



**SUBCONTRACTOR PREQUALIFICATION  
QUESTIONNAIRE (PASS/FAIL)**

**University of California, Santa Barbara  
Trace Metal Clean Laboratory Project  
RFQ No. FM180148P**

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**Attachment ‘C’:** Draft Division 13, Section 13 21 05 Cleanroom Construction Protocol (Not for Construction) .....9 pages

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## I. PREQUALIFICATION QUESTIONNAIRE

### 1. PROJECT SUMMARY

Subject to conditions prescribed by the University of California, Santa Barbara (“University”), responses to the subject Subcontractor Prequalification Questionnaire are sought from qualified specialty contractors holding a current C-6 (Cabinet Millwork & Finish Carpentry) license.

Interested firms must be pre-qualified under the terms of the Subcontractor Prequalification Questionnaire, in order to be allowed to submit subcontractor bids to the prime Bidder (i.e., General Contractor) on the forthcoming Trace Metal Clean Laboratory Project (“Project”). The Project is tentatively scheduled for competitive bidding by the University during the mid-December 2017 timeframe.

The successful subcontractor will not be installing their “normal” represented laboratory casework systems, but will instead be required to install specialized metal-free systems from a specialized manufacturer. Air Control (or approved equal) will be the manufacturer of the laboratory casework and hoods used as the basis of design.

The Project includes the construction of a new Metal Free Clean Laboratory for the Department of Earth Science that will be housed on the 2<sup>nd</sup> floor of an existing building on the University campus. The new lab will be used by one of the nation’s preeminent geochemists who is conducting cutting edge research using isotopic and chemical composition of lavas to gain insight into the make-up of the Earth’s deep interior. This level of research requires a metal free clean lab and an adjacent precision instrument room that will contain a thermal ionization mass spectrometer [TIMS]. Several laminar flow fume hoods will be incorporated into the Project.

Estimated construction cost for the TOTAL Project is \$2,900,000, and the estimated cost of the **Cabinet, Millwork & Finish Carpentry** portion of the Project is approximately **\$550,000**.

Based upon projected needs, the assignable square footage for this project is anticipated to be approximately 1,039 square feet. The laboratory includes two (2) separate suites; both highly specialized and ultra-clean. The suites are generally described as follows:

- (1) The **TMCL Clean Suite** will be a metal free series of rooms. No exposed metal is allowed inside the finished envelope. This suite includes one (1) perchloric acid hood, two (2) horizontal laminar flow hoods, ten (10) vertical flow laminar hoods, two (2) sinks with DI purified water supply. There must be no exposed metals, sheet rock, or plaster in the TMCL Clean Suite.
- (2) The **TIMS Instrument Suite** will house a Thermal Ionization Mass Spectrometer (TIMS) instrument. This suite may have exposed metal inside the finished envelope. This instrument is University-furnished and University-installed. There must be no exposed metals, sheet rock, or plaster in the TMS Instrument Suite.

The overall scope of Work will include architectural, mechanical, plumbing, structural, electrical, and fire protection additions (fire alarm modifications & automatic fire extinguishing piping inside laboratory suites for future use only).



**Testing & Certification Standards:**

Fume hoods must be factory-certified under ISO 6 Test/Cert Class standards, and the remaining work will be tested and certified in accordance with Table 1 below.

Table 1:

CLEANROOM TEST & CERTIFICATION								
Room	Design Class	Test/Cert Class (As-Built)	Airflow Velocity, Volume (Filter Face & Room)	Filter Leak Test	Airborne Particle Counts / Class (0.1 & 0.5 um Particles)	Pressure	Temperature	Humidity
Gowning/Airlock	ISO 6	ISO 6	X	X	X	X	X	
Clean Prep	ISO 6	ISO 6	X	X	X	X	X	
Balance Room	ISO 6	ISO 6	X	X	X	X	X	X
Clean Lab 1	ISO 5	ISO 5	X	X	X	X	X	
Clean Lab 2	ISO 5	ISO 5	X	X	X	X	X	
Clean Lab 3	ISO 5	ISO 5	X	X	X	X	X	
TIMS Prep	ISO 6	ISO 6	X	X	X	X	X	
TIMS Machinery	ISO 6	ISO 6	X	X	X	X	X	X

**2. TENTATIVE PROJECT BIDDING/CONSTRUCTION SCHEDULE**

**Advertisement for Bids:** Mid-December 2017 (Includes list of prequalified C-6 subs)

**Bid Opening:** Late February 2018

**Notice of Award to General Contractor:** Mid-March 2018

**NTP Issued:** March 2018

**Construction Start:** Late March 2018

**Substantial Completion:** September 2018



### 3. GENERAL INSTRUCTIONS

- A. Each prospective subcontractor must respond to each of the questions listed in the Subcontractor Prequalification Questionnaire and provide the information requested therein. Any subcontractor failing to do so may be deemed 'not prequalified' with respect to this particular project, thereby eliminating that firm from further consideration in the competitive bidding process.
- B. All subcontractors submitting a complete Subcontractor Prequalification Questionnaire will be notified in writing as to whether or not they have successfully been prequalified to participate in the competitive bidding process.
- C. Only those subcontractors that have been prequalified will be eligible to submit a bid to the prime Bidder (i.e., General Contractor) for the subject project. The University cannot, however, guarantee that any of the prime bidders will select a particular subcontractor to participate in the bidding process.
- D. If a prospective subcontractor is determined by the University to be "not prequalified," the prospective subcontractor may request a review by the University. Any such request must be received by the University within three (3) calendar days after the prospective subcontractor's receipt of the University's determination.
- E. The decision resulting from such review is final and is not appealable within the University of California. Any person or entity not satisfied with the outcome of the prequalification process described below must file a writ challenging the outcome within ten (10) calendar days from the date of the University's written notice regarding prequalification determination. Any assertion that the outcome of the prequalification process was improper will not be a ground for a bid protest.

All information submitted for prequalification evaluation will be considered official information acquired in confidence, and the University will maintain its confidentiality to the extent permitted by law.

WHERE NECESSARY, COPY THE FORMS IN THIS PACKAGE. USE ONLY THE FORMS PROVIDED HEREIN.

**4. LICENSE & CERTIFICATION(S)**

- A. Does your firm hold the following California contractor's license(s), which is current, active and in good standing with the California Contractor's State License Board?

*License Classification:* Cabinet, Millwork & Finish Carpentry    *License Code(s):* C-6

YES       NO

License Number(s): \_\_\_\_\_

*(NOTE -The entity submitting this prequalification questionnaire must be the holder of the requisite license.)*

An entity wishing to use a predecessor business to satisfy qualification requirements must demonstrate with written information submitted with this Subcontractor Prequalification Questionnaire that it is substantially the same organization as the predecessor business. An entity may meet the requirement of the preceding sentence by demonstrating that the same person is the qualifying individual (under California Contractor's License Law) for:

1. Contractor's license of subcontractor which shall be the same type as license required for the Contract; and
2. Contractor's license of predecessor business which shall also be the same type as the license required for the Contract.

- B. Has your firm's contractor's license has been suspended or revoked by the California Contractor's State License Board within the last five (5) years?

YES       NO

- C. Woodwork Institute ("WI") Certification

1. Is your firm a WI certified shop that is able to obtain WI inspections, program labels on fabrication shop drawings and final WI installation approval?

YES       NO        NOT APPLICABLE

**5. SAFETY**

- A. Does your firm have a written safety program that meets CAL/OSHA requirements?

YES       NO

- B. Has your firm had any Cal-OSHA fines in the Serious and Willful categories within the past five (5) years?

YES       NO

Note: Failure to answer "Yes" to question "4(A)", "4(B)" and, if applicable, "4(C)(1)" listed above will result in the firm being deemed "not prequalified," thereby eliminating that firm from further consideration in the competitive process. A firm's failure to answer "Yes" to questions "5(A)" and "5(B)" or provide an acceptable explanation for a "No" response, determined at the University's sole discretion, will result in that firm being deemed "not prequalified," thereby eliminating that firm from further consideration in the competitive process.

**6. DISCIPLINARY MEASURES HISTORY**

Has your firm under its current name or under any other alias been disqualified or otherwise barred from doing business with a public agency (e.g., federal, state, county, city, University of California System, California State University System, school district,) within the last ten (10) years?

YES  NO

**7. FALSE CLAIMS HISTORY**

Has your firm been found in a final decision of a court to have submitted a false claim to a public agency (e.g., federal, state, county, city, University of California System, California State University System,) within the last five (5) years?

YES  NO

**8. LIQUIDATED DAMAGES**

In the last five years, has your firm been assessed liquidated damages of more than \$5,000 on a construction contract with either a public or private owner?

YES  NO

**9. TERMINATION**

Has your firm been terminated for cause by an Owner or public agency after construction commenced within the last five (5) years?

YES  NO

Note: Failure to answer "No" to questions "6" and "7" will result in that firm being deemed "not prequalified", thereby eliminating it from further consideration in the competitive process. A firm's failure to answer "No" to question "8" and "9", or provide an acceptable explanation for a "Yes" response, determined at the University's sole discretion, will result in that firm being deemed "not prequalified," thereby eliminating it from further consideration in the competitive process.

**10. SURETY**

- A. Is your firm able to obtain both payment and performance bonding in an amount of **\$750,000**?

YES  NO

- B. Has a surety paid out any monies on claims on the **performance bond** issued by a surety for the benefit of an Owner arising out of the construction activities of the your firm within the last five (5) years?

YES  NO

- C. Has a surety paid out any monies on claims on the **payment bond** issued by a surety for the benefit of the an owner or your firm's subcontractors, suppliers or materialmen arising out of the construction activities of your firm within the last five (5) years?

YES  NO

Note: A firm's failure to answer "YES" to question "10A" above will result in that firm being deemed "not prequalified", thereby eliminating it from further consideration in the competitive process. Further, a firm's failure to answer "No" or, in the University's sole discretion, provide an acceptable explanation for a "Yes" response to questions "10B" and "10C" will result in that firm being deemed "not prequalified", thereby eliminating it from further consideration in the competitive process.

**11. SUBCONTRACTOR QUALIFICATIONS & EXPERIENCE****A. REQUIRED PROFESSIONAL QUALIFICATIONS / CERTIFICATIONS:**

1. Your firm must, at the time of award, possess the appropriate professional certification(s) demonstrating that its personnel is/are a factory-trained and authorized representative/installer of the casework, air containment systems, and/or fume hood equipment used as the basis of design for this Project.

