

Labconco Purifier® Axiom™
Class II, Type C1 Biological Safety Cabinet Specification

SECTION 15353 – BIOLOGICAL SAFETY CABINETS AND RELATED PRODUCTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Bench-top Class II Biological Safety Cabinet
 - 2. Biological Safety Cabinet Supporting Base Stand
 - 3. Exhaust Thimble/Canopy Connection

- B. Related Sections **[Insert Appropriate Sections]**
 - 1. Section ____: Laboratory Fittings and Fixtures
 - 2. Section ____: Mechanical
 - 3. Section ____: Plumbing
 - 4. Section ____: HVAC
 - 5. Section ____: Electrical

1.02 SCOPE AND CLASSIFICATION

- A. This specification meets the requirements for the purchase of any of the following bench-mounted Class II, biological safety cabinets; Type A2, or B1, or B2 (total exhaust), or C1.

- B. Bench-mounted Class II, Type C1 biosafety cabinets in 4- and 6-foot widths are covered by this specification.

- C. This specification sets the intent for quality, performance and appearance.

1.03 REFERENCES

- A. The bench-mounted Class II, Type C1 biosafety cabinets must conform to the following regulations and standards.

- B. NSF International – NSF/ANSI Standard 49 for Biohazard Cabinetry.

- C. Directive on the Restriction of the Use of Certain Hazardous Substances in electrical and electronic equipment (2015/863/EU) – RoHS Directive

- D. The bench-mounted Class II, Type C1 biosafety cabinet must carry the ETL listed mark for the following.
 - 1. UL 61010-1 (formerly 3101-1), Underwriters Laboratories Inc., Electrical Equipment for Measurement, Control and Laboratory Use.
 - 2. CAN/CSA C22.2 No. 61010-1, Canadian Standards Association, Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use.

- E. Biosafety Cabinets that are 230 volt models must carry the CE conformity marking as required by the Council of European Communities.

Labconco Purifier® Axiom™
Class II, Type C1 Biological Safety Cabinet Specification

1. Safety Electrical Equip for Laboratory Use – EN 61010-1
2. EMC Requirements – EN 61326-1
3. Electromagnetic Compatibility – 2004/108/EC
4. Radio Disturbance – EN 55022
5. EMC Emissions – EN 61000-3-2
6. EMC Voltage Limitation – EN 61000-3-3
7. Low Voltage Directive – 2006/95/EC

1.04 PERFORMANCE REQUIREMENTS

A. General Design Requirements (See Part 2 for details)

1. Class II, Type C1 – suitable for testing and experimentation with low to moderate risk biological agents.
2. Any Class II, Type C1 may be connected to building exhaust or exhaust back into the laboratory.
 - a. All Type C1s shall be equipped with an exhaust transition with air-relief valve and must be capable of connecting to 10” nominal duct of any laboratory equipment exhaust trunk including ganged systems with other types of vented lab equipment. (When used for work with hazardous chemicals)
 - b. The Class II, Type C1 with exhaust transition with air-relief valve shall be capable of being disconnected and exhaust back into the room for energy savings. (Not for use with hazardous chemicals).
3. Base Stands **[Pick one based on project requirements, delete the other two]**
 - a. Telescoping Stands – Support base adjustable for eight static height positions allowing the work surface height to be set between 30” (Seated Positions) and 37” (Standing Positions).
 - b. Hydraulic Stands – Support base with infinite adjustability for work surface heights between 28” (Seated Positions) and 37” (Standing Positions).
 - c. Mobile Hydraulic Stands - Support base with infinite adjustability for work surface heights between 19.7” and 37” (Standing Positions) and overall installation height as low as 78.2” for transport through doorways.

B. Containment & Safety

1. Cabinet shall provide biological containment protection for both operator and product proven by an actual test, (and listed with the NSF mark) and routinely validated by the manufacturer.
2. Containment of biological hazards is achieved through a combination of HEPA filtration and directional, controlled airflow.
3. Containment of chemical & vaporized hazards is achieved through 100% exhaust of intake air through required exhaust connection when work is performed in a clearly delineated and labeled portion of the work surface. The Type C1 shall have airflow efficiencies which are gained by recirculation of room air and intake air at the ends of the work surface.
 - a. Cabinet shall have an interlock to monitor building exhaust flow. In the event of failure cabinet must be capable of eliminating the potential for hazardous “puff back”.
 - b. In the event of an exhaust alarm – triggered by loss of 20% exhaust or greater - an audible and visual alarm with visual countdown timer is to be activated.
 - c. During an exhaust alarm, the cabinet’s integral exhaust blower (and supply blower) must continue to provide full protection to personnel and samples during a programmable “active protection” period of 15 to 300 seconds. After programmed period (no greater than 300 seconds), the cabinet shuts down.

