# TAB C-3

# LABORATORY PLANNING AND DESIGN CRITERIA

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NOTE

- These criteria are intended to apply to both new construction and renovation projects. Obviously, minor renovation projects will not be expected to comply with broad scope criteria, such as redesigning the entire building to satisfy the “modular planning” goal. Wherever these criteria can be reasonably applied to renovation projects with a resulting improvement in the lab environment and without excessive cost penalties, the University desires to do so.

- **General Laboratory Planning and Design Precepts**

    - Utilize a central core for special spaces,  shared spaces, and building service areas
    - Array laboratories around the perimeter of the building
    - Locate offices and circulation spaces between the core and the perimeter labs

        - Separate office spaces from the labs
        - Maintain adjacency and visibility to labs
        - Provide a hierarchy of office spaces

            - Faculty
            - Graduate students
            - Research technicians

    - Provide a variety of informal gathering spaces, with tack and marker boards in each

        - Eddy spaces in corridors (in addition to lab door recesses)
        - Lounges
        - Break rooms

    - Consider providing clean and “dirty” corridors

        - Clean corridors are restricted to people circulation
        - “Dirty” corridors can not be considered as secondary means of egress
        - “Dirty” corridors provide:

            - Utility distribution
            - Air distribution systems
            - Lab equipment (refrigerators, etc)
            - Building equipment (compressors, air pumps, etc)
            - Circulation route for sensitive items

    - Air pressurization hierarchies are critical
    - Ensure adequate space provisions for major equipment

        - Restrict size of main corridor (code minimum?) to prohibit placement of equipment
        - Utilize a hierarchy of equipment spaces:

            - Shared group spaces in the core
            - Floor space allowance in the ”dirty” corridor
            - Open floor and/or space in each lab
            - Available floor space for cart parking
            - Bench top space for analytical equipment (as appropriate)

    - Recess outswinging lab doors off the corridor
    - Ensure adequate provisions for bulk storage

        - Provide storage for all types of materials required:

            - Dry goods
            - Chemicals
            - Bottled gasses

        - Utilize a hierarchy of distributed storage spaces:

        - General building storage
        - Floor closets
        - Lab closets
        - Millwork cabinets
        - Open and/or closed shelving

    - Design bulk storage areas with appropriate fire resistance ratings for materials and quantities

        - Bulk chemical storage facilities should have these characteristics:

            - Perimeter location
            - Vented room
            - 2-hour fire resistant construction
            - Consider including “blow out” panel

        - More than 10 gallons (in the aggregate) of class I chemicals must be stored in a cabinet

            - Provide adequate floor space in chemical storage rooms for individual cabinets

- **Flexible Laboratory Planning**

    - Plan lab facilities with a distributed hierarchy of shell space for future build-out

        - Floor shells and/or wing shells, as appropriate
        - One or more module shells
        - Semi-custom shells
        - Special shells

    - Provide complete utility service into each shell
    - Plan laboratories as "generic" spaces
    - Accommodate different categories of generic labs

        - Wet
        - Dry
        - Teaching
        - Research
        - Biology
        - Chemistry
        - Biochemistry
        - Electronic
        - Geology
        - Physics

    - Accommodate "exceptions" and unique conditions in separated custom-purpose spaces

        - Animal holding
        - Biohazard activities
        - Cold rooms (storage or working)
        - Electron microscope
        - Environmental
        - Laser
        - Radioisotope activities
        - Tissue culture activities

- Consider use of "semi-custom" spaces (in modular increments) to provide flexible and/or adaptable space for activities which present unforeseen requirements

- Provide connecting doors between homogenous lab categories (may be used as secondary egress when part of a rated area separation assembly)

- Design lab infrastructure with flexibility to accommodate different categories of labs and/or future design changes without a need to revise the infrastructure systems

    - Piped utility distribution
    - Waste and vent systems
    - Air management
    - Power supply

- Ensure that all equipment and appurtenances maintain the flexibility established in the basic planning and design

    - Modular benches, wall cabinets, shelving
    - Removable benches to allow increasing equipment floor space
    - Coordinate lab top seams with joints in casework
    - Allowance for items such as cylinder racks

- **Modular Laboratory Planning**

    - Design labs using a planning module
    - Module selection should incorporate the following determinants:

        - Building structure (and vibration considerations)
        - Typical bench needs and sizes for each lab category
        - ADA access requirements
        - Ceiling panel modules
        - Epoxy top modules

    - 10'-6" seems to accommodate lab activities and ADA requirements
    - Maintain consistent modular planning throughout the facility

        - Lab "length" is multiple of lab "width"
        - Special use, exception, semi-custom areas
        - Offices

