SECTION 13 00 01
GENERAL LABORATORY DESIGN STANDARDS

PART 1 GENERAL

1.1 GENERAL GUIDELINES

A. Brown laboratories, at a minimum, shall be designed to meet the requirements of the latest editions of applicable federal and state regulations including:

1. American National Standards Institute (ANSI)
2. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE)
3. Compressed Gas Association (CGA)
4. Environmental Protection Agency (EPA)
5. National Fire Protection Association (NFPA) Code
6. National Institutes of Health (NIH) Design Requirements Manual
7. National Sanitation Foundation (NSF)/ANSI 49
8. Occupational Safety and Health Administration (OSHA).

B. Project teams are required to follow the policies and procedures in the Laboratory Closeout Policy and Laboratory Closeout Standard Operating Procedure.

C. Laboratory Planning, Design, and Construction shall involve Brown team members from:

1. Planning
2. Project Management
3. Environmental Health & Safety
4. Office of Information Technology
5. Operations and Engineering
6. Department representative
7. End User (Principal investigator, lab manager, etc.)

1.2 PROJECT REQUIREMENTS

A. GENERAL: Successful laboratory project design involves significant effort in coordination, creation of new record documentation (for new projects) and updates of existing record documentation (for renovations within existing facilities) to ensure long-term safe, reliable system operation and troubleshooting. The following is a summary of key record documentation updates and testing required for laboratory projects within existing facilities. For new buildings, the documentation shall be provided as new information.

B. LAB SAFETY LEVEL: Labs shall be designed to meet biosafety level 2 (BSL-2) or animal biosafety level 2 (ABSL-2) containment specifications.

C. FLOOR PLANS AND BUILDING MASTER ROOM LIST: Building floor plans, with room numbers, as well as the building master room list, shall be developed and updated for lab and associated project spaces. Coordinate with the FM Planning Office for room list and room numbering

assignments, and with the FM CAD department for floor plans. Room numbers shall be developed early in the Brown FM Planning and Design process, as they are required record documentation reference information for various building MEP (Mechanical, Electrical and Plumbing) equipment and systems.

D. LAB VENTILATION SYSTEM TYPE: For existing facilities, lab ventilation control schemes shall match existing building lab control scheme, except where program needs dictate revisions. For new lab facilities, identify and review preferred ventilation control schemes for the proposed lab configurations (constant volume versus variable air volume). Perform life-cycle cost analysis to review cost/benefit of variable air volume (VAV) and constant air volume (CAV) HVAC systems, based on the intended lab configuration, use and function.

E. AIRFLOW DOCUMENTATION: HVAC lab ventilation spreadsheets, floor plans and air flow diagrams, for both supply air and exhaust air systems, shall clearly indicate required lab airflows to ensure that proper space airflow and space pressurization levels are achieved. Provide color-coded and keyed HVAC floor plans denoting the areas served by each building supply air-handler and exhaust system. For existing facilities, update existing record documentation; where existing documentation is insufficient, provide new documentation.

F. FUME HOOD/VENTILATED DEVICE MASTER LIST: The Brown Fume Hood/Ventilated Device Master list, developed for each lab building, shall be updated to denote all new and existing devices to be removed.

G. TEST AND BALANCE: Lab supply and exhaust air systems shall be fully tested and balanced (TAB). All affected building supply and exhaust systems affected by a lab renovation project, including spaces outside of the renovation scope but connected to the common building makeup air supply and exhaust systems, shall be retested under the project to ensure that airflow in these areas remains as designed.

H. FUME HOOD HIBERNATION or REMOVAL: Hibernation or removal of existing fume hoods shall be coordinated with FM Operations & Engineering staff. Fume hoods are typically a major component of the lab exhaust air ventilation system; their removal will typically impact the overall operation of the lab ventilation system. Project teams shall investigate and provide supplemental lab ventilation components and/or system rebalancing as required by Brown University.

I. FUME HOOD TESTING: New and modified fume hoods shall each be ASHRAE 110 and HAM tested.

J. SNORKEL EXHAUST SYSTEMS: Snorkel exhaust systems can be used for local exhaust vents or for heat extraction from equipment.

1. Snorkels are effective for capturing discharge from gas chromatographs, mass spectrometers, pipe nipple fittings, tubing if it is placed directly on top of the discharge, dust, noxious nontoxic vapors, and solder fumes.
2. Snorkels shall not be used to capture hazardous materials.
3. Efficient capture is adequate when the discharge source is up to 2 inches away and inadequate if it is 3 inches away. The capture efficiency drops sharply with distance from the intake.
4. Volume flow rate of the hose must be at least 110 - 150% of the flow rate of the discharge.