**B. REQUIRED EXPERIENCE (COMPARABLE PROJECTS):**

Your firm, acting in the role of subcontractor must have successfully completed at least three (3) comparable projects within the last five (5) years. Each comparable project must be described on the attached Project Data Sheet (see Attachment 'A') and must satisfy the minimum experience criteria listed below.

Subject to the above qualifications, a "comparable project" is defined as having the following characteristics 1 thru 5:

1. The project included the interior renovation of a laboratory or equivalent facility, which included the installation of chemical fume hoods for use within an ISO Class 6 or better certified cleanroom space(s); **AND**
2. The **total** construction cost for the entire project at the time of bid was at least \$1,000,000; **AND**
3. The project Work performed by your firm included either WI inspections, program labels on fabrication shop drawings or final WI installation approvals; **AND**
4. The Work involved installation of cleanroom laboratory casework, air containment systems, and fume hoods, or a similar work scope.

**C. DESIRABLE EXPERIENCE (Not required, information only)**

1. The Work involved installation of casework and fume hood systems following a general requirements for all personnel, components, materials, equipment, tools, in accordance with *cleanroom protocol requirements* utilized in the construction, start-up, commissioning, and certification of the cleanroom space(s).

- (a) Acting as a subcontractor, has your firm successfully completed work in the last ten (10) years that involved the installation of a metal-free cleanroom, laboratory casework, air containment system and fume hood?

YES  NO

**Note:** Failure to meet or commit to meeting the requirements set forth under question "11(A)" and submit a description of the required number of comparable projects on the attached Project Data Sheet (see Attachment 'A') that satisfy the criteria set forth under question "11(B)" will result in the Contractor being deemed "not prequalified", thereby eliminating that firm from further consideration in the competitive process.



**II. PREQUALIFICATION DECLARATION**

I, \_\_\_\_\_ (Printed Name),  
 hereby declare that I am the \_\_\_\_\_ (Title)  
 of \_\_\_\_\_ (Name of Entity)  
 submitting this Subcontractor Prequalification Questionnaire; that I am duly authorized to  
 sign this Subcontractor Prequalification Questionnaire on behalf of the above named  
 entity; and that all information set forth in this Subcontractor Prequalification  
 Questionnaire and all attachments hereto are, to the best of my knowledge, true,  
 accurate and complete as of its submission date.

The undersigned declares under penalty of perjury that all of the qualification information  
 submitted with this form is true and correct and that this declaration was executed in  
 \_\_\_\_\_ (County), \_\_\_\_\_ (State) on \_\_\_\_\_ (Date).

\_\_\_\_\_  
 (Signature)

\_\_\_\_\_  
 (Printed Name)

\_\_\_\_\_  
 (Address)

\_\_\_\_\_  
 (City, State, Zip Code)

\_\_\_\_\_ (Telephone Number)      \_\_\_\_\_ (Facsimile Number)

\_\_\_\_\_  
 (E-mail - optional)

COMPLETE AND SUBMIT A PROJECT DATA SHEET FOR EACH COMPARABLE PROJECT.

**ATTACHMENT 'A'**  
**PROJECT DATA SHEET**

(A separate sheet must be prepared for each comparable project submitted.)

1. Project Name: \_\_\_\_\_

2. Project Location (including full address, if any):  
\_\_\_\_\_

City: \_\_\_\_\_ State: \_\_\_\_\_ Zip: \_\_\_\_\_

3. Project Description: \_\_\_\_\_

4. Construction Type: \_\_\_\_\_

5. Size (gross sq. ft.): \_\_\_\_\_

6. Business name of General Contractor that constructed this project:  
\_\_\_\_\_

7. Did your firm perform either the **Cabinet, Millwork & Finish Carpentry (C-6)** portion of the Work on this project?

YES

NO

8. Explain how is this project comparable to the UCSB project to be bid?  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ *[provide separate written detail, if necessary]*

9. Cost at Time of Bid:                   \$ \_\_\_\_\_

Cost at Final Completion:           \$ \_\_\_\_\_

10. Describe the sources and/or causes of the above differences in costs with reference to the following categories:

Document Problems:	\$ _____
Unforeseen Conditions:	\$ _____
Owner Generated Scope:	\$ _____
Regulatory Agency:	\$ _____
Other:	\$ _____

Explain Other: \_\_\_\_\_

11. Was construction of the project completed within the last five (5) years?

YES

NO

Start Date (NTP): \_\_\_\_\_ Completion Date: \_\_\_\_\_

12. \_\_\_\_\_ Contract Time at bid date (Number of calendar days)  
\_\_\_\_\_ Formally adjusted Contract Time (Number of calendar days; if not adjusted, state "Not Applicable")

If completion did not occur within the Contract Time at bid date or within the formally Adjusted Contract Time, then explain the reason(s) for the delay:

\_\_\_\_\_  
\_\_\_\_\_

13. Were either liquidated damages or actual damages for delay assessed by the Owner on this project?

YES

NO

14. Project Owner Name: \_\_\_\_\_  
Project Owner Address: \_\_\_\_\_  
City: \_\_\_\_\_ State: \_\_\_\_\_ Zip: \_\_\_\_\_  
(Telephone Number) \_\_\_\_\_ (Facsimile Number) \_\_\_\_\_  
E-mail Address-optional: \_\_\_\_\_

*(Attach additional pages with other pertinent project information as necessary.)*

SECTION 11 53 10 - LABORATORY CASEWORK AND OTHER FURNISHINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

Attachment B

- A. Non-Metallic Laboratory Casework (no exposed metal construction)
- B. Laboratory Work Surfaces
- C. Balance Tables
- D. Wall Hung Benchtop
- E. Shelving Assemblies
- F. Pass-Through Air Lock
- G. Gowning Bench
- H. Sealant

1.2 RELATED SECTIONS

- A. Section 13 21 40 – Cleanroom Fume Hoods
- B. Division 22 – Plumbing
- C. Division 23 – Heating, Ventilated, and Air-Conditioning
- D. Division 26 – Electrical
- E. Division 27 - Communications

1.3 REFERENCES

- A. Scientific Equipment and Furniture Association: SEFA 2 Recommended Practices for the Installation of Scientific Laboratory Furniture and Equipment.
- B. Scientific Equipment and Furniture Association: SEFA 3 Recommended Practices for Work Surfaces.
- C. Scientific Equipment and Furniture Association: SEFA 8-P Recommended Practices for Laboratory Grade Polypropylene Casework.

1.4 BID SUBMITTALS

- A. Certification of Compliance: All bidders (including those listed in 2.01-A) must submit a compliance certification statement indicating that their bid includes products and installation which comply with every requirement of the project specifications and drawings (accounting for any RFI responses received during the bidding phase).

- B. Certification of Qualifications: All bidders must submit a certification of compliance with the Qualifications requirements outlined below. List specific project experience as evidence of compliance.

## 1.5 SUBMITTALS

- A. Refer to General Conditions and Division 1 "Submittal Procedures" for submittal requirements. In addition to these requirements, provide submittal requirements specified herein.
- B. Submittal requirements:
  - 1. Submittal shall be prepared individually for this specification section. Arrange product data, drawings and information for submission in a complete set for this specification section.
  - 2. Submittal shall contain complete data for all items of this specification section. Periodic or partial submittals of individual components within this specification section will be returned as incomplete and rejected.
  - 3. Submittals shall be organized by specification sequence with section and paragraph number identified.
  - 4. Equipment and components being proposed shall be clearly labeled with all options and accessories indicated and shall be for this specific project. All non-applicable items shall be deleted or struck.
  - 5. Product data submittals provided in PDF format shall consist of fully collated PDF files allowing for collated printing from a single file.
- C. Materials List/Product Data: Submit complete materials list, including catalogue data, of all materials, equipment, and products for work in this section.
  - 1. Product data shall not be duplicative or redundant with shop drawings. Do not include drawings in the product data submittal that are included in the shop drawings.
- D. Shop Drawings: Submit complete shop fabrication and installation drawings, including plans, elevations, sections, details and schedules.
  - 1. Show relationship to adjoining materials and construction, method of field assembly, location and size of each field connection, access features, joint details, and attachment details.
  - 2. Show seaming pattern layout of all joints in work surfaces.
  - 3. Shop Drawings shall be in the form of reproducible, PDF files, or photocopies, to scale, sheet size not to exceed 11 inches x 17 inches (A3).
  - 4. Shop drawing submittals provided in PDF format shall consist of fully collated files allowing for collated printing from a single file. Blue line prints are not acceptable.
- E. Approved Substitution/Approved Equal: In addition to the items required in Division 1, all substitution requests shall include item-by-item comparison of the proposed substitution to this project specification. A copy of the project specification shall be submitted, with each item and subsection of the project specification marked as "Comply" or "Not Comply." In any cases where "Not Comply" is indicated, an explanation of the relative advantages of the proposed design shall be provided.

- F. Submit detailed anchorage and attachment drawings and calculations provided by a licensed Structural Engineer complying with the Uniform Building Code Earthquake Regulations and the California Administrative Code, Title 24 Seismic Restraint requirements.
- G. Samples: Accompanying Materials List, submit for Architect's approval two (2) samples of each type of specified finish and color range available for casework, laboratory work surfaces, painted steel fabrications, cabinet hardware, and shelving.
- H. Certifications/ Test Data: Submit certifications and test data as required elsewhere in this section, including SEFA structural performance test reports, and finish performance test reports.
- I. Operations/Maintenance Manuals: At project close-out, submit for Architect's review and Owner's use, complete operating and maintenance manuals that describe proper operating procedures, maintenance and replacement schedules, components parts list, and closest factory representative for components and service.
- J. Warranty: Submit manufacturer's warranty including any additional certifications as needed to meet the requirements specified.

#### 1.6 QUALITY CONTROL

- A. Raw sheet stock materials shall be 100% inspected prior to fabrication and shall be certified to be free of any visual or structural defects.
- B. Manufacturer to clean and wrap casework in an ISO class 5 cleanroom so that units are delivered in a "cleanroom ready" state.
- C. Installer Qualifications: An authorized representative of the manufacturer shall install units and equipment required for this project.

#### 1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Protection: Use all means necessary to protect work of this section before, during and after installation including installed work and materials of other trades.
- B. PVC laboratory casework to be tested, cleaned, and wrapped for shipment in a Class 100 Cleanroom or better. Units to be "cleanroom-ready" when leave the manufacturer's shipping dock.
- C. Units to be shipped via Air-Ride only, or fully crated.
- D. Replacement: Any damaged work shall be replaced, repaired and restored to original condition to the approval of the Architect at no additional cost or inconvenience to the Owner.