    - Provide for unique "in-lab" needs within the module or multiple modules
    - Provide complete array of utility stubs to each module, even if not always distributed

- **Handicapped Accessibility in Laboratories**

    - Design typical lab benches to be 34" high
    - Provide sit-down handicapped accessible workstation in each lab
    - Appurtenances for each HC station will vary with the category of lab, but in general should include

        - Bench at approximately 30" high
        - Hood
        - Sink with wrist blade faucet handles
        - Lab gasses with wrist blade cock handles
        - Power
        - Storage facilities

        - Writing surfaces

    - Appurtenances must be within regulation-specified reach distances
    - Investigate whether sit-down writing surfaces available to all lab users could be designed to accommodate an HC station when needed
    - Investigate whether removable benches and/or equipment could be designed to allow retrofit for HC accessibility

- **Planning and Design for Laboratory Safety**

    - Resolve lab exiting issues

        - Investigate a design scheme which utilizes "lab suites" thereby allowing individual lab doors to be left open while preventing true corridor doors from being blocked open
        - Investigate providing magnetic hold open / pneumatic closer devices on lab/corridor doors

    - Chemicals management

        - More than 10 gallons (in the aggregate) of class I chemicals must be stored in a cabinet
        - Provide acid, solvent, and/or flammable storage cabinets for supply chemicals as appropriate in each lab

            - Under hood or free standing as required by quantity to be stored
            - Properly vented
            - Cabinets should be compartmented to allow segregation of chemicals

        - Provide space for storage of waste chemical containers

    - Utilize chemical fume hoods only for lab processes, not for storage

    - Utilize canopy hoods and/or snorkels to remove heat only

        - Autoclaves
        - Dishwashers
        - Certain analytical equipment

    - Provide emergency showers with "hands free" eyewash in corridors

        - Locate within 50 feet of each lab door
        - Do not provide showers in labs
        - Provide a 2” floor drain at each shower location.
        - Provide a local warning alarm for water flow

    - Provide flexible hose eyewash at each major bench sink

    - Provide adequate space, outside traffic areas, for waste handling

        - Provide secured storage/space for sensitive waste
        - Provide vented storage/space for hazardous waste (maximum 5 gallon container)
        - Utilize a distributed hierarchy of waste spaces

            - Building
            - Floor
            - Individual labs

- Waste categories include
    - Ordinary trash
    - Recycled paper
    - Other recyclables
    - Broken glass (secured)
    - Waste chemicals (secured, vented)
    - Red bag (secured)
    - Orange bag (secured)
    - Radio-hazard (secured)

- Provide a separate break away from labs. Provide space for microwave, refrigerator, coffee pot, sink, etc.
- Provide vision lite in every lab/corridor door
- Provide a fire extinguisher rated for materials being used in lab on a hook in each lab room
- Alarm systems
    - Provide mini-horn/strobe units in environmental rooms and in labs
    - Do not provide smoke detectors in corridors
- Biosafety levels
    - Not all laboratories present a biohazard condition requiring primary and/or secondary barriers
    - Hazards are classified by biosafety level, and required physical barriers are described
    - Biosafety level 1
        - Handwashing sink
    - Biosafety level 2
        - Class I or II biosafety cabinets may be required
        - Waste decontamination facilities
    - Biosafety level 3
        - Class I or II biosafety cabinets are required
        - Glove boxes may be required
        - Access control to the laboratory
        - Specialized mechanical ventilation
    - Biosafety level 4
        - Class III biosafety cabinets are required (or personal pressure suit)
        - Separate building or completely isolated zone
        - Specialized mechanical ventilation and waste management systems to contain hazards

- **Laboratory Casework**
    - Provide wood casework
        - Natural finish, not plastic laminate
        - Except where matching existing metal
        - Except in areas requiring impervious surfaces

        - Animal care areas
        - Biohazard areas
        - Radioisotope areas
        - Chemical storage rooms

    - Include utility chase behind wall/peninsula/island base cabinets
    - Demonstrate functional useability of corner area where two base cabinets intersect
    - Provide removable access panels at knee spaces and sink cabinets

        - Rear stretcher at knee space should be continuous

    - Provide pull out writing tablet in casework, using drawer glides
    - Provide heavy duty full extension drawer glides (100 pounds minimum)
    - Provide pre-fabricated specialty chemical and flammable storage cabinets where required

- Laboratory bench tops

    - Epoxy resin tops at all wet or semi-wet areas
    - Acid resistant plastic laminate at dry areas
    - Provide dished top at all major lab sinks
    - Provide lip at all sinks in labs
    - Locate seams in tops coincident with seams in benches to allow for modifications
    - Use light colored tops if lighting efficiency can be demonstrated

- Wall / peninsula / island reagent shelving (above lab benches)