K. BAS UPDATES: The BAS (building automation system) sequences of operation, master alarm lists

and critical space room lists and building automation points alarm parameters shall all be updated in coordination with FM Operations & Engineering staff.

L. LVMP UPDATE: The Brown Lab Ventilation Management Plan (LVMP) for each lab building shall be updated as required to reflect and incorporate any changes resulting from a lab renovation project. The LVMP details the overall building MEP (Mechanical Electrical Plumbing) systems description, systems sequence of operation, and preventive maintenance testing procedures and requirements for the ventilated lab equipment.

M. EMERGENCY SHOWER AND EYEWASH MASTER LIST: The Brown emergency safety shower/eyewash List, developed for each lab building, shall be updated to denote all new and existing ones to be removed.

N. INDUSTRIAL HYGIENIST PARTICIPATION: A certified industrial hygienist shall review unique systems, equipment, and/or hazards that require a detailed risk assessment to thoroughly evaluate and recommend engineering controls and other methods to mitigate risks including to highlight potential failures, if any.

PART 2 FINISHES

2.1 SUMMARY COMMENTS

A. Design features and materials selected for the construction of laboratories shall be durable, smooth, non-porous and cleanable, provide ease of maintenance, minimize pest access, and contribute to the creation of a comfortable, productive, and safe work environment. Materials for laboratory finishes shall be as resistant as possible to the corrosive chemical activity of disinfectants and other chemicals used in the laboratory. Selection of materials and design of penetrations through walls and floors have an impact on fire safety in buildings.

2.2 WALL CONSTRUCTION

A. Wall surfaces shall be:

1. Free from cracks, unsealed penetrations, and imperfect junctions with ceiling and floors;
2. Their materials shall be capable of withstanding washing with strong detergents and disinfectants and be capable of withstanding the impact of normal traffic;
3. Corner guards and bumper rails shall be provided to protect wall surfaces in high traffic/impact areas.

2.3 FLOORING

A. Carpets and rugs in laboratories are not permitted.

B. Floor materials shall be:

1. Nonabsorbent, skid-proof, resistant to wear and resistant to the adverse effects of acids, solvents, and detergents;
2. Epoxy flooring with integral base (generally preferred);
3. Monolithic (sheet flooring) with heat-welded joints, vinyl composition tile (VCT), or bio-based tile (BBT) may be acceptable in some instances;
4. Installed to allow for decontamination with liquid disinfectants and to minimize the

potential spread of spills;

C. Project teams shall confirm if anti-static flooring is required for the research.

D. The base for VCT or other tile shall be a 4" high readily cleanable rubber material. When epoxy or sheet flooring is used, a 4" high integrally coved sheet flooring base shall be provided.

E. Wherever possible, general flooring and base shall run beneath and behind lab casework. Fixed casework modules shall receive a 4" rubber base.

F. Vivaria floor and base materials - refer to Standard 13 00 02.

2.4 CEILINGS

A. Ceilings such as washable lay-in acoustical tiles (Mylar face with smooth surface or equivalent) shall be provided for most laboratory spaces.

B. Open ceilings are acceptable provided minimal ducting and piping are present, and all exposed surfaces are smooth and cleanable.

C. Ceilings shall be designed and installed as such:

1. Heights ideally shall be a minimum of 9'-0" in laboratory and laboratory support spaces and a minimum of 8'-0" in administrative spaces.

2. Gypsum board with epoxy paint ceilings, equipped with access panels, will be provided in glassware washing and autoclave rooms, where the potential for a high moisture level exists.

3. Access panels shall be fitted with gaskets that seal the door when closed and also the flange around the panel lip where it meets the ceiling. Review locking requirements with FM-Operations.

2.5 PAINTING

A. Paints shall be durable and as resistant as possible to the corrosive chemical activity of disinfectants and other chemicals used in the laboratory.

B. Neutral color general wall paint throughout, with accent wall paints encouraged.

C. Open ceilings shall be painted with dryfall paint, matte white preferred. Piping, ductwork, equipment and other utilities shall be clearly labeled to Brown standards after painting is complete.

