Exhibit 'F'

UCSB

ENGINEERING III PROGRAM

22 May 2017

lab
Life. Science. Architecture, Inc.

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I. INTRODUCTION

DEAN'S INTRODUCTION

The College of Engineering at UC Santa Barbara is a mid-sized college that is consistently ranked among the upper echelon of engineering schools in the world. We are an interdisciplinary culture of innovation, committed to developing new technology and adding value to the economy in our region, state, and the world. COE is proven to be one of the most successful public-private research partnership environments in the country and a hotbed of new intellectual property.

The College of Engineering offers undergraduate and graduate degree programs in five departments and several affiliated programs. Our academic departments are Chemical Engineering, Computer Science, Electrical & Computer Engineering, Materials, and Mechanical Engineering. Our affiliated programs include a unique Technology Management Program, which offers training, academic programs, and competitions for the business side of engineering; Media Arts & Technology, offering graduate programs and research integrating digital and visual arts with technology; and interdisciplinary graduate programs in Biomolecular Science & Engineering and Computational Science & Engineering. In addition to departments and programs, there are dozens of engineering research centers and institutes affiliated with the College, our departments, and/or our faculty.

The College of Engineering is ranked the #1 public university in the world for engineering research citation impact (Leiden, 2015, 2016). Our Materials graduate program is ranked #1 in the nation among public universities (US News, 2016, and NRC), and our Chemical Engineering program is consistently ranked in the top 5. All of our graduate research programs were ranked in the top 5 for their disciplines (NRC, 2010). Engineering is home to the west coast hub of AIM Photonics, a national photonics technology manufacturing initiative, as well as one of the top NSF Materials Research Science & Engineering Centers in the country, and more.

Our faculty consists of three Nobel laureates, 29 members of the National Academy of Engineering, seven names among the ISI Highly Cited index, seven fellows of the National Academy of Inventors. Many faculty who have won technical awards in the Oscars, Emmys, and more.

Sufficient, quality space, especially state-of-the-art laboratory space, is essential if the College of Engineering is to continue to hire and retain top faculty which, in turn, are critical to our teaching and research mission and continued recognition and rankings. Currently the COE occupies approximately 289,240 asf in 20 buildings across campus. Sixty-six percent of COE space is more than 30 years old. Age, coupled with quality of space, continues to be problematic as research in engineering continues to become more complex and specific in its instrumentation and equipment needs, and also requires more specialized infrastructure to meet those needs, as well as the ever-changing code requirements. In addition to quality of space, each COE department has a minimum of four locations on campus with one department dispersed in eleven separate locations. This fragmenting of departments creates discontinuity that negatively impacts departmental operations and potential in almost every aspect, including faculty and student productivity, collaboration, departmental community, student recruiting, faculty hiring, and instruction.

DEAN'S INTRODUCTION - CONTINUED

The College of Engineering worked with the Office of Budget and Planning to develop an overall College-wide Space Assessment. This model shows a current space deficit of 197,958 asf. This unmet need is based on 2015-16 faculty, student (both graduate and undergraduate), post doc, staff and visitors, it does NOT include growth projections given the current authorized recruitments nor future anticipated growth based on the campus' overall growth. In addition, because we are hiring the very best faculty, who are recruited by others, we are facing an increase in the need for lab space for their large research groups to function. This increase is seen time and time again in both retention cases and new recruitments.

The campus recognized the space need for the College of Engineering and as a result the Engineering III Building was placed on the Campus' 10 year Capital Plan. Accordingly, a comprehensive Space Plan around a new 75,000 asf Engineering III Building, was created to begin to mitigate some of the issues discussed above. As documented in this report, the Materials Department, the Electronics & Photonics group within Electrical and Computer Engineering and a small portion of Chemical Engineering will relocate to Engineering III, leaving released space in Harold Frank Hall, Engineering II and the Engineering Sciences Building. This released space will be distributed among the COE departments to help offset their current unmet space need and position them in a more cohesive alignment of space. While this new building is just the beginning in addressing the College's overall unmet space need, it is a great addition to the current space inventory.