#### 1.8 QUALIFICATIONS

- A. Manufacturers: Work in this section shall be manufactured by a company/companies having a minimum of ten (10) years documented experience manufacturing products

similar to those specified for specialized laboratory applications; an established organization; and production facilities including all tools, equipment and special machinery necessary for specializing in the fabrication of the type of products specified, with skilled personnel, factory trained workmen and an experienced engineering department. Each shall have the demonstrated knowledge, ability and the proven capability to produce the specified work of the required quality, size, and type within the required time limits.

## 1.9 WARRANTY

- A. All products will be warranted to be free from defects in materials and workmanship for a period of one year following substantial completion. The manufacturer/dealer/subcontractor shall repair or replace any products (or parts thereof) that are found to be defective. Replacement will include any parts, labor, shipping, and travel expenses involved. Warranty replacement work must be scheduled in coordination with the client's academic/research schedule and may therefore require evening and/or weekend work.

## PART 2 PRODUCTS

### 2.1 NON-METALLIC LABORATORY CASEWORK

- A. Manufacturers: Products complying with this specification may be provided by the following manufacturers. All products specified in this section shall be the provided by a single manufacturer.
  - 1. Air Control, Inc.
  - 2. Or approved equal.
  
- B. Design Requirements:
  - 1. Casework shall be of non-metallic exposed construction for trace metals laboratory analysis with no exposed metal surface to the environment. Metallic structural members shall be fully encapsulated by non-metal layers such that no metal is exposed.

2. Flush interiors: Units shall have an easily cleanable smooth and flush interior in a dust resistant case.
  3. All tall storage cabinets to have toe space to match base units.
  4. Casework shall be manufactured of FM-4910 compliant fire retardant plastic sheet stock with continuously welded joints
- C. Performance Requirements
1. Units shall be tested for compliance with SEFA-8P. Submit test results for review.
- D. Materials and Finishes:
1. Cabinets:
    - a. White stress-relieved CRP-1 polyvinyl chloride (PVC) sheet stock plastic conforming to FM-4919 approved fire retardant plastics.
    - b. White stress-relieved polypropylene sheet stock plastics conforming to FM-4910 approved fire retardant plastics.
  2. Cabinet glazing: Cabinet glazing to be clear transparent 3/8" Lexan with Margard anti-scratch finish.
  3. No exposed metal is to be present in the finished casework.
- E. Construction:
1. General:
    - a. All non-metallic laboratory casework to be built in accordance with the standard of construction for the laboratory casework industry per SEFA 8-P-2007, and 3rd party tested against same. Test results to be furnished with bidder's package.
    - b. All components, including hardware are solid plastics selected to resist specific chemistries. No metals to be used in the construction of non-metallic casework, including screws and hardware. Coated screws or hardware is not acceptable.
  2. Cabinet:
    - a. Cabinet structure shall be built with 1/2-inch thick solid material. Cabinet shall be CNC "V-notched and folded" such that only one weld is required in rear of unit, providing increased "box-structure" load strength, as well as better aesthetics (no visible front located welds or joints). All cabinet construction to be CNC cut for precise dimensional tolerances and reproducibility.
    - b. Units shall be of flush front construction with intersection of vertical and horizontal case members, such as end panels, in same plane without overlap. Provide heavy back up reinforcement at exterior corners. Face joints shall provide a continuous flat plane. A uniform clearance around door and drawers shall be provided.
    - c. Cabinet Bottom: Case bottom shall be pan type formed up with a radius or be sealed to sides to contain liquids and to provide for ease of cleaning, front shall be offset to provide a door and drawer recess rabbet.



3. Doors: Doors shall be solid ½-inch thick solid material with beveled, smooth edges. Hinges and screws shall be plastic construction. Screws shall be special non-shedding acrylic reinforced polypropylene for tensile and shear strength of up to 10 times greater than polypropylene. Door catches are magnets, which are recessed into both door and cabinet, and encapsulated with plastic. Each door to have magnets both on top and bottom of door for superior bonding.
4. Drawers: Drawer bodies shall be ½-inch thick solid material construction. The drawer bottom and sidewalls shall be thermally welded together making a leak-tight compartment. Drawers shall have built-in stops to prevent accidental pullout, as well as provisions to prevent full drawer from tipping forward and down, while pulling out. Drawer suspension shall utilize PVC “notched groove” system, containing no metal. Glides shall operate smoothly, quietly, and provide sufficient strength.
5. Work Surface: Work surface tops to be manufactured in matching material unless otherwise noted on the drawings. Work surface top thickness shall be 1-inch with a 4-inch tall backsplash thermally fused to top.
6. Joints: All joints shall be thermally welded by special plastics fusing process, which ensures leak-free, superior strength, flush unions. Welds shall be “polished” such that any joints are flush and smooth.
7. Base Cabinets:
  - a. Cabinets shall be capable of being leveled using a leveling device constructed from polypropylene, Teflon, PVC or ABS plastic and accessible for adjustment through clipboard bottoms. Leveling device shall be protected by a cover over a ½ inch (12 mm) spill lip around leg leveling device.
  - b. Intermediate rails shall be provided between doors and drawers, but shall not be provided between drawers. When required, intermediate rails shall be recessed behind door and drawer fronts, designed so that security panels may be added if required and be removable for field revision of cabinet configuration.
  - c. Toe space rail shall extend up and forward to engage bottom rail to form a smooth surfaced fully enclosed toe space, minimum 3 inches deep and 4 inches high. Whenever the base is omitted, this space shall be fully enclosed.
  - d. Toe space rail shall be removable to provide access for cleaning the space under the cabinet, see Laboratory Furnishing drawings for location.
  - e. Cabinet back construction shall provide access to utility chase through either access panels in integral fixed backs or back panels removable from the interior of an installed case. Open backed cabinets are not acceptable.
8. Wall Cabinets: Wall cabinets shall be made of the same quality standards as base units, utilizing the same requirements as applicable.
9. Shelves:
  - a. Shelves are made from solid ½-inch matching plastic material and supported by non-metallic adjustable structure. Shelves have structural “lips” which are integral to design, providing increased strength and dampening characteristics.
  - b. Adjustable shelves shall be adjustable on ½-inch centers in base units and 1-inch centers elsewhere.

- c. Provide 1-inch tall seismic restraining lips on open shelves and on flat tops of cases that are 5 feet or more above finished floor.
10. Doors shall consist of solid one piece construction. Welds, corners and edges to be ground smooth to prevent exposure of sharp edges. Doors shall be readily removable and hinges easily replaceable.
11. Drawers shall be available in a variety of heights and widths. Drawers shall be mountable in any location in cabinet. Sides shall be full height with ½ inch (13 mm) clearance to frame opening. Drawers shall be a minimum of 18 inches front to back.
12. Knee space back panel shall be finished same as cabinets, and easily removable for access to utility chase.
13. Provide filler panels where required between cabinets, at corner intersections of cabinets, between cabinets and walls and wherever else required for a complete finished installation. For tall cabinets, filler panels shall be provided for vertical face and top. For wall cabinets, filler panels shall be provided for vertical face, top and bottom.
14. Provide other items as shown on the laboratory drawings, including pipe drops, fixed shelving systems adjustable shelving systems, end panels, and similar – using polypropylene material and methods as appropriate.

F. Hardware:

1. General: All hardware shall be non-metallic, highly corrosion resistant, and constructed from polypropylene, PVC, PVDF, TFE, or as specified. Nylon, Delron, or similar materials are not allowed. Metallic hardware, when approved, shall be coated with a minimum of 2.0 mils of TFE, PTFE, or other approved corrosion resistant coating and be protected from direct exposure to the ambient environment via embedment in the polypropylene material.
2. Pulls: The drawer and door pulls shall be polypropylene, PVC or ABS plastic recessed (not attached to the top edge of drawers or doors), offering a comfortable handgrip, thru-bolt to door or drawer with non-metal fasteners from back face. Two pulls shall be furnished on drawers wider than 2 feet (610 mm). Use of nylon pulls or other types subject to chemical abuse breakage will not be accepted. Pulls shall meet State and Federal Handicapped Accessibility Regulations.
3. Hinges: Hinges shall be polypropylene, PVC, Teflon or ABS plastic, institutional type, with a five knuckle rounded edge barrel. Hinges shall be attached to both door and case with minimum of two non-metallic screws. Chemical welding of hinges to door or case will not be accepted. Provide one pair for doors less than 36 inches (914 mm) in height and 1½ pair for doors over 36 inches (914 mm).
4. Shelf Adjustment Clips: Shelf adjustment clips shall be polypropylene, PVC or ABS plastic.
5. Drawer Guides: Drawer guides shall provide a quiet smooth operation and integral reels of same materials as cabinets. Two reels shall be provided on drawers 30 inches (762 mm) and wider. Provide integral draw stops of same materials as cabinet to prevent inadvertent drawer removal and contact with back of cabinet, yet allow easy removal without the use of tools. Drawers shall be designed and constructed to support 75 lb (34 kg) capacity.
6. Door Catches: Door catches shall be non-metal with non-metal strike plates. Door catches shall be capable of a minimum 7 lb (31 N) pull. Catches permitting rebound opening are not acceptable.

7. Leveling Shims: Polypropylene or PVC leveling shims shall be provided for final field casework installation.

## 2.2 LABORATORY WORK SURFACES

### A. Epoxy Resin:

1. Manufacturers: Products complying with this specification may be provided by the following manufacturers.
  - a. American Epoxy Scientific
  - b. Durcon Laboratory Tops, Inc.
  - c. Kewaunee Scientific Corporation
  - d. Approved substitution.
2. Thickness:
  - a. Typical work surface: 1 inch (25 mm).
  - b. Curbs and Splashes:  $\frac{3}{4}$  inch (19 mm).
3. Color:
  - a. Black.
  - b. Color sample to be approved by Architect before work is put in hand.
4. Description:
  - a. Monolithic filled epoxy resin work surface consisting of a polymerized cast resin material oven-cured in molds.
  - b. Drip Grooves: Provide under all work surface exposed edges, unless noted otherwise on the Laboratory Furnishing Drawings. Drip grooves shall be  $\frac{1}{2}$  inch (13 mm) from the front edge where the top overhangs 1 inch (25 mm) and  $\frac{1}{4}$  inch (6 mm) from the edge where the edge overhangs  $\frac{1}{2}$  inch (13 mm).
  - c. Edge profile: For all exposed upper edges and corners:
    - 1). Radius eased:  $\frac{1}{4}$  inch (6 mm) machined radius with blended radius corners.
  - d. Curbs and Splashes:
    - 1). Height: 4 inches (100 mm), unless noted otherwise on Laboratory Furnishing Drawings.
    - 2). Bonded to the surface of the top to form a square joint.
  - e. Provide all holes and cutouts as required for built-in equipment and mechanical and electrical service fixtures. Verify size of opening with actual size of equipment to be used prior to making openings. Form inside corners to a radius of not less than  $\frac{1}{8}$  inch (3 mm). After sawing, rout and file cutouts to ensure smooth, crack-free edges. Seal exposed edges after cutting with a waterproofing material recommended by the manufacturer.