2.6 WINDOWS AND WINDOW TREATMENT

A. Windows shall be non-operable, sealed and caulked in laboratory spaces and associated support spaces.

2.7 DOORS

A. Doors into laboratories and equipment spaces shall be:

1. At least 7'-0" high;

2. Minimum 4'-0" wide with a 3'-0" wide active leaf and 1'-0" wide inactive leaf;

3. Wider/higher shall be considered in laboratories where the use of larger equipment is anticipated;
4. Equipped with vision panels in the active leaf;
5. Recessed and swing outward in the direction of egress per code;
6. Fitted with closers, hold opens, etc.;
7. Fitted with kick plates;
8. Fitted with gaskets and drop-seals where darkness or other controlled environments dictate;

B. Hardware and keying shall comply with requirements outlined in Brown University design standards.

C. Laboratory doors are considered high-use doors. Door assemblies shall comply with all appropriate codes:
1. Fiberglass-reinforced polyester (FRP) doors shall be considered for areas subject to impact or abuse;
2. All hardware shall be appropriately specified to withstand high-use;
3. Light commercial grade hardware shall not be used;
4. All appropriate hardware to meet security, accessibility, and life safety requirements shall be provided.

2.8 FURNITURE & FIXTURES

A. Laboratory furniture shall be capable of supporting anticipated loads and uses.

B. Spaces between benches, cabinets, and equipment shall be accessible for cleaning.

C. Table tops in the lab shall be impervious to water and resistant to heat, organic solvents, acids, alkalis, and other chemicals;

D. Chairs and stools used in laboratory work shall be covered with a non-porous material that can be easily cleaned and decontaminated with appropriate disinfectant

E. Conveniently placed coat hooks or similar storage shall be provided inside the laboratory to hang laboratory coats when not in use.

F. Whiteboards or other interactive visual expression surfaces.

PART 3 CASEWORK

3.1 GENERAL

A. Laboratory casework shall be easily cleanable, and finishes shall be compatible with materials used for cleaning and disinfection.

B. For renovations, match typical building standards. For new construction, large renovations, modular metal casework systems with sustainably responsible wood drawers and cabinet fronts is preferred.

3.2 MODULAR CASEWORK SYSTEMS

A. Racked equipment, mobile casework on wheels, or other options that minimize cost and maximize flexibility shall be considered.

B. The casework selected shall be interchangeable and readily available so reconfigurations can easily occur. Modules in regular dimensions of 4'-0", 5'-0", 6'-0", etc. shall be considered.

C. Adaptable height casework systems are preferred. Confirm height can be adjusted high enough to accommodate standard under-counter equipment (typ. 34" tall).

D. Four-legged table style systems are preferred to cantilever systems; different styles are open for consideration.

E. Island benches shall have integral shelving, raceway, utilities, etc. Benches along a wall to be standalone with wall-mounted shelving, raceway, utilities.

F. Modular under counter storage shall be specified based on lab requirements and usage. Allowable configurations include:

1. Suspended cabinets and drawers shall typically slide horizontally along the bench;
2. Mobile cabinets/drawers on wheels shall have countertop surfaces consistent with intended lab functions;
3. Lockable wheels/casters shall be provided. For large benches/equipment, provide Zambus casters or equal.

3.3 FIXED CASEWORK

A. Long installations of fixed casework shall be minimized. Fixed casework shall be limited to:

1. Casework including a sink;
2. Small spaces, to maximize linear foot of bench surface;
3. Spaces with particular concerns.

B. Fixed casework and countertops shall be sealed to walls and floors during installation to provide a cleanable joint.

3.4 COUNTERTOPS

A. Countertop materials will vary depending on usage. Epoxy resin is preferred and will apply to most applications where corrosive chemicals are used or where sinks or heavy water usage occurs.

1. Epoxy resin countertops shall be 1" thick;
2. Black color is preferred due to lower cost, but color may vary depending on usage;
3. Other materials such as phenolic resin and chemical resistant plastic laminate are not preferred, but may be considered for cost-effectiveness and durability where appropriate;
4. Stainless steel can be used for glassware wash areas, cold rooms, and other areas as the program requires.

B. Countertop edges shall be chamfered at the top of the primary working face, and receive a drip edge below.

C. Countertops shall overhang fixed casework below by 1".

PART 4 FUME HOODS

4.1 General Requirements:

A. All engineering controls shall be located in the laboratory in areas of minimum air turbulence, away from high traffic areas to avoid cross drafts and to not block egress. For proper positioning of the fume hood, the designer shall follow the design methodologies in the NIH publication Methodology for Optimization of Laboratory Hood Containment to evaluate containment performance.