Labconco Purifier® Axiom™
Class II, Type C1 Biological Safety Cabinet Specification

- d. Upon start up, the Class II, Type C1 shall not initiate integral exhaust and supply blower start up until adequate exhaust volume is achieved and monitored by the cabinet.

C. Airflow

1. Calculated Air Velocity: 100 to 110 fpm (0.51 to 0.56 m/s) through the sash opening with audible alarms which sound when safety glass sash window is not at its proper operating height.
2. The cabinet must have the capability and NSF listed to operate at both 8" and 10" sash openings without changing of any cabinet hardware.
3. Sash height must be software selectable by the certifier to operate at either desired height of 8" or 10" opening.
4. Measured Downflow Velocity: 60 to 70 fpm (0.30 to 0.36 m/s) for 4' widths, and 50 to 70 fpm (0.25 to 0.30 m/s) for 6' widths. Airflow must be measured 4" (100 mm) above operating sash opening height and must be true laminar (unidirectional) downflow as defined in NSF/ANSI Standard 49. Zoned laminar downflow is not acceptable.
5. If desired to be connected to building exhaust, the requirements for Class II, Type C1 shall not exceed these volumetric flows and static pressures: **[Select appropriate size cabinet – leave both 8" and 10" numbers per size selected]**
 - a. 4-foot, 8" sash – 323 CFM (CBV – 387 CFM @ 0.2" WC)
 - b. 4-foot, 10" sash – 400 CFM (CBV – 480 CFM @ 0.2" WC)
 - c. 6-foot, 8" sash – 463 CFM (CBV – 556 CFM @ 0.2" WC)
 - d. 6-foot, 10" sash – 570 CFM (CBV – 684 CFM @ 0.2" WC)
6. Supply Blower with Electronically Commutated Motor (ECM) shall be programmed to deliver a precise volume of supply air as required and automatically adjusts as filters load without relying on airflow sensors, pressure gauges or pressure transducers to control blower speed when adjusting velocity or volume of cabinet airflow. Blower must be protected from voltage (electrical) fluctuation.
7. Integral Exhaust Blower with Electronically Commutated Motor (ECM) shall be programmed to deliver a precise volume of supply air as required and automatically adjusts as filters load without relying on airflow sensors, pressure gauges or pressure transducers to control blower speed when adjusting velocity or volume of cabinet airflow. Blower must be protected from voltage (electrical) fluctuation.
8. The Cabinet shall provide an audible signal accompanied by a color digital display of alert or alarm status type specific to the alarm with diagnostic measures. The display of operating parameters and warnings shall be:
 - a. located inside the work area
 - b. fully sealed behind a protective glass panel
 - c. on a line-of-sight with user while seated at the cabinet
 - d. in an easily decontaminated housing
 - e. able to withstand exposure to UV light without damage

D. HEPA Filters

1. One supply and one exhaust HEPA filter. Each shall be a minimum of 99.99% efficient on all particles 0.3µm as scan-tested with DOP, PAO or equivalent.
2. Supply HEPA filter must be capable of being 100% scanned. Downstream average leak detection scanning is not acceptable.
3. Exhaust HEPA filter must be capable of being 100% scanned in either recirculating or ducted modes. Downstream average leak detection scanning is not acceptable.
4. HEPA filters shall be industry-standard size.
5. Motor-Blower shall be positioned so as to promote even filter loading, thereby prolonging

Labconco Purifier® Axiom™
Class II, Type C1 Biological Safety Cabinet Specification

the life of HEPA filters

6. Motor-Blower shall automatically handle HEPA filter pressure equal to 200% of initial pressure without reducing total air delivery by more than 2%.

