SECTION 11611
LABORATORY BIOLOGICAL SAFETY CABINETS

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Laboratory biological safety cabinets, support cabinets and related service fixtures.

B. Related Sections:

2. Division 12 - Furnishings: Laboratory casework and service fixtures.
3. Division 16 - Electrical.
4. Division 15 - Mechanical: Plumbing, vent connections, and special exhaust systems.
5. Appendix #11 - EH&S Design Guidelines for Chemical Use Areas
6. Appendix #12 - EH&S Design Guidelines For Laboratory Construction and Renovation Projects

1.2 SUBMITTALS:

A. Product Data:

1. Submit manufacturer's data and installation instructions for each type of biological safety cabinet.

B. Shop Drawings:

1. Submit shop drawings for safety cabinets showing plans, elevations, ends, cross-sections, service run spaces, location and type of service fixtures with lines thereto; layout of units with relation to surrounding walls, doors, windows, lighting and air-conditioning fixtures, and other building components; location of access doors, cut-off valves, junction boxes.

   a. Coordinate shop drawings with other work involved.

   b. Include roughing-in drawings for mechanical and electrical services.

C. Performance Tests:

1. Submit as manufactured quality control performance test reports, prepared by manufacturer's testing personnel following requirements of National Sanitation Foundation International/American National Standard International (NSF/ANSI) Standard No. 49 (latest edition) for each type and size of safety cabinet required.

D. Operation and Maintenance Instructions:
1. Submit 5 copies of written instructions for biological safety cabinets.

1.3 QUALITY ASSURANCE:

A. Single Source Responsibility:

1. Provide biological safety cabinets manufactured by a single manufacturer.

B. Source Quality Control:

1. Manufacturer must certify safety cabinet performance prior to shipment to prove compliance with contract requirements. Test safety cabinets, testing facility, necessary instrumentation, apparatus and equipment will be supplied by manufacturer at no cost to Owner.

2. Prior to shipment of any laboratory safety cabinets, test all sizes of each type of biological safety cabinet required for the project in the manufacturer's test room to verify conformance with performance requirements of the design, materials, and finishes in accordance with the following:


3. Failure to meet the performance specified shall be cause for rejection of the safety cabinets.


5. Location of Tests and Test Facility: Perform all tests referenced herein in the manufacturer's biological safety cabinet test facility.

6. The test facility shall meet the following requirements:

   a. Provide a test facility with sufficient area so that a minimum of 10' of clear space is available in front of and 5' on both sides of the hood for viewing tests.

   b. Provide facility's ventilation system with adequate heating and air conditioning so that room air temperatures can be maintained within the desired ranges.

   c. Room air currents in the test area shall be less than 20 fpm.

   d. Properly calibrate biological safety cabinet air systems so that the desired air volumes can be easily attained.

C. Instrumentation, Equipment and Test Personnel:

1. Qualified personnel to perform the tests shall be supplied by the manufacturer.

2. Instrumentation and equipment required shall be supplied by the manufacturer.
1.4 WARRANTY:

A. The manufacturer shall guarantee all materials and workmanship provided for a period or 1 year from date of Notice of Acceptance. Any defects due to the use of improper material or workmanship on the part of the manufacturer occurring within that time shall be promptly rectified, by repair or replacement of the defective materials or correction of defective workmanship by manufacturer at his own expense, after notification by the Owner.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Provide biological safety cabinets by one of the following:

1. NuAire, Inc.
3. Labconco

2.2 MATERIALS, DESIGN AND CONSTRUCTION:

A. Materials

1. Materials shall withstand normal wear, corrosive action of gases or liquids, cleaning compounds, and decontaminating agents and procedures. Materials shall be structurally sound, dimensionally stable, and fire and moisture resistant.