B. Only "high-performance" style fume hoods shall be installed. The following vendors and models have been approved for use at Brown:

1. Lab Crafters – Air Sentry
2. Labconco – Protector Xstream
3. Kewaunee – Supreme Air LV
4. ThermoScientific Hamilton – Concept
5. Mott - RFV2

C. Constant-volume fume hoods shall have bypass grills of adequate size to maintain an acceptable face velocity over the entire range of sash movement.

D. "Auxiliary air" style fume hoods shall not be used. Ductless fume hoods shall only be provided upon approved waiver request.

E. No chemical fume hood installations are allowed in rooms with return air to other spaces. All chemical use rooms (wet labs) shall have 100% exhaust.

F. Hoods which are of high hazard or unique use, such as perchloric or other acid digestive systems, as well as radioiodination hoods shall not be installed in plenum-type systems and shall be separately exhausted. Such hoods shall be reviewed by EH&S, Brown FM and an independent industrial hygienist prior to final specification.

G. All new hoods shall be designed to provide safe operation at an average face velocity of 60 to 100 FPM @ 18-inch sash opening height.

H. All new fume hoods shall have a sash stop @ 18 inch opening height.

I. The design professional shall specify, on design drawings, the following parameters for each fume hood: flowrate at 18-inch sash height, flowrate at minimum sash position, design face velocities and sash length.

J. On VAV systems, setback of fume hood exhaust flowrate shall be by room occupancy sensors, with time delay, rather than by proximity sensors.

K. Hood placement: The location of fume hoods, supply air terminals, laboratory furniture and pedestrian traffic shall encourage horizontal, laminar flow of supply air into the hood, perpendicular to the hood opening.

1. Hoods shall be placed at least 10 feet from any doors;

2. Hoods shall be separated from each other as far as practical;
3. Corner locations shall be avoided;
4. Keep hoods at least 12" from sidewalls to avoid turbulence;
5. Hoods shall be placed to avoid pedestrian traffic immediately in front of the hood;
6. Large pieces of equipment shall not be positioned in front of a hood;
7. Hoods shall not be placed where they would face each other across a narrow aisle (6 ft. minimum spacing), as this will cause turbulence at the face of the hood.

L. Hoods shall be labeled to identify the supply and exhaust units with which they are associated.

M. Hazardous waste collection systems, cup sinks and sinks are prohibited within fume hoods.

4.2 BIOSAFETY LAB REQUIREMENTS

A. Laminar flow hoods shall not be installed in laboratories for use with potentially infectious materials. Biological cabinets (BSCs) are required for work with these materials.

B. Biosafety cabinets shall be:

1. Installed so that they meet NSF Standard 49 requirements.
2. Installed so that fluctuations of the room air supply and exhaust do not interfere with proper operations. Personnel traffic results in air pattern disruption in BSCs.
3. Installed so that they have a flow monitor and alarm.

C. Proper use of the BSC and sterile disposable supplies obviates the need for flame sterilization in most experimental procedures and has since eliminated the need for natural gas to be supplied to the BSCs. In the event that the research protocol dictates a need for natural gas, a type B (ducted) BSC shall be used. In areas that are already served by type A (non-ducted) BSCs piped to receive natural gas, there is no need to replace them with a type B BSC. A manual gas shutoff valve shall be installed on the exterior of the cabinet, and gas shall be turned off when not in use. All future requests for natural gas supply to type A BSCs will be considered on a case-by-case basis.

D. Biosafety Cabinet Placement, refer to NIH Design Requirements Manual Appendix A for further information on BSC workspace design. The following requirements are excerpted from Appendix A for design and implementation.

1. Placed out of the direct traffic pattern of the laboratory;
2. Not placed under or behind air supply diffusers or exhaust vents where the movement of air can affect the airflow of the cabinet;
3. 40" of undisturbed space shall be maintained around BSCs;
4. 12" of space shall be maintained between BSCs and adjacent walls;
5. 80" of space shall be maintained between BSCs and opposite walls;
6. 60" of space shall be maintained between BSCs and benchtops or primary areas of traffic;

7. 12″ of space shall be maintained between BSCs and columns;
8. 120″ of space shall be maintained between opposing BSCs;
9. 40″ of space shall be maintained between two BSCs on the same wall;
10. 48″ of space shall be maintained between two BSCs on perpendicular walls.