E. Controls and Display

1. Cabinet shall utilize a microprocessor control system.
2. Accessible* mounted controls (* ADA Compliant - with knee space over 30" tall and front access less than 48" tall) for operation of:
 - a. Blower
 - b. Light
 - c. Electrical Outlets
 - d. UV Light
 - e. Timers
 - f. Alarm Mute (5 minute ring-back)
 - g. Menu navigation
3. Easy to Use/Navigate Operating System performs the following functions:
 - a. User Programmable and customizable biosafety cabinet operation (including blower, light, optional UV light, and timer start/stop functions) controllable by movement and position of the Safety Glass Sash.
 - b. User Programmable and customizable biosafety cabinet operation that idles the motor in a reduced flow mode, reducing energy consumption by over 80% while maintaining ISO Class 5 conditions when installed in recirculation mode.
 - c. Digital 12- or 24-hour time of day clock.
 - d. Performance-based HEPA filter life for both Supply Filter and Exhaust Filter is displayed as a percentage using real time feedback from the ECM-blower. Timer/countdown-style HEPA filter life gauges or meters are not acceptable.
 - e. Complete diagnostic and troubleshooting functionality.
 - f. Security password protection of cabinet use (optional selection).
 - g. Programmable timed operation of direct drive LED and (optional) germicidal ultraviolet (UV) light.
 - h. Password Protected Service menu for calibration and configuration of biosafety cabinet installation and operational parameters.
 - i. Selectable units of measure (Imperial or Metric).
4. Alarms and Alerts – The cabinet shall provide both an audible signal and digital display that communicates and describes the alarm condition, provides corrective actions and utilizes a cross sectional diagram highlighting the potentially affected areas of the biosafety cabinet. Alarms shall exist for the following conditions:
 - a. Sash Height Alarm – indicating that the sash is higher or lower than its nominal set point.
 - b. Airflow Alert – signifies that the automatically adjusting supply blower has had to make an abrupt change in order to maintain safe airflow indicating obstruction to airflow.
 - c. Airflow Alarm – indicates that inflow or downflow velocities are excessively high or low.
 - d. Cabinet Exhaust Error – indicates that the cabinet exhaust blower is not capable of proper operation.
 - e. Building Exhaust Error – if connected to building exhaust, indicates that the cabinet is not detecting suitable exhaust air volumes. Cabinet however will maintain safe containment during a 0-5 minute programmed exhaust alarm period.
 - f. System Error – Indicates a failure in the communication between the microprocessor controller and the ECM blower.

Labconco Purifier® Axiom™
Class II, Type C1 Biological Safety Cabinet Specification

5. Programmable Sash Height – Cabinet must be able to convert to/from 8” and 10” sash openings via software selection.
6. Data Management – Cabinet must include mini USB port capable of exporting cabinet functions in real time.

F. Noise

1. Sound level (as factory tested) for 4’ widths shall be no more than 64 dBA, and 66 dBA for 6’ widths measured 15 inches (381 mm) above the work surface and 12 inches (305 mm) in front of the tempered safety glass sash, as stated by NSF/ANSI Standard 49.

G. Illumination

1. LED lighting shall provide 60 to 153 foot-candles (646 to 1647 lux) on work surface per NSF/ANSI Standard 49. The use of ballasts is not acceptable.
2. LED lighting shall be externally mounted from the work zone, energy efficient, and replaceable from front of the biosafety cabinet.
3. Optional UV light shall be a 254 nanometer germicidal lamp with life timer and replacement notifications.
4. The UV light shall be interlocked with the sash and only operable when the sash is closed.

H. Pass-Through and Bulkheads

1. Sealed Service Pass-Through – All permanent and durable structures for the passing of electrical wires, cords and tubes are to be permanently sealed air-tight, and shall not allow for movement of the items passing through.
2. Sealed Service Penetration – Penetrations will be air tight and sealed, and will provide for the addition of field installed service fixture/valves or testing equipment.
3. User-Modified Pass-Through – Cord, Tube & Cable Portals for the passing of such so to connect to instruments, one inside the biosafety cabinet, the other outside. Shall provide an airtight seal and be protected by a vacuum or negative pressure source.
4. All Pass-Through & Bulkhead types shall be tested and approved by NSF to the NSF/ANSI Standard 49.

I. Efficiency

1. Biosafety cabinets shall operate at, or lower than, the listed energy usage:
 - a. 4’ Models – 343 Watts
 - b. 6’ Models – 373 Watts
2. During periods of non-use, the cabinet’s set-back mode should operate at an 85% reduction in energy consumption when not connected to an exhaust system.

1.05 QUALITY ASSURANCE

A. NSF Qualification

1. Biosafety cabinets, Class II, Type C1 will meet or exceed the minimum requirements of NSF/ANSI Standard 49, bear the NSF Mark, and appear in NSF’s Official Product Listings.