- f. Provide full-length, one-piece tops and backsplashes wherever possible, and keep field joints to an absolute minimum.

5. Physical Properties:

a. Chemical resistance:

- 1). Organic solvents: A cotton ball, saturated with the test chemical, is placed in a one ounce bottle with a reservoir of liquid above the ball. The container is inverted on the test material surface for a period of 24 hours. Test temperature: 23°C ±2°C.
- 2). Other test chemicals: Five drops (1/4 cc) of the test chemical are placed on the test material surface. The chemical is covered with a 1 inch diameter watch glass for a period of 24 hours. Test temperature: 23°C ±2°C.
- 3). Evaluation: After 24 hours exposure, exposed areas are washed with water, then a detergent solution, finally with naphtha, then rinsed with distilled water, dried with a cloth, and rated as follows:

0	No effect	No detectable change in the material surface.
1	Excellent	Slight detectable change in color or gloss but no change in function or life of the surface.
2	Good	A clearly discernable change in color or gloss but no significant impairment of surface life or function.
3	Fair	Objectionable change in appearance due to discoloration or etch, possibly resulting in deterioration of function over an extended period of time.
4	Failure	Pitting, cratering, or erosion of the surface. Obvious and significant deterioration.

4). Test results:

Test chemical	Concentration	Concentration			
		Black	Dark gray	Light gray	Beige
Chromic acid	40%	3	2	2	2
Hydrochloric acid	10%	0	0	0	0
Hydrochloric acid (conc.)	37%	0	0	0	0
Nitric acid	40%	0	0	0	0
Nitric acid (conc.)	70%	0	0	0	0
Sulfuric acid	60%	0	0	0	0
Sulfuric acid (conc.)	96%	4	4	4	4
Acetic acid	5%	0	0	0	0

Test chemical	Concentration	Black	Dark gray	Light gray	Beige
Acetic acid (glacial)		0	0	0	0
Citric acid	1%	0	0	0	0
Oleic acid		0	0	0	0
Phenol solution	5%	0	0	0	0
Ammonium hydroxide	10%	0	0	0	0
Sodium carbonate sol.	20%	0	0	0	0
Sodium hydroxide sol.	60%	0	0	0	0
Sodium hypochlorite sol.	4%	0	0	0	0
Acetone		1	1	1	1
Benzene		1	1	1	1
Carbon tetrachloride		1	1	0	0
Diethyl ether		0	0	1	1
Dimethyl formamide		0	0	0	0
Ethyl acetate		0	1	1	0
Ethyl alcohol	95%	0	0	0	0
Ethylene dichloride		0	0	0	0
Heptane		0	0	1	0
Isooctane		0	0	0	0
Kerosene		0	0	0	0
Methyl alcohol		0	0	0	0
Toluene		0	0	0	0
Aniline		0	0	0	0
Mineral oil		0	0	0	0
Olive oil		0	0	0	0
Soap solution	1%	0	0	0	0
Transformer oil		0	0	0	0
Turpentine		0	0	0	0

b. Heat resistance:

- 1). High temperature test: A porcelain crucible is heated to a dull red color, placed on the test material, and allowed to cool to ambient temperature. Result: No observable surface deformation.
- 2). Flame test: A 3/8 inch (10 mm) Bunsen burner is adjusted to a quiet flame with a 1½ inch (38 mm) inner cone, overturned on the test material, and allowed to stay for 5 minutes. Result: no observable surface deformation.

c. Physical properties:

Compressive strength	ASTM D695	31,400 psi (216 MPa)
Tensile strength	ASTM D638	8,000 psi (55 MPa)
Flexural strength	ASTM D790	11,700 psi (81 MPa)

Rockwell hardness "M"	ASTM D785	105-110
Specific density	ASTM D792	122.4 lb/ft <sup>3</sup> (1960 kg/m <sup>3</sup> )
Water absorption	ASTM D570	0.01%
Fire Resistance	ASTM D635	ATB (sec)=0
Heat deflection @ 264 psi (1.82 MPa)	ASTM D648	205°F (172°C)

## 2.3 BALANCE TABLES

- A. Tops: 2½ inch (63 mm) thick epoxy resin work surface, described in the Laboratory Work Surfaces section of this specification, mounted on frame.
- B. Frame: Fully welded tubular stainless steel faming members completely encapsulated with welded plastic liner to provide a no-exposed metal finish.

## 2.4 WALL HUNG BENCHTOP

- A. Framing Channel, Fittings, and End Caps: Stainless steel slotted channel framing as specified elsewhere on this Section and as indicated on the drawings.
- B. Benchtop material shall be as indicated on the drawings and as specified elsewhere in this Section.
- C. Unit shall be designed to support 200 pounds per square foot (10 kPa), completely wall supported with no legs or support members extending to the floor. Coordinate with wall or partition framing for blocking.

## 2.5 SHELVING ASSEMBLIES

- A. High-Pressure Decorative (Plastic) Laminate Shelving:
  - 1. Manufacturers/Facing material: Products complying with this specification may be provided by the following manufacturers.
    - a. Nevamar Decorative Surfaces
    - b. Pionite Decorative Surfaces
    - c. Wilsonart International
    - d. Approved substitution
  - 2. Approved Products:
    - a. Nevamar ChemArmor.
    - b. Pionite ChemGuard.
    - c. Wilsonart ChemSurf
  - 3. Color: To be selected by Architect.
  - 4. Description:
    - a. High-pressure decorative laminate, meeting or exceeding NEMA Standard LD3 2005 Grade HGP, HGL, or HGS requirements, consisting of a resin

formulation applied over the decorative surface paper to achieve chemical resistance. The decorative paper shall be treated with melamine resin, and the core shall consist of kraft papers impregnated with phenolic resin. Sheets shall be bonded under high temperature and pressure. Product shall be developed for casework, work surface, and shelving surfaces in laboratories.

- b. Laminate shall be applied to top and bottom surfaces.
- c. Finish: Fine pebble-grained "crystal" texture or matte texture with slight sheen to minimize smudges and finger marks, and to provide optimum scratch resistance.

- 1). Gloss: 15-16 +/- 3 gloss units.

- d. Physical Properties:

- 1). Reference Standard: Plastic laminates shall meet or exceed ANSI/NEMA Specification LD3-2005 as specified herein.
- 2). Minimum Thickness: 0.038 inches ± 0.005 inches (0.97 mm ± 0.13 mm).
- 3). Cleanability: 10 cycles (NEMA LD3 test method 3.4).
- 4). Boiling Water Resistance: No effect (NEMA LD3 test method 3.5).
- 5). High Temperature Resistance: Slight effect (NEMA LD3 test method 3.6).
- 6). Scratch Resistance: 4.5 Newtons (NEMA LD3 test method 3.7).
- 7). Ball Impact Resistance: 60 inches (1524 mm) (NEMA LD3 test method 3.8).
- 8). Radiant Heat Resistance: 200 sec (NEMA LD3 test method 3.10).
- 9). Dimensional change:
- 10). Machine direction: 0.50% (NEMA LD3 test method 3.11).
- 11). Cross direction: 0.80% (NEMA LD3 test method 3.11).
- 12). Wear resistance: 1,500 cycles, min. (black); 700 cycles, min. (other colors) (NEMA LD3 test method 3.13).
- 13). Blister Resistance: 70 sec (NEMA LD3 test method 3.15).
- 14). Stain Resistance Performance Test Results: The surface shall show essentially no effect on Black (Lab grade) plastic laminate when left in contact for 16 hours either when reagents were kept covered or allowed to evaporate.

0	No effect	No detectable change in the material surface.
1	Excellent	Slight detectable change in color or gloss but no change in function or life of the surface.
2	Good	A clearly discernable change in color or gloss but no significant impairment of surface life or function.
3	Fair	Objectionable change in appearance due to discoloration or etch, possibly resulting in deterioration of function over an extended period of time.
4	Failure	Pitting, cratering, or erosion of the surface. Obvious and significant

deterioration.		
Acids	Concentration	Rating
Acetic acid	All	0
Aqua regia		0
Chromic trioxide (Chromic acid cleaning solution)		1
Glacial acetic acid	99%	0
Hydrochloric acid	All	0
Hydrofluoric acid	48%	0
Formic acid	All	0
Nitric acid	All	3
Sulfuric acid	All	0
Perchloric acid (concentrated)		0
Phosphoric acid	All	0
Picric acid	1.2%	0
Tannic acid (saturated)		0
Uric acid (saturated)		0
Alkalis		
Ammonium hydroxide	All	0
Sodium hydroxide	All	3
Sodium sulfide	15%	0
Solvents		
Acetone		0
Amyl acetate		0
Amyl alcohol		0
Butyl alcohol		0
Carbon disulfide		0
Carbon tetrachloride		0
Chlorobenzene		0
Chloroform		0
Cresol		0
Dimethylformamide		0
Dioxane		0
EDTA		0
Ethyl acetate		0
Ethyl alcohol		0



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Solvents	
Formaldehyde	0
Methanol	0
Methyl ethyl ketone	0
Methylene chloride	0
n-Hexane	0
Naphthalene	0
Phenol	0
Tetrahydrofuran	0
Toluene	0
Trichlorethane	0
Xylene	0

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General Reagents	
Alconox (lab detergent)	0
Aluminon	0
Ammonium phosphate	0
Aromatic ammonia	0
Benedicts solution	0
Calcium hypochlorite (concentrated)	0
Camphorated parachlorophenol	1
Cellosolve	0
Copper sulfate	0
Ethylene glycol	0
Eucalyptol	0
Formalin	0
Gasoline	0
Hydrogen peroxide	3% 0
Iodine	0
Karl Fisher Reagent	0
Kerosene	0
Lactated ringers	0
Lysol	0
Methyl methacrylate	0
Mineral Oil	0
Monsel's solution (Ferric subsulfate)	0
Naphtha	0
Petroleum jelly	0
Phosphate buffered saline (PBS)	0
Pine oil	0
Potassium permanganate	0
Povidone iodine	0
Procaine	0
Quaternary ammonia compounds	0
Silver nitrate	0
Sodium azide	0
Sodium chromate	0

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General Reagents		
Sodium hypochlorite	5%	0
Sodium thiocyanate		0
Sucrose	50%	0
Thymol & Alcohol		0
Tincture of Iodine		0
Tincture of Mercurochrome		0
Tincture of Merthiolate		0
Trisodium phosphate	30%	0
Urea		0
Vegetable oils		0
Water		0
Zephiran chloride		0
Zinc chloride		0
Zinc oxide ointment		0

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Stains and Indicators		
Ag Eosin Bluish 5% in Alcohol		0
Bromothymol Blue		0
Cresol Red		0
Crystal Violet		0
Gentian Violet	1%	0
Gram Stains		0
Malachite Green		0
Methyl Orange		0
Methyl Red		0
Methylene Blue		0
Nigrosine		0
Safranin O		0
Sudan III		0
Thymol Blue		0
Wright's Blood Stain		0

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5. Plastic laminate adhesive: High-pressure decorative laminate shall be bonded to core with thermosetting resorcinol or phenol-resorcinol adhesive, or as recommended by the manufacturer for the application, at temperature above 65°F (18.3°C) at a pressure no less than 15 pounds per square inch. Laminate core is not to exceed 10% moisture content and is to be laminated and cured in a controlled environment between 45% and 60% RH.
6. Core material: Hardwood Veneer Plywood.
  - a. Description: A one step calibrated core +/- .5mm (to avoid voids) with type 1 waterproof nauf glue. Grade 2 face, and back of mill choice plywood veneer.
  - b. Thickness/Plies:
    - 1). 1 inch (25 mm): minimum 9-ply.

