back of the fume hood. Engineered perforations are acceptable. Operator adjustable baffles and monolithic rear panels are not acceptable.
  - o. Provide the manufacturer's standard tissue screens to prevent tissues from entering mechanical systems.

## CHEMICAL FUME HOODS

1. General Product Requirements
  - a. All chemical fume hoods shall meet the Campus' review team's approval. The review team is composed of University's Representative, UCSC EH&S and University of California Santa Cruz Facilities Management (UCSC FM).
  - b. The following chemical fume hood manufacturers currently approved for campus are: ThermoFisher/Hamilton, Kewaunee, Jamestown, Mott Manufacturing, LabConco and H.H. Hawkins Ltd, or equal, no known equal. Manufacturer's specifications for specific model types shall be submitted to University's Representative for approval.
  - c. Shall have been in commercial production and usage for a minimum of 5 years.
  - d. Shall be tested using most current American National Standards Institute (ANSI)/ASHRAE 110 method.
  - e. Noise generated by the functioning hood within 6 inches of the plane of the sash and by-pass opening in any position shall not exceed 60 dBA.
2. Fume Hood Materials
  - a. Fume hood shall be constructed of materials compatible with intended usage.
    1. Chemical fume hoods shall be constructed of type 316 stainless steel, polyresin, etc. Confirm with the University's Representative.

2. Work Surface: The work surface shall have a raised lip on all 4 sides, and be constructed of materials to meet usage. Union between work surface and counter shall be covered at a 3/4-inch radius and watertight.
  3. Cup Sink: Flush with work surface and conforming to usage requirements, complete with stainless steel tailpiece.
  - b. Air Foil that provides an air sweep across the work surface with the sash in the fully lowered position. Provide air foils installed over the work surface edge, allowing for air flow under the air foil.
  - c. Interior end panels require an access panel with gas tight gasket.
  - d. Exterior Construction
    1. Chemical resistant finish.
    2. End panels fastened to frame with screws.
    3. Unused holes (interior and exterior) shall be plugged or blanked.
3. Fabrication
- a. Shop fabricate and assemble complete units insofar as dimensions permit shipment and installations.
  - b. Fume hood Assembly
    1. Assemble hood with continuous welding of all metal-to-metal joints.
    2. Grind joints round so that all surfaces are smooth (3/4 inch radius), or glass fiber reinforced fire retardant polyester resin one-piece molded hood chamber completely seamless and crevice free. Basin shall be an integral part of the chamber.
4. Sash
- a. Vertical type: 1/4-inch thick laminated safety glass complete with 1/4 inch deep stainless steel metal channels on sides, top and bottom; or frameless.
  - b. Combination sashes shall be approved by UCSC EH&S.
  - c. Mechanical stops (not friction) to ensure that sash work opening is 18 inches, as measured from the top of the fume hood work surface to the bottom of the sash.
  - d. A manual override to allow the vertical sash to be raised above the maximum opening to allow lab apparatus to be installed or removed.
  - e. Operating face velocity at 18 inches shall be set between 100-120 fpm.
5. Fume hood Air Flow Indicator/Alarm: Provide an airflow alarm. The hood shall be prepared at the factory to receive the specified alarm/monitor. As a minimum, the alarm shall accommodate the following:
- a. The Safety Monitor/Alarm System shall monitor face velocity and provide audible and visual alarm if face velocity is less than 80 percent or more than 120 percent of the required airflow. Audible alarm shall pulse at 80 dbA.
  - b. The monitor shall be UL listed, with all alarm circuit electric components, external tubing, restrictors and manifolds furnished complete. Monitor shall have light emitting diode display, which provides clear indication of airflow conditions. Safety monitor shall be tamperproof.
  - c. Alarm Signal: Audible pulsating signal and a visual, large flashing red light emitting diode.
    1. Silence push button, which temporarily overrides the audible alarm for a period no longer than 5 minutes, shall be accessible on the front of the

Safety Monitor. Note: Teaching laboratory hood alarm override shall not exceed a one-minute period. Once the “unsafe” operating condition has been corrected, the audio alarm shall automatically reset.