B. Manufacturer Qualification

1. ISO 9001 Certified manufacturing plant and processes.
2. Manufacturer must maintain a testing facility at their place of business for the performance testing of bench-mounted Class II, Type C1 biosafety cabinets.
3. The test facility and manufacturing facility must be available for owner/user inspection and

Labconco Purifier® Axiom™
Class II, Type C1 Biological Safety Cabinet Specification

- its quality control procedures.
4. Manufacturer shall provide evidence and documentation of specialization and manufacturing of biosafety cabinets with a minimum of no less than ten years' experience to the market.
 5. All biosafety cabinets wired for 115V, 60 Hz and 230V, 60 Hz shall be built to meet or exceed all minimum requirements of UL Standard 61010-1 (formerly 3101-1) and CAN/CSA C22.2 No. 1010.1. The biosafety cabinets shall be listed by a Nationally Recognized Testing Laboratory (NRTL).
 6. All biosafety cabinets wired for 230V, 50 Hz shall be built in conformance to CE requirements of the Electrical Safety Standard: IEC 1010-1 and Electromagnetic Compatibility Directive 89/336/EEC.
- C. Biosafety Cabinets shall be "Made in America".
1. 95% or more of raw material and component suppliers shall be United States based.
 2. Stainless and cold rolled steel used in manufacturing shall be sourced from United States steel mills.
 3. Final product must be fabricated and assembled within the United States of America.
 4. Owner reserves the right to evaluate Made in America claims for compliance with the Bureau of Consumer Protection.
- D. Supply all equipment in accordance with this specification. Offering a product differing in materials, construction, or performance from this specification requires written approval obtained seven days or more before the proposal deadline.
- E. The owner/architect reserves the right to reject qualified or alternate proposals and to award based on product value, safety, cost of ownership and where such action assures the owner greater integrity of product.
- F. Manufacturer's warranty against defects in material or workmanship on its biosafety cabinets will be for 5 years from the date of installation or 6 years from date of purchase, whichever is sooner, and includes replacement of parts and labor (excluding filters, lamps and glass breakage).

1.06 SUBMITTALS

- A. Action Submittals
1. Biosafety Cabinet specification sheets and product manuals shall be submitted by the manufacturer upon request, and include safe and proper operation and maintenance information.
 2. Shop Drawings: Include plans, elevations, sections, and details.
 - a. Indicate details for anchoring biosafety cabinets to floor as required by seismic code.
 - b. Indicate locations and types of service fittings together with associated service supply connection required.
 - c. Indicate duct connections (if building exhaust is required), electrical connections, and User-Modified Pass Through.
 - d. Include roughing-in information for mechanical, plumbing, and electrical connections.
 - e. (If building exhaust connection is required) Provide face opening, volumetric rates, and static pressure drop data.
- B. Informational Submittals
1. Production Test Reports: A copy of the "as manufactured" test reports conducted prior to

Labconco Purifier® Axiom™
Class II, Type C1 Biological Safety Cabinet Specification

shipping ensures compliance with NSF/ANSI Standard 49 and is shipped with each biosafety cabinet.

2. Independent validation:
 - a. Written verification that the biosafety cabinets carry listed markings for the following:
 - 1) NSF/ANSI Standard 49, National Sanitation Foundation, (Laminar Flow) Biological Safety Cabinetry
 - 2) UL 61010-1, Underwriters Laboratories Inc., Electrical Equipment for Measurement, Control and Laboratory Use. (115V & 230V, 60Hz models)
 - 3) CAN/CSA C22.2 No. 61010-1, Canadian Standards Association, Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use. (115V & 230V, 60Hz models)
3. CE requirements: [for Non-USA/Canada installation use – Delete if “domestic”]
 - a. Safety Electrical Equip for Laboratory Use – EN 61010-1
 - b. EMC Requirements – EN 61326-1
 - c. Electromagnetic Compatibility – 2004/108/EC
 - d. Radio Disturbance – EN 55022
 - e. EMC Emissions – EN 61000-3-2
 - f. EMC Voltage Limitation – EN 61000-3-3
 - g. Low Voltage Directive – 2006/95/EC
 - h. Machinery Directive – 2006/42/EC
4. Documentation of ISO 9001 Certified manufacturing plant and processes.
5. List of five installations (of equal or greater size/scope and requirements) is available upon request.
6. Declaration of “Made in America”. Owner reserves the right to evaluate Made in America claims for compliance with the Bureau of Consumer Protection.
7. Start-Up Test Report shall be submitted by independent 3rd party, accredited by NSF to test and balance biosafety cabinets.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Protect finished surfaces during handling, installation and through completion of construction with protective covering of polyethylene film or another suitable material.
- B. Schedule delivery of equipment so that spaces are sufficiently complete that equipment can be installed immediately following delivery.