2. Interior work surfaces shall be smooth, 300-series stainless steel. Exposed interior surfaces shall be smooth and abrasion and corrosion resistant or shall be rendered corrosion resistant with nontoxic material that resists crazing, cracking, and chipping. Recirculated air diffuser materials shall be tested in accordance with UL Standard No. 94 (latest edition). Nonrigid diffuser materials shall conform to Class 94HBF; rigid diffuser materials shall conform to Class 94HB. Other interior and exterior surfaces shall be smooth and abrasion and corrosion resistant or shall be rendered corrosion resistant with nontoxic materials that resist crazing, cracking, and chipping.

3. Windows shall be optically clear and not adversely affected by accepted cleaning methods and decontaminating agents. Glazing materials shall be laminated glass, tempered glass, safety plastic, or equal. Edges shall be ground or provided with protective stripping. Safety plastic view screens shall be tested in accordance with UL Standard No. 94 (latest edition) and conform to Class 94HB. Windows shall be abrasion resistant and show no more than 5% change in haze when tested in accordance with 5.17, Test No. 17 of ANSI Standard 226.2 (latest edition).

4. Chemical and abrasion resistance shall be tested in accordance with and meet the requirements of NSF/ANSI Standard No. 49 (latest edition).

5. Plastics, welded seams, and deposited weld material shall meet the applicable requirements of NSF/ANSI Standard No. 49 (latest edition).
6. Gaskets and sealants shall be closed cell, durable, resistant to cleaning and disinfecting agents, and resistant to general use. They shall be made of materials that do not release halogens, are non-hardening, nontoxic, stable, odor free, not detrimentally absorbent, and are unaffected by exposure to gases, liquids, cleaning compounds, and decontamination agents listed in NSF/ANSI Standard No. 49 (latest edition). Exposed surfaces of gaskets for all access panels, doors, structural seams, and windows shall be skinned and smooth. Gaskets supplied with HEPA filters shall be exempt from this requirement.

7. Sound dampening materials shall comply with the requirements for the area in which used. They shall not be used in areas subject to contamination. Non-hardening and porous types shall not be accepted.

8. Hard (silver) solder shall be formulated to be corrosion resistant.

B. Design and Construction

1. Cabinets shall be designed and constructed to function properly and operate in a safe manner, minimize contamination, provide personnel and product protection, and be capable of being cleaned and decontaminated. Exposed burrs and sharp edges (including, but not limited to, sheet metal screws) shall be eliminated from those surfaces of the cabinet that are subject to normal operation, field certification, and maintenance (including those maintained with simple tools).

2. Interior work, exposed interior, and the other interior surfaces subject to splash or spillage shall be readily accessible and easily cleanable as assembled or when removed. Interior work, exposed interior, and other interior surfaces, including plenums, shall be capable of being vapor or gas decontaminated.

3. Cabinets shall be designed to be decontaminated with an inactivating agent (such as formaldehyde gas) without being moved. Closure to contain decontaminating agents should be limited to gas-tight sealing of air intake and exhaust openings with metal plates, or plastic film and tape, or equal. Pressure tight valves, if provided, suitable for decontamination shall be located on the clean side of the HEPA filter.

4. Plenum design:
   
a. Type A1 cabinets can have biologically contaminated plenums under positive or negative pressure to the room.
   
b. All biologically contaminated ducts and plenums in Types B1 and A2 cabinets shall be maintained under negative pressure or enclosed within a negative pressure zone.
   
c. Plenums or ducts carrying contaminated air in Type B2 cabinets shall be maintained under negative pressure or enclosed within a directly exhausted (nonrecirculated) negative pressure zone.

5. Internal corners and angles:
   
a. An internal angle of 2 rad (110 degrees) or less formed by the intersection of two planes, which is subject to manual cleaning, shall have a minimum continuous and
smooth radius of 0.13 inches.

b. An internal corner formed by the intersection of three planes at 2 rad (110 degrees) or less, subject to manual cleaning, shall have a minimum continuous and smooth radius of 0.25 inches for a vertical or horizontal intersection. The alternative intersections shall have a minimum continuous and smooth radius of 0.13 inches.

c. Parent material or hard solder may be used as fillet material in structurally sound seams.