- c. Physical Properties:
  - 1). Average modulus of rupture: 7346 psi (50.65 N/mm<sup>2</sup>).
  - 2). Face Screw Holding Strength: 355 lbf (1579 N).
  
- 7. Edging:
  - a. Unless otherwise indicated, all edges shall be edgebanded with 3 mm PVC edge banding set in hot melt adhesive. Adhesive shall have a minimum softening point of 150°F (65.6°C). Apply primer to substrate when recommended by adhesive manufacturer. Contact cement is not acceptable. Color of edgebanding to be selected by the Architect.
  
- B. Safety Edges:
  - 1. Types:
    - a. Retainer Rail: ¼ inch (6 mm) diameter stainless steel retainer rail, as indicated on the drawings.
  - 2. Refer to the description of each system below for locations of each type.
  
- C. Adjustable Wall Shelves:
  - 1. Shelving: High-Pressure Decorative Laminate shelving as specified above.
  - 2. Double Slot Shelf Standards:
    - a. Manufacturers: Products complying with this specification may be provided by the following manufacturers. All products specified in this section shall be the provided by a single manufacturer.
      - 1). Knappe & Vogt Manufacturing Company, 2700 Oak Industrial Drive NE, Grand Rapids, MI 49505 Tel: 616 459-3311.
      - 2). Approved substitution.
    - b. Basis of Design: Knappe & Vogt 85 ANO series uprights, or equal. Length as indicated on the drawings.
  - 3. Shelf Brackets: 16 gauge (1.6 mm) bookend type, as detailed on drawings.
  - 4. Safety edging:
    - a. Front Edge:
      - 1). Retainer rail.
  - 5. Load capacity: System shall support a minimum of 35 pounds per square foot applied at all shelves simultaneously. Maximum deflection shall be 0.35 inches (9mm) under load.
  - 6. Finish: Factory finish standards and brackets with epoxy powder coating. Color to be selected by the Architect.

## 2.6 PASS-THROUGH AIR LOCK

- A. Manufacturers: Products complying with this specification may be provided by the following manufacturers. All products specified in this section shall be the provided by a single manufacturer.
1. Air Control, Inc.
  2. LabAire Systems, Inc.
  3. NuAire, Inc.
  4. Terra Universal Inc.
  5. Approved substitution.
- B. Provide white Polypropylene or PVC with hinged clear acrylic window door each side. United shall be fully welded to form an airtight chamber.
- C. Doors shall be fitted with an interlocking device to prevent both doors being open at the same time.
- D. Dimensions: 12 inches x 12 inches x 12 inches.
- E. Accessories: Provide a 1-1/2" or 2" wide, 4-sided trim collar for each side of wall for the pass-through unit. Trim collar shall have fully welded seams finished smooth and use matching material to chamber construction.

## 2.7 GOWNING BENCH

- A. Manufacturers: Products complying with this specification may be provided by the following manufacturers. All products specified in this section shall be the provided by a single manufacturer.
1. Air Control, Inc.
  2. Innotech Products Inc.
  3. LabAire Systems, Inc.
  4. NuAire, Inc.
  5. Terra Universal Inc.
  6. Approved substitution.
- B. Description: Fully welded floor-supported mobile gowning bench capable of supporting a single 250 pound person without deflection.
- C. Product characteristics:
1. No exposed metal construction for use in a trace metals laboratory.
  2. Polypropylene or PVC material to match laboratory casework construction.
  3. ISO Class 5 environment design.

## 2.8 SEALANT

- A. Manufacturers: Products complying with this specification may be provided by the following manufacturers.

1. Dow Corning Corporation
2. General Electric Company
3. Sika Corporation
4. Approved substitution.

B. Characteristics:

1. Type: One-part silicone rubber, MIL-A-46106.
2. Physical form: Non-slumping paste.
3. Cure: Cures at room temperature on exposure to water vapor in the air.
4. Authorizations:
  - a. FDA Regulation No. 21 CFR 177.2600.
  - b. USDA Rating P1.
  - c. NSF Rating C2.
  - d. UL 150 C Rating, File No. E40195(N).
5. Properties:
  - a. Tack Free Time: 45 minutes, maximum.
  - b. Durometer, Shore A Hardness: 20, minimum.
  - c. Tensile Strength: 220 pounds per square inch, minimum.
  - d. Elongation: 350 percent, minimum.
  - e. Extrusion Rate: 220 to 525 grams per minute.

### PART 3 EXECUTION

#### 3.1 SITE CONDITIONS

A. Inspection:

1. Prior to installation of the work of this Section, carefully inspect the installed work specified in other Sections and verify that all such work is complete to the point where this installation may properly commence.
2. Verify that all work may be installed in complete accordance with the original design, reviewed submittals, and the manufacturer's recommendations.
3. Where floor conditions require shimming or leveling of more than  $\frac{3}{4}$  inch at any point, do not install casework in those locations. Notify the contractor and design team that remedial measures will be required to bring the floors closer to a level situation.

B. Discrepancy: In the event of discrepancy, immediately notify the Architect.

C. Flooring: Casework will typically be installed on top of finished flooring. Coordinate sequencing, protection, and installation requirements with the contractor to prevent damage of flooring.

#### 3.2 INSTALLATION

A. Coordinate work with any Owner furnished and/or installed components indicated on drawings.

- B. General: Assemble units into one integral unit with joints flush, tight, and uniform. Align similar adjoining units to a tolerance of 1/16 inch (1.5 mm).
- C. Cabinets:
  - 1. Install cabinets to create a plumb, level, true and straight installation.
  - 2. Installation of casework shall be performed using shims. Shimming shall be minimized as much as possible, yet be sufficient to achieve a level and plumb condition.
  - 3. Installation shall maintain the required height of countertops, but in all cases must stay within the range required by the ADA regulations.
  - 4. Securely fasten wall units to solid supporting material, not plaster, lath, or wallboard. Anchor, adjust, and align wall cabinets as specified for base cabinets. Verify that all required backing and reinforcement necessary to support wall-mounted units is in place, secure, and accurately located.
- D. Installation materials:
  - 1. Installation of non-metallic casework shall use shims, spacers, cleats, straps, and other such items of matching plastic construction only. No wood or metal materials shall be part of the permanent installation of polypropylene casework.
- E. Laboratory Tops:
  - 1. Scribe tops as necessary for close and accurate fit.
  - 2. Field Joints: Factory-prepared and identical to factory joints, locate only where indicated on approved Shop Drawings. Field processing of top and edge surfaces is not acceptable, except as described by manufacturer in approved Submittal Data. Provide full length, one-piece tops and backsplashes wherever possible, and keep field joints to an absolute minimum.
  - 3. Abut top and edge surface in one true plane, with internal supports placed to prevent any deflection. Joints in top units shall be flush and the narrowest for the respective materials of construction. Cement joint in accordance with the manufacturers' specifications.
- F. Sealant:
  - 1. Caulk edges of tops, backsplashes and side splashes to adjacent wall surface with silicone sealant.

### 3.3 CLEANING AND PROTECTION

- A. Repair or remove and replace defective work as approved by the Architect at no additional cost to the Owner.
- B. Clean finished units, touch up as required, and remove and refinish damaged or soiled areas.
- C. Cover tops with kraft paper or polyethylene sheeting after installation for protection against scratching, soiling, and deterioration during remainder of construction period. Remove protection prior to final cleaning.

- D. Clean counter tops with diluted dishwashing liquid and water leaving tops free of all grease and streaks. Use no wax or oils.

END OF SECTION 11 53 10

## SECTION 13 21 05 – CLEANROOM CONSTRUCTION PROTOCOL

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Drawings and general provisions of the Contract, and Division 1 Sections apply to work of this Section.
- B. This section specifies the general requirements for all personnel, components, materials, equipment, tools, and protocol requirements to be utilized in the construction, start-up, commissioning, and certification of the Cleanroom spaces.
- C. The Cleanroom Protocol procedures shall be developed and implemented by a contractor regularly engaged in the business of cleanroom construction, installation protocols for cleanliness, and certifying cleanrooms.
- D. The cleanroom manufacturer/installation contractor shall provide certification listed herein from a third party source.

#### 1.2 REFERENCES

- A. Air cleanliness classification for cleanrooms and definition of terms for cleanroom work shall be in accordance with ISO Class 4, 5 and 6 (Formerly Class 10, 100 and 1,000). All cleanroom construction shall be in accordance with International and Local building codes.

#### 1.3 RELATED DOCUMENTS

- A. Section 11 53 43 – Laboratory Service Fittings and Fixtures
- B. Section 13 21 00 – Cleanroom Construction
- C. Section 13 21 40 – Cleanroom Fume Hoods and Other Air Containment Units
- D. Division 21: Fire Suppression
- E. Division 22: Plumbing
- F. Division 23: HVAC
- G. Division 26: Electrical

#### 1.4 DEFINITIONS

- A. Clean Zone: A defined area, including the cleanroom and adjacent spaces, that is exposed to the cleanroom supply and return airstreams.
- B. HEPA Filter: High efficiency particulate air filter, including ULPA (Ultra-High efficiency particulate air) filters.