1.08 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install biosafety cabinet until:
 1. building is enclosed
 2. wet work and utility rough-ins are complete
 3. HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturer: Labconco Corporation, 8811 Prospect Avenue, Kansas City,

Labconco Purifier® Axiom™
Class II, Type C1 Biological Safety Cabinet Specification

Missouri 64132

- B. Basis-of-Design Product: Labconco Purifier® Axiom™
 - 1. 4' Models –3044 Series: Exterior Dims – 54.3” wide x 32.7” deep x 64.2” high (1379 mm wide x 830 mm deep x 1631 mm high)
 - 2. 6' Models –3046 Series: Exterior Dims – 78.3” wide x 32.7” deep x 64.2” high (1989 mm wide x 830 mm deep x 1631 mm high)
- C. Comparable product by one of the following permitted following substitution request and approval.
- D. Other substitutions are not permitted.

2.02 MATERIALS

- A. Biosafety Cabinet Interior
 - 1. The Interior Liner (sides and back) shall be 16 gauge, Type 304 Stainless Steel.
 - 2. The Work Surface shall be 18 gauge or greater, Type 304 Stainless Steel.
 - 3. The Work Surface shall be separated into well-defined zones for single pass exhaust and for recirculation to save energy (reduce exhaust air).
 - 4. The center Work Surface shall have raised, cleanable edges to stop spills. A dedicated central overflow pan must be provided below the center Work Surface.
 - 5. An optional NSF-approved flat center Work Surface must be available.
 - 6. Exhaust and Supply Motor shall be a thermally protected, DC-ECM type with resilient mounted ball bearings. Motors with bushings are not acceptable.
 - a. 1/3 HP ECM shall provide 42 oz-ft (3.56 Nm) of torque
 - 7. Electrical Outlets will have interlocking ground fault interruption (115V models only).
 - 8. Internal ductwork and plenums shall be constructed of metal (galvanized, stainless steel, or epoxy-coated steel) and shall be RoHS compliant. Flexible, removable or replaceable plenums and ductwork are not acceptable.
 - 9. Safety Glass Sash shall be ¼” (6 mm) thick tempered safety glass.
- B. Biosafety Cabinet Exterior
 - 1. Cabinet shall have 18 gauge cold rolled steel powder-coated Exterior Side Panels. Cabinets with exposed liner sides and services are not acceptable.
- C. HEPA Filters
 - 1. Filters are to be borosilicate glass, mini-pleat, and separator-less HEPA filters.
 - 2. Filter frames shall be aluminum with closed cell neoprene gaskets; gel seals are not acceptable.

2.03 CONSTRUCTION

- A. Biosafety Cabinet Interior
 - 1. Unitized single-frame construction of 16 gauge, Type 304 Stainless Steel. Shall pass factory test for holding pressure of 2” w.g. (0.50 kPa) (per NSF/ANSI Standard 49).
 - 2. Cabinet assembly shall be constructed such that all positive pressure contaminated plenums are surrounded by negative pressure plenums.
 - 3. Drain trough beneath the work tray is equipped to accommodate a 3/8” ball-type drain valve.
 - 4. Optional service fixture (on models with fixture) shall be quarter-turn, ball valve. [Modify]

Labconco Purifier® Axiom™
Class II, Type C1 Biological Safety Cabinet Specification

or remove this depending on if service(s) is required]