6. All external corners and angles subject to splash or spillage or both shall be sealed as smooth as the surfaces being joined and formed to eliminate sharp edges that may interfere with use, cleaning, or maintenance.

7. Joints and seams:

a. All joints and seams subject to routine manual cleaning shall be sealed as smooth as the surfaces being joined. Perimeter drain spillage trough joints and seams shall be welded and sealed. All other seams shall be sealed. Equipment parts shall be stamped, extruded, formed, or cast in one piece. Joints shall be fabricated to eliminate dirt-catching horizontal ledges.

b. All joints and seams subject to routine splash or spillage or both shall be sealed and smooth. All joints and seams subject to exposure to vapor or toxic volatile substances or both shall be sealed. All other seams shall be closed.

8. Fastening methods:

a. Exposed screw threads, projecting screws, and studs shall not be used on interior work surfaces. They shall only be used on exposed interior and other interior surfaces when other fastening methods are impractical. All metal fasteners and studs subject to maintenance shall not be subject to excessive overspray.

b. Fasteners for exterior removable panels that are gasketed and subject to pressure shall be studs with solid acorn nuts, or equal, such that the gasket is sealed. Fasteners for other removable panels may be low profile-type fasteners (truss, round counter sunk, flat counter sunk head) or studs with solid acorn nuts. All metal fasteners and studs subject to maintenance shall not be subject to excessive overspray.

c. In areas subject to cleaning, interior fastenings and joinings shall be fabricated to minimize projections, ledges, and recesses. All metal fasteners and studs subject to maintenance shall not be subject to excessive overspray.

9. Welds shall meet the smoothness requirements of the applicable surface.

10. Solder shall only be used to seal structurally sound seams or as a fillet material.

11. All maintenance panels to access the blower/motor assemblies and filters shall be front access. Panels shall remain in place when sealing fasteners are removed. All cabinets shall be provided with a blower access panel. Cabinets fabricated without an access panel large enough to allow removal of the blower motor assembly as one piece shall be prohibited. The design and construction of removable panels shall minimize projections and openings. Removable panels for access into contaminated areas shall be designed so that upon
12. Cabinets shall stand on the floor or bench top in a stable and secure manner and not tip or fall when tested in accordance with NSF/ANSI Standard No. 49 (latest edition).

13. All cabinets shall be designed and constructed with one of the following provisions for mounting:

a. The cabinet base shall be designed to be sealed to the mounting surface (floor, raised base, bench top).

b. The cabinet shall be mounted on adjustable legs, or other acceptable means, to assure a minimum of 4 inches of unobstructed clearance beneath the unit. A 2 inch minimum clearance beneath the ends of the cabinet is acceptable if the front is open for cleaning and the side panel is equal to or less than 2 inch thick.

14. Legs and feet shall be sufficiently rigid to provide support with a minimum of cross bracing. They shall be fastened to the cabinet and shaped at floor or bench top contact to minimize the accumulation of splash and spillage. Legs and feet shall be of simple design, with no exposed threads. The minimum contact diameter of the foot shall be 0.75 inches. The foot shall be fabricated with a smooth material to prevent floor damage.

15. Reinforcing and framing members, not totally enclosed or within walls, shall be easily cleanable. Reinforcing and framing members shall not provide harborage for vermin. The ends of all hollow sections, not subject to gas decontamination, shall be closed. Reinforcing and framing members subject to splash or spillage or both shall be sealed. Horizontal angle reinforcing and gussets shall not be placed where soil may accumulate. Where angles are used horizontally, they shall have one leg turned down wherever the equipment permits or be formed integrally with the sides. All vertical channel sections shall be completely closed or open.