- C. Protocol Level: The phase or degree of construction completion that mandates specified activities, training, security clearance, dress, work means and methods, cleaning procedures, and system performance to maintain the cleanliness of the clean zone.
- D. Protocol Manager: The person vested with authority by the cleanroom protocol contractor to supervise all construction personnel working within the clean zone and ensure requirements of the contract documents are met in completion of the clean zone construction.

## 1.5 SUBMITTALS

### A. Cleanroom Protocol:

- 1. Written performance and method protocol procedures shall be prepared and submitted by contractor performing tasks and services specified herein. Cleanroom protocol procedures shall include the following items used in the performance of services:
  - a. Manpower, organization, and responsibilities of all members performing work.
  - b. Procedures to be utilized.
  - c. Sequence of construction events and protocol levels.
  - d. Products to be utilized.
  - e. Equipment to be utilized.
- 2. Written protocol procedures shall be developed for each of the construction protocol levels for the following activities and services:
  - a. Instruction and training material and procedures for clean construction workers.
  - b. Monitoring and enforcement of clean construction protocol.
  - c. Design and use of temporary construction and equipment to maintain clean construction boundary and entry/exit of personnel and equipment to the clean construction boundary.
  - d. Procedures and equipment for continuous and special cleaning.
  - e. Testing procedures and equipment including for air, water, and other cleanroom related activities.

- B. Submit manufacturer's product data for all supplies and equipment used in cleanroom protocol procedures.
- C. Submit MSDS information for all products used inside the cleanroom for cleaning supplies, sealants, and other applicable products.

## 1.6 CLEANROOM PROTOCOL CONTRACTOR QUALIFICATIONS

- A. In addition to the general standards and as a condition of award, special standards must be met by the cleanroom protocol contractor to demonstrate that the bidder possesses certain expertise that has been determined essential for adequate contract performance.

- B. The following will be required of the bidding contractors prior to award: A list of at least five (5) projects, completed within the last five (5) years, which included construction of ISO Class 6 (Class 1,000) or better clean spaces. These projects should be equal to this project's cleanroom scope of work. Include documented experience for monitoring a cleanroom protocol program for all subcontractors working within the clean zone, including subcontractors not working directly for the cleanroom subcontractor.

## PART 2 PRODUCTS

### 2.1 INSTALLATION PROTOCOL MANAGEMENT CONTRACTORS

- A. Contractors: Subject to compliance with requirements, provide products and services by one of the following:
1. AM Cleanroom Build & Performance Division (AM Technical Solutions)
  2. Cleanrooms West
  3. Protocol Management Services, Inc.
  4. Performance Contracting, Inc.
  5. Approved equal – Subject to approval by Owner's representative obtained during bidding submittal process and prior to project award.

### 2.2 INSTALLATION PROTOCOL

- A. The Following guidelines shall be followed in order to establish procedures for dress, conduct, and activities inside the Clean Zone as necessary to maintain safety and contamination requirements:
1. The protocol manager shall have full authority over all operations inside the clean zone.
  2. All persons entering the clean zone shall complete training respective of the protocol level incorporated.
  3. Construction personnel shall receive training on clean build protocol, at regularly scheduled training sessions from the protocol management contractor. Manufacturer's representatives, service personnel, Owner representatives and end users to receive special training on clean protocol prior to entering the clean zone.
  4. There shall be one training session for protocol levels 2 and 3, and another for protocol level 4.
  5. Personnel access to the clean zone shall be through the designated personnel construction gowning entrance. Material and tool entry shall be through a material entry pass-through, and pre-clean area only.
  6. Any approved sub-contractor shall use dedicated, clean construction tools in the clean zone inspected for each level of protocol. Tools which are used on a daily or regular basis are to remain in the clean zone until they are no longer needed.
  7. Any approved sub-contractor shall clean as they work, always leaving the construction zone in at least the same or better condition than when the work began.
- B. The following activities are banned anywhere inside the clean zone and adjacent spaces during all construction protocol levels:

1. Eating or drinking foodstuffs.
2. Chewing gum.
3. Smoking or chewing tobacco.
4. Spitting.
5. Standing, walking or sitting on electrical conduits, and bus duct, HVAC ductwork, fire sprinkler piping, or other building utility piping, process high purity piping, specialty gas piping, HEPA filter modules, cleanroom light fixtures or any other cleanroom component.
6. Breaking open any clean products specially sealed and wrapped for protection prior to the material entry airlock.
7. Cutting, threading, grinding, or welding pipe, conduit, bus duct, or fittings.
8. Operating any propane, acetylene, diesel, gas, air, or oil fueled tools, high-lift or other construction equipment.
9. Installing or spilling oil, stain, paint, sealant, cleaning agent, caulking, or other diffusing product onto the structural floor before application of specified sealers and paints.
10. Using chemicals and cleaners not previously approved by the cleanroom protocol management contractor and site environmental health and safety representative.
11. Entering or working inside the clean zone in garments and footwear that are not in compliance with the posted construction protocol level.
12. Entering or working inside the clean zone without clearance from the cleanroom protocol management contractor and Protocol Manager.

C. The following procedures and criteria shall be followed by all persons entering and working in the clean zone during all construction protocol levels:

1. Walk on sections of tacky walk-off mat provided at entry to the clean zone.
2. Unpack, wipe down, and vacuum clean all construction material, tools, and accessories to remove grease and contamination in the material entry pass-through.
3. Wipe up spills of caulking, sealant, paint and the like immediately.
4. Dispose of all outer packaging materials including tie-straps, plastic seal wraps, product protecting devices and other debris in trash receptacles. Do not let debris accumulate on floor.
5. Provide continuous HEPA filtered vacuum pick-up during drilling, coring, cutting, or similar particle generating work activities after beginning cleanroom protocol level.
6. Provide all necessary construction tools that are cleaned, stored, and used only within the designated clean zone after beginning of protocol level.
7. No wood, paper, foam, or cardboard containers or packing allowed in the clean zone after beginning of protocol level 2.
8. Limit quantity of material inventory stored in the clean zone to a quantity that can be used during the current shift.

## 2.3 CLEAN / BUILD PROTOCOL TRAINING PROGRAM

A. Prior to construction start, the cleanroom protocol management contractor will provide a cleanroom protocol-training program. A draft protocol and training program shall be submitted during the proposal stage to confirm the requirements of the specifications. Its intent will be to expose each individual trade to the intricacies of a cleanroom and the

“clean build” process. Attendance is mandatory for all workers involved with the cleanroom project. The primary goal of the protocol training is to:

1. Help contractors understand the reasons for various restrictions on activities within the cleanroom.
2. Provide overall exposure to the sub-micron level of cleanliness required in the different cleanroom classifications.
3. Inform them on specific cleanroom components such as the use of air locks, air showers, and gowning procedures.
4. Emphasize the necessity for continuous daily clean-up programs.
5. In conjunction with the pre-construction training activity the process will be monitored and adjusted at the weekly contractor coordination meeting. These meetings will further:
  - a. Gauge the level of compliance to these restrictions and allow the cleanroom contractor to adjust enforcement of same if necessary.
  - b. Ensure tradesman participation and involvement in an overall commitment to maintain the integrity of this facility.
  - c. Serve as a venue to present and post any and all weekly “restricted access” area(s) and help schedule clearance of the areas.

## 2.4 PRE-CLEANROOM CONSTRUCTION ACTIVITIES

- A. The following describes construction activities to be complete prior to the cleanroom construction
1. The building superstructure must be complete including slab floors, exterior walls, roof, exterior windows and doors, structural steel and welding.
  2. Fire protection mains, plumbing drains, and cleanroom perimeter walls shall all be in place at this time.
  3. All interior surfaces (i.e., columns, joists, walls, etc.) shall be painted or coated to prevent future shedding of particulate into the cleanroom.
  4. Temporary gowning room and a material entry pass-through shall be constructed at the cleanroom entrances.
    - a. The temporary gowning room and material entry pass-through may be constructed of corrugated plastic sheets (coroplast), heavy-duty sheet plastic, and a structural support system as necessary.
  5. All utilities required for the clean zone are brought through the perimeter clean zone boundary wall and capped for final distribution in clean zone. All penetrations through the clean zone boundary wall to be sealed airtight.

## 2.5 CLEAN ZONE CONSTRUCTION PROTOCOL LEVELS

- A. General milestones for clean construction protocol levels include (Note: levels may overlap):
1. Level 1: Rough Construction Phase
  2. Level 2: Cleanroom Floor/Ceiling/Wall Finish Installation
  3. Level 3: Cleanroom Furnishings and Equipment Installation

4. Level 4: Start-up test and Certification

2.6 PROTOCOL LEVEL 1 (ROUGH CONSTRUCTION PHASE)

A. Level 1 Activities:

1. The building superstructure must be complete including slab floors, exterior walls, roof, exterior windows and doors, structural steel and welding.
2. Interior partitions walls must be complete.
3. Fire protection mains, plumbing drains, and cleanroom perimeter walls shall all be in place at this time.
4. All interior surfaces (i.e., columns, joists, walls, etc.) shall be painted or coated to prevent future shedding of particulate into the cleanroom.
5. Temporary gowning/material staging areas shall be constructed at the cleanroom entrance(s).
6. Install air handling units and associated ductwork, including ductwork required for outdoor make-up air.
7. Hang cleanroom ceiling support system.
8. Install MEP overhead rough in.
9. Seal air tight all duct openings.
10. Initial gross cleanup of the clean construction zone including overhead mechanical systems prior to entering Level 2 protocol.
11. Provide startup of make-up air systems for room pressurization prior to moving to Level 2 protocol.

B. Cleanliness Level (Level 1):

1. No smoking or chewing tobacco is allowed.
2. No eating or drinking within the clean zone.
3. No gasoline or diesel powered equipment allowed. All lifting equipment/power tools shall be electric powered.
4. Grinding, cutting, drilling, or other operations (i.e. cutting drywall) which generate dust contamination must be controlled by means of daily vacuuming or cleanup.
5. Substrates, over which succeeding work is to be installed, shall be carefully inspected and wiped clean to eliminate entrapment of any contamination in the finished work.
6. Surfaces of material and equipment being installed shall be wiped clean using clean water and lint-free wipes. Oil and grease must be cleaned with a solution approved by the Protocol Manager. Dirty wipes must be replaced and disposed of.
7. Floors must be vacuumed or wet mopped weekly.
8. All trash and debris must be removed from building daily.
9. Thorough cleaning with HEPA vacuuming and dry/wet wipe down to remove all loose dirt, dust, debris from all exposed surfaces prior to moving to protocol level 2.