- a. Valve shall be constructed of chrome-plated brass (or other based on requirements of service/utility provided).
 - b. Location of fixtures shall be ADA compliant for wheel chair accessibility.
 5. Internal air balancing system shall be automatically controlled by programmable ECM supply and integral exhaust motors without the need for tools
 6. The Work Surface shall be of three sections removable without screws:
 - a. Must have dished section with dedicated ventilation (area of work surface that guarantees single pass exhaust of volatile chemicals)
 - b. Must have removable side flat work surfaces for recirculation area of work surface
 - c. Work Surface parts shall not exceed 5 lbs (2.25 kg) for 4-ft and not to exceed 7 lbs (3.1 kg) for 6-ft models for ease of lifting
 - d. Dished ventilated section of work surface shall have the means to pivot up and latch to the back wall for easy cleaning underneath without removal
 7. A metallic diffuser screen shall promote true laminar air flow and protect surface of supply HEPA filter.
 8. The cabinet shall accommodate up to 4 factory or field-installable service fixtures.
 9. The cabinet shall be double wall construction with negative pressure airflow from drain pan to top surrounding the back of work area.
- B. Biosafety Cabinet Exterior
1. Exterior front panel shall slope approximately 10° and has no visibility-interfering protrusions.
 2. Cabinet is designed such that all major service operations can be performed from the front of the cabinet.
 3. HEPA filters are fully serviceable and removable from the front of the cabinet.
- C. Dimensions
1. The biosafety cabinet shall be capable of transport through a 33" (838 mm) wide opening.
 2. Overall exterior dimensions are as follows: (excluding Base Support)
 - a. 4' Models –3044 Series: Exterior Dims – 54.3" wide x 32.7" deep x 64.2" high (1379 mm wide x 830 mm deep x 1631 mm high)
 - b. 6' Models –3046 Series: Exterior Dims – 78.3" wide x 32.7" deep x 64.2" high (1989 mm wide x 828 mm deep x 1631 mm high)
 3. Overall interior dimensions are as follows:
 - a. 4 foot nominal width: 48.5" wide x 25.6" deep x 25.7" high (1232 mm wide x 650 mm deep x 653 high)
 - b. 6 foot nominal width: 72.5" wide x 25.6" deep x 25.7" high (1842 mm wide x 650 mm deep x 653 high)
- D. Blower
1. Blower assembly shall be direct drive powered by energy saving ECM motor type.
 - a. 4' and 6' models will utilize 2ea 1/3 HP ECMs.
 - b. Motor mounting system shall consist of 16 Gauge, stamped steel legs with integral vibration isolation.
 2. Blower shall be optimally determined forward-curved fan for each model size/width to maximize both energy efficiency and filter loading capacity.
 3. Supply Blower shall be upstream of Supply HEPA filter to allow for 100% filter scan.
 4. Exhaust Blower shall be upstream of Exhaust HEPA filter to allow for 100% filter scan.
- E. Sash Assembly

Labconco Purifier® Axiom™
Class II, Type C1 Biological Safety Cabinet Specification

1. Sash shall be single pane, tempered safety glass and angled 10° from vertical and be of a sliding operation.
2. Sash shall be capable of being closed when cabinet is not in operation.
3. Sash shall fully open to a height of 22.5” (572 mm).
4. Total sash height shall provide a viewing window that is no less than 27.0” (686 mm) tall.
5. A sash position indicator shall identify to the user where the sash is to be open to its optimum operating level.
6. Sash shall not require removal for routine filter or motor/blower service.
7. Bottom edge of sash shall be frameless and ground to a smooth edge so as to not disrupt line of sight. Framed sashes are not acceptable.
8. Sash will be interlocked to cabinet operation such that UV light (if equipped) will not operate when sash is open, and the biosafety cabinet will alarm (audio & visual) when the sash is opened beyond its nominal height when the blower is in operation.
9. Provide guides capable of holding the sash in place regardless of position and cushion sash with bumpers when fully opened or closed.
10. Maximum force required to operate sash shall not exceed 7 lbs (3.1 kg).
11. Sash movement shall be assisted by gravity. No springs or motors.

F. Airflow and Foils

1. Bottom of sash opening (Air Inlet Grille) is an aerodynamic, radiused foil to ensure smooth, even flow of air into biosafety cabinet.
2. Air inlet grille will have perforations on the leading edge to draw air into the biosafety cabinet should the operator inadvertently block the grille area.
3. Corner posts are designed to be aerodynamic, ensuring smooth, even flow of air into the sides of the sash opening on the biosafety cabinet.
4. A negative pressure channel shall exist at the top of the sash opening to prevent loss of containment at the top of the sash. Mechanical wipers at the top of the work area promote the creation of hazardous aerosols, and are not acceptable.
5. The Air Inlet Grille shall be retained and removable without the need for fasteners