16. Fixed panels shall be designed, constructed, and fastened to eliminate projections and openings.

17. Doors and covers shall fit properly and close completely. Horizontal sliding doors shall not be used for the work area. When used for storage areas, doors shall slide easily and be readily removable. Piano and butt-type hinges are acceptable. Handles shall be designed, constructed, and installed to eliminate sharp edges or unnecessary projections. Latches and hold-open mechanisms shall provide even and secure support.

a. Single panel doors and covers shall be fabricated to minimize the collection of foreign matter and be designed without channel sections at the bottom. Channel sections, if used, shall be inverted or shallow and wide enough to be easily cleanable. Clean-out holes shall be provided in all channels that are not inverted.

b. Double panel doors and covers shall be fabricated to minimize the collection of foreign matter. Openings to hollow sections shall be closed. If subject to splash or spillage or both, openings shall be sealed.

c. Viewing panels shall be fabricated to prevent particles from entering the workspace by induction through joints, tracks, or guides.

d. Sliding sash enclosures shall include an audible alarm activated when the sash is
All louvers and openings outside the work area and air plenums shall:
   a. be of drip deflecting design; or
   b. not be subject to routine splash, spillage, or overhead drippage; or
   c. be designed and constructed to be readily accessible and the space behind easily
cleanable; or
d. louvers through double panel doors and covers shall be sleeved.

All tracks and guides for doors, window covers, and access panels shall be designed and
constructed to be easily cleaned.

Filters:
   a. HEPA filters shall be required for the downflow and exhaust air systems.
   b. The HEPA filters for downflow and exhaust systems shall conform to the materials,
construction, and aerosol efficiency requirements of IEST-RP-CC-001 for type C
filters. Filter media shall conform to MIL-F-51079B. Filter units of sizes not
covered by these specifications shall be of the same type, materials, and
construction as filters that have been qualified for the filter manufacturer In
addition, HEPA filters shall be scan tested for a leakage not to exceed 0.01% when
tested in accordance with NSF/ANSI Standard No. 49 (latest edition).
c. The cabinet shall be designed to provide accessibility for filter installation, testing,
and sealing.
d. HEPA filters shall be mounted to prevent air bypass of the filters. When required,
one or more 0.4 inch I.P.S. threaded plugged penetrations shall be located in the
plenum upstream of the HEPA filters and accessible from the front of the cabinet.
These penetrations are used to measure the aerosol concentration upstream of the
HEPA filters during the HEPA filter leak test. When the penetration enters a
potentially contaminated space, it shall be labeled “Decontaminate Cabinet Before
Opening;”
e. Cabinets exhausting into the room shall be provided with a perforated exhaust filter
guard to prevent damage to the filter and blockage of exhaust air.
f. An additional airflow sensor may be provided to indicate blockage of exhaust air.
g. HEPA filter patches shall not exceed 3% of the total face area of the side being
patched. The maximum width of any one patch shall not exceed 1.5 inches.

Exposed surfaces of gaskets shall be easily cleanable and shall not contain internal angles
(angles less than 2.4 rad (135 degrees)). All corner joints and hollow sections of gaskets shall
be sealed.
   a. Fixed gaskets shall be securely fastened and sealed in place.
   b. HEPA filter seals shall be leakproof when tested in accordance with NSF/ANSI
Standard No. 49 (latest edition). Gaskets on HEPA filters shall have interlocking
corners or sealed joints.
c. Gaskets used in cabinet seams or on the facing of service panels shall have sealed
joints. Structural strength of seams and service panel joints shall be independent of
the seal produced by the gasket.
The structural strength of joints or assemblies where sealant bonding has been applied shall be independent of the sealants.

22. Stopcocks and service outlets shall be readily accessible. Electrical outlets on exposed interior surfaces shall have drip-proof caps or gasket seal blade openings.