2. During temporary silence of audible alarm the visual alarm remains activated until the alarm condition is corrected.
  3. It shall not be possible to routinely disable the alarm signal. Locate electrical outlet on top of hood.
  4. When alarm condition is corrected and face velocity and volume is return to specified levels, the safety monitor shall automatically reset and begin routine monitoring.
- d. Test circuit shall be provided to verify proper safety monitor operation.
  - e. Electrical Rating: Maximum 15 VDC and maximum current rating of 200 MA.
  - f. Connect between fume hood and the filter or damper.
  - g. Flow tube device (floating indicators), magnehelic, or ribbons hanging in the air stream are not acceptable airflow indicators.
6. Electrical Items
- a. Pre-wire all items.
  - b. Receptacles per NEMA 5-15R: 15A-125V AC three-wire duplex polarized receptacles. Harvey Hubbel-Inc.’s No. 5252, Arrow-Hart, Leviton, or equal. Receptacles shall be GFI.
  - c. Plate Covers: Meet usage, Bell or equal.
  - d. Switch for lighting: Hubbel #1221 or equal.
  - e. Flexible Conduit: 1/2-inch complete with wiring.
  - f. Light Fixture: Heavy-duty, vapor-proof, fluorescent strip light with 430 Ma rapid- start lamps and 120-volt HPF ballasts. Provide three-foot length for four-foot hoods, and four-foot for six-foot hoods. Garco #RN 9942- 36H; Columbia Lighting, Inc.; Smoot-Holman Company; Benjamin Products of Thomas Industries, Inc.; or equal.
  - g. Shall be accessible for service from outside the hood.
  - h. No fan switch at the fume hood.
7. Utilities (gas, air, water, steam, and vacuum)
- a. Provide utilities required per specific use; consult the University’s Representative.
  - b. Utilities controls shall be located outside of hood interior for convenient access and use.
  - c. Run internal electric wiring in conduit. Do not run conduit through hood interior or across hood front.
  - d. When cold water is required, provide vacuum breaker.
  - e. Fixtures shall be Water Saver Faucet Company, Chicago Faucet, T & S, or equal. The following specifications refer to Water Saver Faucet Company to establish quality, utility, and appearances.
    1. Gas, air, water, steam, and vacuum fixtures shall be made up of remote control valves L-3185 (1/2 inch IPS inlet pipe thread, 3/8 inch NNPT outlet pipe threads) with guide bushing “B” with 4-arm handle and colored plastic index disc, for service specified.
    2. For gas, air, and vacuum, the remote control valve shall be connected to a Water Saver L-14 or equal serrated nozzle with 3/8 inch male threads, 10

- serrations, and of dimensions as shown on Drawings. Valve shall have stainless steel seat and stainless steel renewable floating cone unit.
3. For water, the remote control valve shall be connected to a Water Saver L171-WSA with vacuum breaker or equal serrated nozzle with a 1/2 inch pipe and elbow. Valves shall have "Water Saver: standardized renewable operating unit."
  4. Access panel to service utilities shall be gasketed with gasket material specific to use.
  5. Do not run plumbing through hood interior or across front of hood.
  6. Water faucet shall have vacuum breaker.
  7. Pre-plumb all utilities.
8. Duct Work:
    - a. Materials shall be non-reactive, acid resistant and compatible with intended usage.
    - b. Include trim damper in duct above fume hood, when required.
    - c. Outlet shall be round or a square-to-round transition shall be provided.
  9. Fan: Use only acid-resistant metallic fan protected by an inorganic coating. Refer to Division 23, Section 23 38 16 for fan requirements.
  10. Under fume hood storage cabinets: Flammable storage cabinets shall be UL listed and/or NFPA approved.
    - a. Flammable liquid storage cabinets do not require venting. If flammable liquid storage cabinets are vented, they shall be separate from the fume hood exhaust. The vent may be connected at the point where the fume hood exhaust duct enters the general fume hood exhaust manifold. Cabinets shall not be vented directly into the fume hood or through the fume hood work surface. Vents shall be stainless steel.
    - b. Acid storage cabinets are approved for under fume hood storage. Acid/corrosive storage cabinets do not require venting. If acid/corrosive storage cabinets are vented, they shall be separate from the fume hood exhaust. The vent may be connected at the point where the fume hood exhaust duct enters the general fume hood exhaust manifold. Cabinets shall not be vented directly into the fume hood, through the fume hood work surface. Vents shall be PVC, polypropylene, or other appropriate material.