2.7 PROTOCOL LEVEL 2 (FLOOR / CEILING / WALL FINISH INSTALLATION)

A. Level 2 Activities:

1. This establishes the time at which major building construction activities within the clean zone should be completed and access limited.

2. Cleanroom space shall be subject to daily cleaning.
3. All material entering clean zone must be wiped down at established temporary material entry pass-through.
4. Installation of secondary overhead suspension (turnbuckle & threaded rod).
5. All tools entering the clean zone shall be thoroughly cleaned with solution approved by the protocol manager.
6. Contractors working within the cleanroom envelope shall wear booties and hairnets.
7. Install cleanroom piping systems.
8. Install flooring and protective covering.
9. Install ceiling and finishes.
10. Install wall finishes.

B. Cleanliness Level (Level 2):

1. No smoking or chewing tobacco is allowed in clean zone or its perimeter.
2. No eating or drinking at the clean zone levels.
3. Immediate clean-up of debris created by construction activities.
4. No grinding, cutting, welding or drilling is allowed within clean zone.
5. No powder or air actuated tools allowed.
6. No gasoline or diesel powered equipment allowed.
7. Ladder, scaffold and/or gang box feet/wheels must have protective covers.
8. All tools (including ladders, scaffolding, and gang boxes) entering the clean zone must be thoroughly cleaned of all dirt, grease and oil. If this is not possible then new tools must be utilized.
9. All materials entering the clean zone shall be unwrapped/uncrated in an established material entry pass-through, and all surfaces thoroughly cleaned of all dirt, grease, oil, lint or other contaminants by means of non-shedding, lint-free wipes and approved cleaning solution. If vacuuming is required, vacuum must be HEPA filtered.
10. Work shoes must be cleaned before entering clean zone (and donning of shoe covers) by use of shoe cleaners and/or tacky mats.
11. All personnel entering the clean zone must wear clean work boots, clean work clothes, shoe covers/booties, latex gloves, and hairnets. Shoe covers that are torn or soiled must be replaced immediately.
12. Intermediate cleaning with HEPA vacuuming brush/bristle agitation of surfaces and wet IPA wipe down of surfaces and components to remove all dirt, dust, debris from all areas. Perform cleaning immediately prior to moving to Level 3 Protocol.

2.8 PROTOCOL LEVEL 3 (CLEANROOM FURNISHINGS INSTALLATION)

A. Level 3 Activities:

1. Continuous daily clean-up procedures are accelerated.
2. Cleanroom furnishing systems are installed and sealed to floor, walls, and ceiling.
3. Cleanroom ceiling and wall systems and all overhead work complete.
4. Install all wall-mounted devices i.e. control sensors, fire alarm sensors, strobes, horns, pull stations, exit and emergency lighting.
5. Install all wall-mounted cleanroom furnishings and equipment.
6. Remove airtight seal from all air handling units & blowers and perform final blow down.

7. Seal fire sprinkler system in the ceiling system.
8. Final installation and hook-up of light fixtures in ceiling system.
9. All overhead electrical, fire alarm, telecommunications, and controls work shall be completed.

B. Cleanliness Level (Level 3):

1. No tobacco use allowed.
2. No food of any kind is allowed.
3. No powder or air actuated tools are allowed.
4. No gasoline or diesel powered equipment allowed.
5. No grinding, cutting, drilling or dust generating activities allowed in the clean zone.
6. When it becomes necessary to change any work already installed by cutting or drilling, the material must be removed to the staging area. If this is not possible or timely, then temporary barriers must be installed to isolate the work from surrounding cleanroom materials and continuous vacuum removal must be incorporated.
7. All personnel entering the clean zone must wear clean work boots, clean work clothes, shoe covers/booties, latex gloves, smock lab coats, beard covers, and hairnets. Any torn or soiled cleanroom garments must be replaced.
8. Continuous cleaning, vacuuming and trash removal is required as generated.
9. All materials entering the clean zone shall be unwrapped/uncrated in a designated material entry pass-through and all surfaces thoroughly cleaned of all dirt, grease, oil, lint or other contaminants by means of non-shedding, lint-free wipes and approved cleaning solution. If vacuuming is required, vacuum must be HEPA filtered.
10. Superclean complete cleaning with HEPA vacuuming brush/bristle agitation of surfaces and wet IPA wipe down of all surfaces and components to remove residual dirt, dust, debris from all areas. Perform cleaning immediately prior to moving to Level 4 Protocol.

2.9 PROTOCOL LEVEL 4 (START UP TEST)

A. Level 4 Activities:

1. Install HEPA filters in air-handling systems.
2. Install cleanroom ceiling air screens.
3. Cleanroom certification and testing.
4. Perform final wipedown of cleanroom walls, ceiling, and furnishing surfaces.

B. Cleanliness level (Level 4):

1. All level 3 requirements in effect with the following additions:
  - a. Access to clean zones shall be limited only to personnel needing access to perform work and who have gone through a cleanroom construction indoctrination program (security badges issued).
  - b. Cleanroom badges are to be worn on the outside of the cleanroom gowns and be visible.
  - c. Signage installed at all clean zone access points which include a checklist for required cleaning to be performed prior to access.

- d. Gowning to include cleanroom coveralls with hood and face masks, boot covers, hairnet, beard covers and gloves.
- e. Material entry pass-through areas and gowning rooms to be strictly controlled by cleanroom monitor.

### PART 3 EXECUTION

#### 3.1 JOB CONDITIONS

- A. The General Contractor shall provide the shell space and an adjacent staging area in vacuum clean and wiped down condition and shall assist in maintaining the conditions necessary for the performance of the work in this area.
- B. Check project for conditions that affect work. Do not begin activities and services until unsatisfactory conditions are corrected. Defects caused by unsatisfactory conditions or untimely installation shall be corrected at no cost to Owner.
- C. The Cleanroom Protocol Contractor shall monitor and coordinate all work performed within the cleanroom area as required to safeguard the cleanliness of the cleanroom area.

END OF SECTION 13 21 05



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**SECTION 13 21 40 – CLEANROOM FUME HOODS AND OTHER AIR CONTAINMENT UNITS****PART 1 GENERAL****1.1 SUMMARY**

- A. This Section includes the following equipment and related accessories for use in cleanroom environments.
  - 1. Non-metallic acid chemical fume hoods.
  - 2. Benchtop vertical laminar flow workstation.

**1.2 RELATED DOCUMENTS**

- A. General and Supplementary Conditions and Division 1
- B. Related Sections for cleanroom construction and construction protocol.
- C. Section 11 53 10: Laboratory Casework
- D. Division 21: Fire Suppression
- E. Division 22: Plumbing
- F. Division 23: HVAC
- G. Division 26: Electrical

**1.3 REFERENCES (LATEST EDITION)**

- A. NFPA 70 - National Electric Code
- B. NFPA 318 - Protection of Cleanrooms
- C. ANSI/FM Approvals 4910 – Cleanroom Materials Flammability Test Protocol
- D. FM Global Data Sheet 1-56 – Property Loss Prevention Data Sheet for Cleanrooms
- E. ISO Standard 14644-1 - Classification of Cleanliness for Cleanrooms
- F. IES-RP-CC-002.2 - IES Standard for Unidirectional Flow Clean Air Devices
- G. American Council of Industrial Hygienist - Latest edition
- H. ASHRAE - 110 - Method of Laboratory Fume Hood Testing
- I. NSF 49 – Biosafety Cabinetry: Design, Construction, Performance, and Field Certification.
- J. ISO Standard 14644-2 Specification of Testing and Monitoring for Compliance w/ 14644-1

- K. IES-RP-CCO 34.1 HEPA and ULPA Filter Leak Testing
- L. NFPA 45 - Standard on Fire Protection for Laboratories Using Chemicals
- M. NFPA 496 – Standard for Purged and Pressurized Enclosures for Electrical Equipment
- N. Underwriters Laboratories 6-1010-1 International Standard for Laboratory Hoods and Cabinets

#### 1.4 DEFINITIONS

- A. OEM: Original Equipment Manufacturer- A company who produces hardware to be marketed under another company's brand or be included as an integral part of another company's product.
- B. PAH: Perchloric Acid Hood
- C. VLFH: Vertical Laminar Flow Hood

#### 1.5 EQUIPMENT DESCRIPTIONS

##### A. Design Requirements:

1. Fume hoods and other air containment units shall be purpose – designed specifically for ISO classified cleanroom use with trace metals analysis. Materials of construction and finishes that may shed particles or may off-gas shall not be used. All exposed materials and surfaces to room air and internal chamber airstream shall be non-metallic or purpose-coated materials to avoid any exposed metal surfaces. Construction materials for all work decks and containment plenums shall be matched specifically based on the end-user chemical review.
2. Electrical wiring shall comply with the National Electrical Code and compliant with UL approved methods.

##### B. Performance Requirements:

1. Fume hoods shall be manufactured to meet FM Global standard 4910 requirements for installation and use inside cleanroom facilities.
2. Fume hoods and other air containment units shall meet specified exhaust requirements and maintain design exhaust velocities across the front access opening with less than 125 Pa (0.50 inch wg) static air pressure drop developed across the unit from the room to the exhaust duct connection.
3. Units shall be tested and evaluated "AM" (As Manufactured) under a modified ANSI/AHRAE 110 testing procedures at design operating conditions and shall meet a minimum performance rating:
  - a. Static Tests: 4.0 AM 0.05 ppm
  - b. Walk-by: 4.0 AM 0.10 ppm maximum and must return to 0.05 ppm within 15 seconds.
4. Electrical wiring shall comply with the National Electrical Code and compliant with UL approved methods.

## 1.6 SUBMITTALS

### A. Quality Assurance:

1. Manufacturer and installing contractor qualifications.

### B. Product Data:

1. Provide manufacturers description, materials of construction, finish, itemized features, and operating characteristics for each hood and wet processing bench station. Include original equipment manufacturers' (OEM's) documentation for furnished specialties, equipment, and accessories.
2. Submit testing and quality assurance procedures.
3. Describe finishing and cleaning for materials to be used in the Cleanroom.
4. Describe packaging and shipping procedures.
5. Provide on-site product inspection procedures.

### C. Shop Drawings: For each fume hood and wet processing bench station provide:

1. Fabrication drawings, including dimensions, weights, required clearances, method of field assembly, location and size of each field connection, and access features. At a minimum provide views for working deck plan, front and rear elevations, and side section(s).
2. OEM equipment installation details.
3. Airside Performance: Exhaust and laminar supply airflows and static pressure requirements.
4. Wiring Diagrams: Power, signal, and control wiring.
5. Plumbing Diagrams.