23. Alarms:
   a. Sliding sash enclosures shall include an audible and visual alarm, activated when the sash is raised above the manufacturer’s specified opening height.
   b. When a cabinet contains both an internal downflow and exhaust fan, they shall be interlocked so that the downflow fan shuts off whenever the exhaust fails. An audible and visual alarm shall signal the failure. If the downflow fan fails, the exhaust fan shall continue to operate, and an audible and visual alarm shall signal failure.
   c. Type B cabinets shall be exhausted by a remote fan. Once the cabinet is set or certified in its acceptable airflow range, audible and visual alarms shall be required to indicate a 20% loss of exhaust volume within 15 seconds. The internal cabinet fan(s) shall be interlocked to shut off at the same time the alarms are activated.
   d. Type A1 or A2 cabinets, when canopy connected and exhausted by a remote fan, should have an audible and visual alarm to indicate a loss of exhaust airflow.

24. Motor:
   a. A thermal protector shall be provided. It shall not trip at 115% of the rated voltage under maximum load and ambient temperature conditions. The motor shall be rated for continuous operation.
   b. Fan motors shall be sized to operate at a static pressure sufficient to meet the requirements of NSF/ANSI Standard No. 49 (latest edition).
   c. All fan motors shall be variable speed and shall have controls that can be secured. Controls shall be installed behind a removable or locked panel. Motor controls shall permit the adjustment of fan speeds to achieve proper airflow balance.
   d. Motor and lights shall be separately protected from the receptacles. Circuit overload protection conforming to the National Electrical Code (NEC) shall be provided. Flexible power cords for single-phase power shall be 3 wire, with the ground wire connected to the frame, unless otherwise specified and sized in accordance with the NEC for the specified load(s).

25. Replaceable electrical components shall not be located in contaminated air plenums, except for fan motors, sealed nonporous or jacketed wiring, and necessary airflow sensors. All wiring penetrations of contaminated spaces shall be sealed in accordance with NSF/ANSI Standard No. 49 (latest edition). Circuit overload protection shall be provided for all receptacles. Switches shall be mounted outside the work area. A wiring diagram showing connection of all electrical components shall be permanently attached to the unit in an accessible location outside of air plenum systems. A statement providing starting current, running power and circuit requirements shall be provided with the installation instructions.

26. Lighting:
a. The light intensity at the work surface shall comply with 6.5 Lamps, ballasts, and starters shall be accessible and not installed in contaminated areas. Lamps shall be located so reflection does not interfere with visibility through the window, and the operator’s eyes are shielded from direct radiation.

b. UV lighting is not recommended in Class II (laminar flow) biosafety cabinetry and must be approved by EH&S prior to purchase. If requested by the purchaser, it shall be installed in such a manner that it does not reduce the required performance as specified in NSF/ANSI Standard No. 49 (latest edition).

27. Pressure gauges indicating the differential pressure across the recirculated air filter, if provided, shall be installed in accordance with the manufacturer’s instructions. Hose connections to the gauge and sampling port shall be secured by positive compression clamps. If threaded connections are used to penetrate the plenum, an engagement of 3 continuous threads shall be required.

28. A drain spillage trough shall be provided below the work surface to retain spillage from the work area and shall be easily cleanable. A drainpipe shall be connected to the drain spillage trough and fitted with a 0.37 inch or larger ball valve. The drainpipe and valve shall conform to the material requirements of the drain pan or trough. The drain spillage trough shall accommodate at least 1 gallon. The drain valve shall be identified with a label and operating instructions placed in close proximity to, or on, the valve.

29. Removable diffusers shall be designed and constructed to assure reassembly in the proper operating position.

30. Readily removable interior work area work surfaces, intake air grills, and exhaust air grills shall be designed and constructed to assure fixed reinstallation in their proper operating positions.

31. The cabinet, excluding removable light fixture, exhaust filter housings and guards, and adjustable legs or feet, shall be sized to fit through 79 by 35 inch doorway using commonly available furniture moving equipment (jacks and dollies).

32. A date plate(s) indicating the following shall be readily visible on the front of the cabinet:
   a. manufacturer’s name and address;
   b. cabinet model;
   c. cabinet serial number;
   d. nominal set point for downflow and inflow velocities (DIM and thermal anemometer);
   e. type classification;
   f. downflow velocity test grid dimensions;
   g. indication that the cabinet has potentially contaminated plenums that are at positive pressure directly to the room (if applicable);
   h. voltage requirements; and
   i. inflow velocity test grid and method.