## ACID FUME HOODS

1. Additional Product Requirements for Acid Fume hoods (Perchloric, other hot inorganic acid digestions, etc.).
  - a. Constant volume hood with by-pass feature.
  - b. Perchloric acid and other hot acid digestion hoods shall be on a dedicated system and have an automatic wash down system. High use solvent extraction and solvent use hoods (ether, other flammable solvents, etc.) shall be on a dedicated system designed for their intended purpose.
  - c. Under fume hood storage cabinets: Flammable liquid storage cabinets are not approved for installation under acid fume hoods.

2. Materials
  - a. Fume hood Construction
    1. Fume hood shall be constructed of PVC lined stainless steel; consult the University's Representative for substitutions.
    2. Wash Down System - shall thoroughly wash in sequence from the exhaust stack, fan, exhaust duct and behind fume hood baffles. Wash down shall not include the interior fume "cupboard."
  - b. Sash: No combination sash allowed.

#### HYDROFLUORIC (HF) ACID FUME HOOD

1. Additional Product Requirements for HF acid fume hoods
  - a. Constant volume hood with by-pass feature.
  - b. Hoods shall be on a dedicated system.
  - c. Flammable liquid storage cabinets are not approved for installation under HF acid fume hoods.
2. Materials
  - a. Fume hood Construction
    1. Fume hood shall be constructed of PVC lined stainless steel; consult the University's Representative for substitutions.
    2. Interior shall be non-metallic, non-fiberglass, non-glass.
  - b. Adjustable baffles are not acceptable.
3. Sash
  - a. Provide a polycarbonate resin (Lexan) or similar sash. Glass is not acceptable. Contact EH&S and University's Representative for more information.
  - b. No combination sash allowed.
4. Lens on light fixture shall be polycarbonate resin (Lexan).

#### OTHER SPECIALTY HOODS & LOCAL EXHAUST

1. Histology hoods, specimen hoods, and other local exhaust specialty hoods require a minimum operating face velocity of 100 fpm with a range of 100-120 fpm. An audible/visual flow alarm may be required depending on use.
2. Glove Boxes
  - a. Glove hood (box) may be required for special applications using highly toxic, extremely reactive or California Occupational Safety and Health Act (COSHA) regulated chemical carcinogens.
  - b. A totally enclosed, ventilated cabinet of leak-tight construction. Operations in the cabinet are conducted through attached rubber gloves. The cabinet is maintained under negative air pressure of at least 0.50 in. w.g. (120 Pa).
  - c. Glove boxes shall meet ANSI standard Z9.5, "Standard on Lab Ventilation" and the American Glove Box Society Standard, "Guidelines for Glove Boxes."

GENERAL:

1. All BSCs shall meet the specifications within the most recent edition of the National Sanitation Standard 49 – Class II (Laminar Flow) Biosafety Cabinetry.
2. The BSC make and model must be on the NSF website of certified BSCs.  
(<http://www.nsf.org/certified/biosafety/listings.asp>)
3. Do not provide any class/type of biosafety cabinet other than Class II Type A2 without prior authorization from the Biological Safety Officer. Consult the University's Representative.
4. Biosafety cabinets shall not be connected or reconnected to laboratory gas lines.