    - Custom fabricated using unistrut-type system (not stock item)
    - Extend unistrut from floor through bench top to structure above

        - Seal penetration with epoxy seaming material
        - Do not use a "wrapped splash"
        - Earthquake lip (12" or 18" clear dimension)
        - Acid resistant plastic laminate on wood substrate

            - Do not use an epoxy paint or clear finish

        - Do not install reagent shelving above sinks

    - Enclosed wall reagent cabinet (above lab benches)

        - 12" clear dimension
        - Glass or opaque doors as requested by User
        - Do not install wall cabinets above sinks

    - Wall shelving (non-reagent)

        - Must have backing in wall
        - Clear finish wood
        - Heavy duty adjustable kv-type brackets
        - End caps
        - Use unistrut-type reagent shelves for extra deep wall shelving
        - Install top-most shelf 24” minimum below ceiling
        - Do not install wall shelving above sink

- **Laboratory Equipment and Appurtenances**
    - Provide a 3'-6" minimum single leaf at each lab/corridor door
    - Discuss fume hood selection with UA Facilities Design & Construction
        - Investigate special user requirements
            - Laminar flow clean hoods
            - Radioisotope hoods
            - Perchloric acid hoods
            - Biosafety cabinets
    - Laminar flow clean hoods
        - Used only to protect process (not to protect operator)
        - Not exhausted
    - Radioisotope hoods
        - Special purpose fume hood with hepa-filtered exhaust discharge
        - Generally uses slightly higher face velocity than conventional fume hoods (125 fpm)
        - Requires welded stainless steel exhaust duct system
        - Can be open or gas-tight (glove box)
    - Perchloric acid hoods
        - Straight exhaust duct run (no horizontal offsets) is mandatory
        - Requires automatic wash down system
            - Timer-controlled for washing once per week
            - Discharge must be carried to the lab waste system
        - Requires welded stainless steel exhaust duct system
    - Biosafety cabinets
        - Identify specific type of hood required, based on User process
            - Class I biosafety cabinet: 100 fpm, single pass air, out through hepa filter
            - Class II-A biosafety cabinet: 100 fpm, 70% recirculated through hepa, 30% exhaust to room through hepa
            - Class II-B1 biosafety cabinet: 100 fpm, 30% recirculated through hepa, 70% exhausted to exterior through hepa
            - Class II-B2 biosafety cabinet: 100 fpm, 100% exhausted to exterior through hepa
            - Class II-B3 biosafety cabinet: 100 fpm, 100% exhausted to exterior through hepa, plena under negative pressure to room
            - Class III biosafety cabinet: gas-tight cabinet, supply through hepa, exhaust through 2 hepa
        - Biosafety cabinet exhausts may be manifolded together, but not with chemical fume hoods
    - Exhaust hood control
        - Chemical fume hoods may not be User controllable, must be on 24 hours

        - Also includes radioisotope and perchloric acid hoods
        - Consider off-hours setback and vav systems, for energy conservation

    - Interior recirculation ("supply") fans of biosafety cabinets may be User controllable

        - Must be interlocked with hood and/or general exhaust fans to ensure that operator safety and room pressure are not compromised
        - Applies to all class II biosafety cabinets, only

    - Provide tank farm with chains, not dividers, when required

        - Design to be near the door, for ease of service
        - Utilize University-standard tank manifold

    - Provide wall space for UA-standard towel and soap dispensers at each lab sink
    - Provide tack surfaces and writing boards in all labs
    - Carefully coordinate all equipment specifications

        - Fixed or moveable, must specify details
        - Sizes and floor space allowances

    - Use electric autoclaves instead of steam

- **Laboratory Finishes**

    - Floor finishes

        - Available choices

            - Vinyl composition tile is appropriate for most labs
            - Epoxy sealer is also appropriate for most labs, including chemistry
            - Seamless vinyl provides a "pan" in very wet areas
            - Seamless vinyl is cleanable for biology labs

        - Continue flooring under casework
        - Seal toekick of all benches (to prohibit water penetration)
        - Use topset cove base at toekicks

    - Provide epoxy wall paint in all wet labs

        - Also on ceilings, if hard surface

    - Ceilings

        - Available options

            - Suspended acoustical tile ceilings are acceptable in most laboratories
            - No ceiling is an option where appropriate
            - Provide hard ceilings only where required by lab activity

    - Provide a sealed sleeve with a lip at all floor penetrations

- **Laboratory Utility Service and Distribution**

    - Utilities distribution

- Overhead, in corridor ceiling
- Valve on each utility stub, in corridor
- Drop on wall surface or freestanding to each lab bench
- Distribute to positions in utility space at rear of casework
    - Make joints in horizontal piping only at removable panels
- Visible and accessible
- Consider special delivery systems where appropriate
    - Lab gas "pedestal" or "drop pods"
    - Electric "drop cords"