PART 3 - EXECUTION

3.1 INSTALLATION:
A. General:

1. Coordinate sequence of work with mechanical and electrical trades and laboratory casework and fixtures specified in Division 12.

2. The design consultant shall inspect biological safety cabinet for proper design and construction as specified in this Section prior to installation.

3. The design consultant shall ensure conformance with requirements of the Center for Disease Control (CDC) and the National Institute of Health (NIH) Biosafety in Microbiological and Biomedical Laboratories, NIH Guidelines for Research Involving Recombinant DNA Molecules, and OSHA Bloodborne Pathogen Standard 29 CFR 1910.1030. If NIH funding is used to facilitate project, then the *NIH Building and Construction* requirements must be followed.

4. Cabinets shall be located in close proximity to where biological materials are stored, and should be a minimum of 10 feet from any door or doorway where interfering air currents and cross drafts from windows, high traffic areas, HVAC systems, or other apparatus, could adversely affect the proper function of the cabinet enclosure. Any source which disrupts the containment provided by the work access opening air barrier shall be mitigated.

5. The work access opening air barrier shall remain unobstructed from large equipment, casework, or any item(s) which will impede the inward flow of air proportionally across this opening.

6. A hand washing sink shall be located in the same room as the cabinet for immediate access and the path of travel shall be free of obstructions that may inhibit the immediate use of the equipment, including doors.

7. All Biosafety Level 2 rooms shall have an eye/face wash station provided in accordance with UCB Standard, Section 12349.

8. All Biosafety Level 2 rooms shall be maintained at an air pressure of at least 0.03" wg* that is negative to the corridors or adjacent non-laboratory areas for all new construction and whenever feasible for renovated or existing spaces.

9. Vacuum lines should be protected with High Efficiency Particulate Air (HEPA) filters, or their equivalent. Filters must be replaced as needed. Liquid disinfectant traps may be required.

10. If there is a window in the laboratory, it should remain closed at all times. Cabinets should not be located where room ventilation air inlets blow across the front opening or onto the exhaust filter.

11. Where space permits, a 12 inch clearance should be provided behind and on each side of the cabinet. If not feasible, a minimum of 3 inch clearance on each side and 1.5 inch in back are recommended. The electrical outlet for the cabinet should be accessible for the cabinet service and electrical safety testing without moving the cabinet.
3.2 FIELD QUALITY CONTROL:

A. Field Test:

1. Field test each unit after completion of installation to verify proper operation of hoods in accordance with specified requirements. Perform field tests in accordance with NSF/ANSI Standard No. 49 (latest edition). Submit field test results and recertification.

2. Perform the following field tests:
   a. Downflow velocity profile test.
   b. Inflow velocity test.
   c. Airflow smoke patterns test.
   d. HEPA filter leak test.
   e. Cabinet integrity test (A1 cabinets only).
   f. Site installation assessment tests.
      i. alarm functions as required by NSF/ANSI No. 49 (latest edition)
      ii. blower interlock
      iii. exhaust system performance (proper exhaust duct negative pressure and canopy performance)
   g. Lighting intensity
   h. Vibration.
   i. Noise level.
   j. Electrical leakage, ground circuit resistance, and polarity tests.

B. Record of Field Certification:

1. A cabinet that has met all the field test criteria listed NSF/ANSI No. 49 (latest edition) shall have the following information posted on the front of the cabinet in a location readily visible to the user:
   a. Date of certification.
   b. Date cabinet should be recertified: no later than ____________.
   c. Certifier’s report number (reference document showing tests performed and results).
   d. Name, address, and telephone number of certifying company.
   e. Signature of the person who performed the field certification tests.

3.3 DEMONSTRATION:

A. Demonstrate use, cleaning and maintenance of biological safety cabinets.

END OF SECTION 11611