G. Electrical

1. A 10 foot (3 m) 3-wire cord and plug will be provided to connect to electrical supply.
 - a. 4’ and 6’ 115V North American models will be provided with an IEC 60320 connector and NEMA 5-20 plug.
 - b. 230V North American models are provided with an IEC 60320 connector and NEMA 6-15 plug.
2. Two internal Electrical Outlet Duplexes will be standard, one mounted on each side wall. Outlets mounted on the rear wall of the work area are not ADA compliant, and are not acceptable.
 - a. Duplexes shall be mounted flush to the stainless steel side walls of the biosafety cabinet’s interior for easy cleaning,
 - b. Duplexes shall have a self-closing stainless steel splash cover with dampened (slowed action) operation for safe operator use. Splash covers shall fully close in 1 second or greater. Un-dampened, spring-loaded doors are not acceptable.
 - c. Duplexes will be located in compliance with ADA for wheelchair accessibility.
 - d. 115V N. American model receptacles are NEMA 5-15.
 - e. 230V N. American model receptacles are NEMA 6-15.
3. All major electronic components (ballasts, starters, switches, circuit breakers) shall be housed in a removable module for service or testing and be accessible from the front.
4. Wiring Harness shall be color coded and alphanumerically labeled for identification. Removable wire tags shall not be used.

Labconco Purifier® Axiom™
Class II, Type C1 Biological Safety Cabinet Specification

5. Biosafety Cabinet shall have two separate internal circuits with breaker protection. One for service of controls, lighting and blower motor; one for internal electrical outlets.
 6. Biosafety Cabinet shall have optional dry relay contacts for connection to building management system. Will communicate alarms or use for control of HVAC Mechanical System (remote blower, valves) devices. (See Required Accessories – Section 2.03-M)
- H. Decontamination
1. Cabinet shall be easily fumigated employing an established procedure such as that recommended by NSF/ANSI Standard 49.
 2. Liner assembly shall have an integral face flange for sealing the cabinet during decontamination and pressure test operations.
- I. HEPA Filters and Plenums
1. The positive pressure, contaminated plenum shall be permanent in construction, telescoping steel and provide uniform HEPA filter loading. Flexible, consumable plasticized plenums are not acceptable.
 2. Supply HEPA Filter shall be of full cabinet work zone width and depth, and be tilted with the angle of the biosafety cabinet's front so as to provide laminar airflow behind the sash.
 3. Supply HEPA Filter shall be protected by a perforated metal diffuser covering the entire top of the work zone.
 4. Supply and Exhaust HEPA filters are secured in the upper cabinet assembly by clamps.
- J. Controls and Display
1. Control panel with easy-to-clean membrane touchpad for system operations (blower, lights, mute) and Operating System navigation are mounted on the front of the cabinet and shall be ADA compliant. Controls mounted above sash are not acceptable.
 2. The audible/visual alarm indicator and mute switch shall be ADA compliant.
 3. The mute function will silence audible alarms for 5 minutes before engaging a ring-back function.
 4. Display shall be mounted in a position where it is line-of-sight while seated at the cabinet and can be viewed without strain to the operator.
 5. Display shall be a color digital LCD and communicate cabinet status, HEPA filter life, alarms and cabinet set up. Analog pressure gauges do not adequately provide user communication adequate to specific cabinet function and are not acceptable.
 6. Display shall be located inside the work area in a housing that is easily decontaminated and is un-phased by UV light.
- K. Pass-Through and Bulkheads
1. Service Fixture provisions will be provided to accommodate up to four valve installations, shall be sealed to meet air tight pressure requirements, and shall be ADA Compliant.
 2. Cord and Cable Portal shall ship with a solid closed cell neoprene plug and be user-modified as needed per application.
 3. Cord and Cable Portals shall not require further space requirements than recommended by the manufacturer and NSF/ANSI Standard 49.
 4. Cord and Cable Portal design shall be approved by NSF testing.
- L. Ergonomics – The biosafety cabinet shall be ergonomically designed for maximum user comfort and adjustability to meet the requirements of the American with Disabilities Act (ADA).
1. Biosafety Cabinet installation with base stand shall be positioned to provide work surface heights between 30” and 37”, and be in compliance with ADA.