### D. Performance/Certification Submittals:

1. Factory UL field inspection reports for each unit.
2. Factory As-Manufactured (AM) test results in accordance with modified ANSI/ASHRAE 110 performed on each hood size, style, and configuration.
3. Field As-Installed (AI) test results in accordance with modified ANSI/ASHRAE 110 for each installed hood.

## 1.7 WARRANTY

- A. Provide warranties in accordance with Division 1 requirements.

## 1.8 QUALITY ASSURANCE

- A. In addition to the General Standards and as a condition of award, special standards must be met by the cleanroom hood Manufacturer/Installation Contractor to demonstrate that the bidder possesses certain expertise that has been determined essential for adequate contract performance.

1. Manufacturer Qualifications: Provide a list of at least five (5) projects, completed within the last five (5) years, which included manufacturing of chemical fume hoods for use within ISO Class 5 or better certified cleanroom spaces. These projects

should be similar to this project's scope of work and include materials and systems of similar design and installation. Include documented experience for academic and research University cleanroom projects over the same period. List should include the project title, place of performance, General Contractor's project manager's contact information for reference, and Owner's representative and contact information for reference.

- B. Product Options: As fabricated, drawings for each unit, which indicate size, profiles, and dimensional requirements of hoods, and processing stations, and show location and installation details of OEM equipment.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use. Design and construction of the hoods shall comply with NFPA 70, "National Electrical Code."
- D. Installation: Installation shall be performed by an factory trained and authorized representative of the manufacturer and at a minimum shall include the following:
  - 1. Equipment setting.
  - 2. Coordination and verification of utility connections.
  - 3. Start-up, Testing, and Commissioning.
  - 4. Programming adjustments.
  - 5. Owner Training.

#### 1.9 DELIVERY, STORAGE AND HANDLING

- A. Delivery, storage and handling shall be in accordance with the submitted detail procedures as approved by manufacturer.
- B. High purity OEM components shall be shipped to site in OEM's original protective packaging and only opened for direct installation in the Cleanroom.
- C. Installed piping shall be protected with both end caps and bagged ends. Exposed ends or projections shall be encased and protected from shipping and handling damage.

- D. Manufactured units shall be completely cleaned, sealed, and packaged in an ISO Class 5 Cleanroom before shipping to maintain the highest level of factory cleanliness through the shipping and handling process.

## PART 2 PRODUCTS

### 2.1 ACID CHEMICAL FUME HOODS

#### A. MANUFACTURERS

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Air Control, Inc. P.O. Box 1738, Henderson, North Carolina 27536, USA;  
Phone: 252.492.2300

#### B. MANUFACTURED UNITS

1. Fume hoods and wet processing bench stations as described in Part 1 of this Section shall be factory-assembled, pre-wired, pre-plumbed, and factory-tested.
2. Cleanliness critical fabrications and component installations shall be performed under clean conditions as submitted by the manufacturer and approved by Owner.
3. During the fabrication process and after testing is complete, the manufactured units shall be cleaned of all dust, dirt, grease, oils, stains and fabrication markings as a preparation for Cleanroom installation prior to sealing and packaging for shipment.

#### C. MATERIALS

1. Non-metallic fume hoods shall be fabricated from the following:
  - a. White stress-relieved polypropylene or PVC sheet stock plastics conforming to FM-4910 approved fire retardant plastics unless otherwise noted.
  - b. Raw sheet stock materials shall be inspected prior to fabrication and shall be certified to be free of any visual or structural defects.
  - c. All joints shall be thermally welded to make leak tight, structurally sound, flush joints.
  - d. Fasteners: Fasteners shall be non-metallic or have protective sealed plastic caps.

#### D. COMPONENTS

1. Acid fume hoods:
  - a. Units shall have an instrument compartment-mounted "Low Face Velocity Alarm" which provides audible and visual warnings when the exhaust volume drops below a safe level as detected by a face velocity airflow monitor. Alarm

- shall be housed in a negative pressure enclosure with swing open clear access door for operator interface to provide no exposed metal to the room.
- b. Exhaust louver above rear work surface shall be adjustable and set at the factory for design conditions. A permanent means of identifying the louver adjustment position(s) for certification shall be provided.
  - c. Units identified for free-standing mounting against fixed walls shall be configured for top connection of air ducts and electrical services with service access from the top of the unit unless otherwise noted. Plumbing connection(s) shall be located as indicated in the drawings. Electrical connection shall be located at top right hand side of unit. The exhaust plenum, exhaust transition connection(s), and utility connections shall be configured to allow the rear of the unit to make contact with the fixed wall in final location.
  - d. Where equipped, base cabinets shall be vented to accommodate chemical storage beneath the work surface or containment tub. Base cabinet storage areas shall have hinged access doors on the cleanroom side.
  - e. Slide-out trays shall be installed in the base cabinet storage areas to provide "pull-out" access of stored contents. Trays shall be fully welded to provide leak tight containment.
  - f. Refer to contract drawings for required external piping utility connections.
  - g. Sink drains and tailpiece shall be polypropylene for non-metallic units with DWV pipe. The installer of the Cleanroom drain piping system shall install P-traps within the sink cabinet when connecting the unit directly to a laboratory wastewater drain system.
  - h. All other internal utility piping shall be Teflon PFA tubing which terminates with a NPT, flare, or union fitting.
  - i. General-purpose sinks shall have a formed bottom sloping to a 25 mm (1 in.) center drain and shall be plumbed to drain.
  - j. Non-recirculating PVDF gooseneck faucet for UHP-DI water shall be installed at the general-purpose sink and factory piped to the hood pure water equipment base cabinet for connection to pure water supply valve by Div 22.
  - k. LED lighting shall provide 100 foot-candles minimum at the work surface for non-UV filtered lighting. Lighting shall utilized LED tube or strip lamps, 3500K color temperature. Lights shall be mounted above ceiling panel in a fume-tight, sealed compartment. Light switch shall be mounted on the instrument panel and include a sealed cover to provide metal-free exposure to the room.
  - l. Duplex electrical GFCI-type receptacles shall be mounted at locations indicated in the drawings.
  - m. Units shall have leveling feet with nominal 2" floor clearance for airflow and a minimum of 25 mm (1 in.) adjustment travel. A minimum of six leveling feet shall be used to support unit with one at each corner and 2 at the mid-span of the front and rear long-axis sides. The base cabinets shall be reinforced for leveling feet load attachment and to support upper loads without distortion or deflection.
  - n. Exhaust and supply air plenums shall transition to a standard ANSI bolted pattern duct flange for connection to the duct systems by the Mechanical Contractor.
  - o. Fabricate fume hoods with a front canted at 7 degrees away from operator for ergonomic comfort.

- p. Provide a full view, vertically rising safety sash with encapsulated counter weights for ease of operation. Sash shall close within one inch of the work surface or close completely with a bypass airfoil sill. Provide sash stop with manual override at normal operating height as indicated in the drawings. Provide side post labeling with arrow at specified normal sash operating height stating "MAXIMUM OPERATING SASH HEIGHT".
- q. For units operating with constant air volume (CAV) exhaust airflow controls, air by-pass louvers shall be located in the upper front of the hood to provide a near constant exhaust volume design without excessive face velocities at lower sash openings. For units operating with variable air volume (VAV) exhaust airflow controls, provide a restricted bypass closure to limit bypass air.
- r. Fume hoods shall have solid flat work decks.

## 2.2 BENCHTOP VERTICAL LAMINAR FLOW WORKSTATIONS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. AirClean Systems
  - 2. Approved equal
- B. Description: Self-contained benchtop vertical laminar flow workstation to provide clean ISO 4 (Class 10) work zone for laminar air flow for process protection when supplied with ISO 4 (Class 10) supply air.
- C. Basis of Design: AirClean Systems model AC6624LF.
- D. Features:
  - 1. Microprocessor controller.
  - 2. ISO 4 vertical laminar flow air.
  - 3. Clear polycarbonate shell for front/sides visibility.
  - 4. Polypropylene construction for chemical resistance.
  - 5. Integral lighting.
  - 6. Ductless – no external duct connections.
  - 7. Power cord with NEMA plug for standard 110vac receptacle.
  - 8. Timer.
- E. Safety Features:
  - 1. Real-time filter load monitoring.
  - 2. Filter safety lockout to ensure correct filter replacements.
  - 3. Filter and electronics located above the workspace.
  - 4. Fully assembled and tested.
  - 5. Certifications: UL, CSA, CE.
  - 6. ISO 4 tested.

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PART 3 EXECUTION

3.1 SOURCE QUALITY CONTROL:

A. Testing:

1. General: One of each style and size of fume hood manufactured according to the approved shop drawing shall be factory tested in accordance with modified ANSI/ASHRAE 110 testing. Owner reserves the right to attend the hood testing. Hood Manufacturer shall provide all testing facility and all equipment necessary for the test. At least two week notice of proposed test date shall be provided to Owner.
2. Test Room: The hood to be tested shall be set up in a test room of sufficient size so that a minimum on 1500 mm (5 ft.) of clear space is available in front of and on both sides of the hood for viewing of performance tests.
3. Exhaust System: A hood exhaust system, properly calibrated so that known exhaust air volumes can be easily attained, shall be provided. The exhaust capacity shall be sufficient to exhaust the hood with the design face velocity.

3.2 INSTALLATION

A. For the purposes of this specification installation is broken down into two (2) work events. The setting of the individual hoods and the facility connection hook-ups to each hood.

B. Equipment Setting:

1. Equipment supplier will set and level hoods and benches into location. Setting of equipment will not take place until cleanroom work is such that all hoods can be set in their entirety and equipment will not be subject to damage from other trades.
2. Facility Connections:
  - a. All facility connections to hoods to be performed by others. All connections shall be installed in accordance with manufacturer's documentation.

3.3 CONTAINMENT FIELD TESTING

A. Fume Hoods:

1. Balance, test and certify each exhausted fume hood in accordance with ASHRAE 110 As-Installed (AI) for Flow Visualization, Face Velocity, and Tracer Gas Containment Testing Requirements.
2. Field tests shall be performed by a qualified independent testing company on each unit to determine face velocity, air flow patterns, and containment.
3. Units shall achieve an As-Installed (AI) performance rating equal or better than 0.10 ppm with 4.0 Lpm tracer gas release rate when tested in accordance with ASHRAE 110 or modified ASHRAE 110 procedures.
4. Balancing and air terminal controls of the exhaust air system serving the units shall be by Division 23.

END OF SECTION 13 21 40