E. BSC Class I, Class II-B1 and Class II-B2 requirements:

1. Hard ducted to a dedicated building exhaust air system.

   Factory provided with means of shutting down the BSCs internal fan, whenever the static pressure, in the building exhaust air system connected to the BSC drops below the required set point.
   a. This is required to avoid having a positive-pressurized BSC and positive-pressurized exhaust ductwork.
   b. This will prevent the release of hazardous products into the laboratory space.
2. Whenever multiple BSCs of this type are connected to the same exhaust system, each BSC shall be provided with a dedicated exhaust type air terminal unit. This will ensure the proper exhaust air amount is maintained through each BSC.
3. Building exhaust air systems serving these BSCs shall include provisions for increasing the systems' static pressure to compensate for loading of the exhaust HEPA filters within the BSC, i.e. VFDs.
4. Rooms with ducted BSCs shall be provided with an additional room exhaust air grille connected to a dedicated exhaust air terminal unit. Whenever the manual isolation damper associated with the BSC is closed, during the certification process of the BSC, the room ventilation system shall automatically adjust in order to maintain the negative pressure within the laboratory.
5. Regardless of class and type, all BSCs shall be provided with unit mounted HEPA filtration of the exhaust air prior to its discharge to the room space or to the outdoors.

F. BSCs can also be:

1. Connected to the laboratory exhaust system by either a thimble (canopy) connection (class II, type A1 or type A2, which shall NOT be hard ducted to the building exhaust air system, nor shall thimble connections be used) or;
2. Directly exhausted to the outside through a hard connection as long as provisions to assure proper safety cabinet performance and air system operation are verified.

G. Class II, Type A1, Cabinets:

1. Not to be used for work involving volatile toxic chemicals.
2. It is possible to exhaust the air from a type A1 or A2 cabinet outside of the building. However, it shall be done in a manner that does not alter the air balance of the cabinet exhaust system, thereby disturbing the internal cabinet airflow. The proper method of connecting a type A1 or A2 cabinet to the building exhaust system is through the use of a canopy hood, which provides a small opening or air gap (usually 1 inch) around the cabinet exhaust filter housing.
   a. The airflow of the building exhaust shall be sufficient to maintain the flow of room air into the gap between the canopy unit and the filter housing.
   b. The canopy shall be removable or be designed to allow for operational testing of the

cabinet (see section VI. BMBL 5).

c. Class II type A1 or A2 cabinets shall never be hard-ducted to the building exhaust system. Fluctuations in air volume and pressure that are common to all building exhaust systems sometimes make it difficult to match the airflow requirements of the cabinet.

H. Class II, Type B1, Cabinets:

1. Class II type B1 cabinets are the most versatile of all the BSCs, and their installation results in more flexible laboratory space. However, these cabinets require that they be hard ducted to the building exhaust system and such ducting is not always possible in retrofit projects.

2. Exhaust from the work surface in type B1 cabinets is to the back of the cabinet, and this exhaust is not recirculated in the cabinet. Potentially contaminated air from the work surface that is exhausted through the front vent of the cabinet is HEPA filtered below the work surface and then recirculated to the work surface.

3. The HEPA-filtered exhaust from these cabinets is hard ducted through the facility ventilation system. All contaminated areas of these cabinets are under negative pressure.

4. A gas-tight roll-valve (Baker Company, Sanford, Maine; Martin/ Peterson, Kenosha, Wisconsin; or the equivalent) shall be provided on the class II, type B1, cabinet exhaust. This valve is required in order to facilitate decontamination and testing of the cabinets.

I. Class II, Type B2, Cabinets:

1. Installation of class II, type B2, cabinets requires special ventilation engineering considerations. It is important to evaluate the ventilation of the laboratory to ensure that sufficient air is supplied to the room to prevent robbing adjacent areas of air. Failure to adequately supply such cabinets could result in the failure of other containment devices (e.g., fume hoods, BSCs, etc.) in adjacent laboratories.

4.3 AUTOCLAVES

A. For maximum flexibility, autoclave space shall be provided on each floor where microbiological research is performed. Actual installation of autoclaves and their use are an operational decision. Quality control considerations may require separate autoclaves for clean and dirty procedures. Space shall be considered for both clean autoclaves (for sterilization of microbiological media and clean instruments) and dirty autoclaves (for decontamination purposes or waste). The design team shall review the requirements of the lab users when designing and specifying autoclave space.

B. The space shall have adequate exhaust capacity to remove heat, steam, and odors generated by the use of the autoclave(s). Epoxy floor coverings, floor drains, wash-down rated walls and ceilings and wash-down rated (IEC IP-54/NEMA 4X) electrical components shall be provided in autoclave rooms. A canopy exhaust hood shall be provided over the door of the autoclave. The autoclave space shall operate at negative pressure to the surrounding areas.

END OF SECTION