Labconco Purifier® Axiom™
Class II, Type C1 Biological Safety Cabinet Specification

2. Safety Glass Sash Assembly shall be anti-racking and counterbalanced with a weight and pulley system allowing for effortless movement up and down with one hand. Sash shall open to 22.5" (572 mm). Spring-loaded sash counterbalances require greater force as the sash raises and exerts force against the user's arms, this design is not acceptable.
 3. Air Inlet Grille shall have a large (greater than 2") integrated curved armrest (waterfall ergonomic design) to provide comfort for user when in a resting position while maintaining containment performance. Non-metal armrests such as PVC are not acceptable. Hard and sharp angles and elevated add-on arm/elbow rests promote poor ergonomic pressure points and posture and are not acceptable.
 4. Maximum visibility into cabinet work zone shall be at least 27" from front access airfoil to exterior light housing.
 5. The biosafety cabinets work surface shall have easy-lift knobs located on the front corners and be removable through the front opening. The dished work surface will have corners acceptable to NSF for easy cleaning.
 6. The biosafety cabinet shall have a 10° slope front.
 7. All controls (touchpad, service fixtures valves, electrical outlet duplexes, cord and cable portals) shall be in compliance with ADA front access under 48" height.
 8. The digital display shall be positioned line-of-sight while seated at the biosafety cabinet and communicate cabinet status and programming in full intuitive sentences.
- M. Required Accessories **[Select and Keep the options required for the project, delete rest]**
1. Telescoping Base Stands – shall be adjustable at installation to provide work surface heights between 30" and 37" and come with leg levelers. – Shall be NSF Approved
 - a. Powder coated steel square tubing construction
 - b. Shall include a full width storage shelf
 - c. Shall be capable of adding 5" casters
 - d. Shall accommodate seismic restraints that anchor to the floor
 2. Hydraulic Stands – models available to provide infinite settings for work surface heights between 16.5" and 36" (419 and 914 mm)
 - a. Shall be capable of being mobile
 3. Air-tight Damper with flange to mate to top of canopy exhaust transition, control airflow through canopy and allow proper decontamination of the biosafety cabinet. (For use when the cabinet is installed connected to building exhaust).
 4. Ultraviolet (UV) lamp – germicidal 254 nm wavelength lamp – Shall be NSF Approved
 5. Utility valves – greaseless, allowing for connection of service utilities (air, vacuum, gas)
 6. IV Bar with stainless steel hooks – shall be NSF Approved
 7. Mass Airflow Monitor with integration into operating system that provides digital display of airflow readings and audible/visual alarms should readings be excessively low or high.
 8. Aspirator (Pump) Systems – for safe removal and handling of hazardous fluids
 9. Ergonomic Footrest
 10. Ergonomic Adjustable Arm Chair
 11. Ergonomic stainless steel Turn Table
 12. Convenient Cord Management System
 13. Easy-reach interior Wire Shelves.
 14. Mobile Storage Cart with pull drawers and bins. 27" (686 mm) tall.
 15. Dry Contact Relay Kit – Communications Package for BMS
 16. ULPA filters 99.999% @ 0.12 micron
 17. Bag-In/Bag-Out option available on exhaust filter

PART 3 – EXECUTION

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Class II, Type C1 Biological Safety Cabinet Specification

3.01 EXAMINATION

- A. Examine areas, with installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of biosafety cabinets.
- B. Coordinate with other trades for the proper and correct installation of plumbing and electrical rough-in and for rough opening dimensions required for the installation of biosafety cabinets.
- C. Examine the carton and its contents for damage that might have occurred in transit.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. General: Install biosafety cabinets according to shop drawings and manufacturer's written instructions.
- B. Install level, plumb and true; securely anchor as required.
- C. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.
- D. Install according to standards required by authority having jurisdiction.
- E. Touch up minor damaged surfaces caused by installation. Replace damaged components as directed by Architect.

3.03 FIELD QUALITY CONTROL

- A. NSF/ANSI Standard 49 requires that biosafety cabinets be field tested after installation and prior to use.
 - 1. A qualified independent (3rd party) certifier should certify the cabinet in accordance with NSF/ANSI Standard 49, Normative Annex 5.
 - 2. Make all corrections until biosafety cabinet passes NSF/ANSI 49 Field Certification.
 - 3. If connected to building exhaust system, retest all other ventilation equipment that failed to perform as specified.

3.04 ADJUSTING AND CLEANING

- A. Adjust moving parts for smooth, near silent, accurate sash operation with one hand. Verify that counterbalances operate without interference.
- B. Clean finished surfaces, including both sides of glass; touch up as required; and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.
- C. Clean adjacent construction and surfaces that may have been soiled or damaged in the course of installation of work in this section.
- D. Provide all necessary protective measures to prevent exposure of equipment and surfaces from exposure to other construction activity.

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Class II, Type C1 Biological Safety Cabinet Specification

- E. Advise contractor of procedures and precautions for protection of material and installed equipment and casework from damage by work of other trades.