- Utilities on bench tops
    - Place turrets toward rear of bench
    - Use turrets with angled discharge to enhance hose management

- Utilities racked on reagent shelf
    - Generally avoid (hoses get in the way)
    - If doing so, rack on unistrut verticals, not shelf
    - If doing so, maintain 22" clear height above bench top

- Piped utilities
    - distribute to benches and hoods
        - controls must be outside hoods

- building provides central
    - potable water
    - ro water
        - Provide special (di) polish at individual labs
    - Natural gas
        - Some Users prefer bench top cylinders for gas service
    - Compressed air
        - Confirm if required
    - Building does not provide central
        - Vacuum
        - Hot water
        - Specialty gasses
        - Provide in individual lab as needed
    - Use building chilled water wherever possible for process

        - Provide heat exchanger between building and process
        - Recirculate chilled water (do not use "single pass")
        - Where demand is excessive, varies from building system, or need is critical

            - Use stand alone chiller
            - Consider placing chiller on emergency power system

- Waste system and piping

    - Do not use acid neutralization systems (building or stand-alone)
    - Separate lab waste from domestic waste

        - Utilize separate piping system to exterior of building
        - Provide sampling manhole for lab waste piping
        - Combine lab and domestic waste piping after sampling manhole

    - Use acid-resistant piping system for lab waste

- Lab sinks

    - Confirm with User need for large/deep sinks
    - Plan major sinks at ends of benches, in base cabinet
    - Use gooseneck faucets with wrist blades at all sinks
    - Cup sinks are not routinely needed on benches or in hoods

        - Install only is specifically required
        - Always provide lip
        - In hoods, sink must be at rear to avoid trap being in under-hood storage cabinet

- Do not use plastic di faucet

    - Aluminum faucet (with plastic piping) is acceptable

        - Self-closing
        - Easily replaceable

- Floor drains

    - Use only when required to discharge condensate or other similar non-hazardous material

    - Must be lipped and guarded

- Electrical & telecommunications typically required

    - Provide an adequate number and arrangement of circuits
    - Provide an adequate number and arrangement of 120v receptacles
    - Provide an adequate number and arrangement of 208v receptacles
    - Provide wiremold electrical distribution above all lab benches

        - Double raceway
        - Install quantity of receptacles as required by User process
        - Receptacles above bench must have gfci protection *within 5' of water source*
        - Install of data jacks as required by User in second raceway

    - Label each receptacle's circuit

- Alternate circuits in each lab and in each wiremold run
- Provide wall phone jacks where required. Do not provide data jacks at wall phone jacks.
- Provide date jacks along benches where required.

- Lighting

  - Place general fixtures to eliminate shadows from work surfaces
  - Do not rely on general fixtures for the complete lighting environment
  - Provide task lighting above lab benches and other work surfaces

    - Utilize 2-tube fixtures with shades to minimize glare

  - Evaluate color and reflectivity of finishes and bench tops as part of lighting design
  - Provide emergency lighting in each lab room or distinct space

- **Laboratory Air Management Technology**

  - Preferred system

    - Building ahu to supply make up air to labs
    - Lab fan coil units to remove sensible cooling load of lab equipment
    - Investigate manifold and vav exhaust system if project has many hoods

      - Use multiple fans in manifolded system

        - To allow programmed maintenance

  - Basic system design issues

    - Provide pressure hierarchy between lab spaces

      - Provide capability to measure velocity and pressure downstream of terminal boxes

    - Provide exhaust discharge velocity of 3000 - 3500 fpm

      - Provide bypass on manifold vav systems at roof

    - Provide filtration or scrubbing for hazardous emissions

  - Temperature control

    - St individual room thermostats at 75°F, ± 2°F

  - Humidity control – discuss with UA FDC

  - Filtration requirements

    - Provide minimum 4" deep 30% efficiency filter banks in 100% outside air systems

  - Design exhaust systems for materials being removed

    - Heavier or lighter than air
    - Concentrations and processes
    - Discuss design hood face velocity with UA FDC
    - Limit use of canopies and snorkels to heat removal

- Ductwork materials
    - Spiral 316L stainless steel shall be used for fume hood applications
    - PVC coated galvanized may be used on manifold vav systems applications
        - Clearly specify strict construction controls
    - Welded 316L stainless steel must be used for perchloric acid hoods

- Design exhaust system for noise reduction
    - Duct size, design, and route
    - Fan selection and location
    - Low pressure drop hood

- Specify appropriate vent conduits for storage cabinets
    - Explosive / flammable
    - Vapors