In summary, space, especially state-of-the art research labs, is a key resource that is needed for the College to continue to conduct quality research, mentor graduate students to maintain our high rankings, reputation and continue to grow.

-Rod Alferness, Dean of the College of Engineering

The findings presented here are the result of a series of extended working meetings with the College of Engineering and the LAB Life. Science. Architecture. consulting firm. The highest priority of these meetings was the specification of high-performace research laboratory spaces. High-performance research laboratories require excellent environmental controls, utilities, and services. Laboratory types, quantities, and their detailed specifications are spelled out in this document and must be properly documented in the subsequent stages of the design process.

PROJECT TEAM

UCSB College of Engineering

Rod Alferness, Dean, College of Engineering

Tresa Pollock, Department Chair, Materials
Michael Chabinyc, Associate Chair, Materials
Steve DenBaars, Distinguished Professor, Materials
Dan Gianola, Associate Professor, Materials
Chris Palmstrøm, Distinguished Professor, Materials
Jim Speck, Distinguished Professor, Materials
Stephen Wilson, Associate Professor, Materials
Mark Cornish, Principal Development Engineer, Materials
Aidan Taylor, Associate Project Scientist, Materials
Kurt Olsson, Principal Development Engineer, Materials
Deryck Stave, Principal Development Engineer, Materials
Chris Torbet, Research Specialist, Materials
Dawn McTague, Management Services Officer, Materials

Joao Hespanha, Department Chair, Electrical and Computer Engineering
Jim Buckwalter, Professor, Electrical and Computer Engineering
Jonathan Klamkin, Associate Professor, Electrical and Computer Engineering
Jon Schuller, Assistant Professor, Electrical and Computer Engineering
Stacia Keller, Principal Development Engineer, Electrical and Computer Engineering
Robin Jenneve, Academic Business Officer, Electrical and Computer Engineering

Rachel Segalman, Department Chair, Chemical Engineering

Ambuj Singh, Department Chair, Computer Science
Giovanni Vigna, Professor, Computer Science

Chris LaVino, Assistant Dean Building Construction & Space Management
Rob Callaway, Multimedia and Computing Facilities Manager

Mark Nocciolo, Acting Director Capital Development
Carolyn Franco, Associate Educational Facilities Planner

LAB Life. Science. Architecture, Inc.

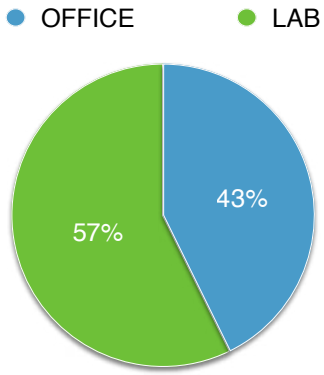
Mark Reed, Principal
Michael P. Maloof, Architect

II. PROGRAM SUMMARY

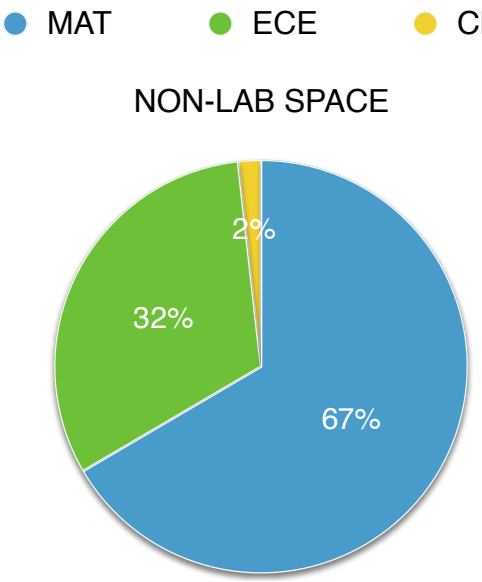
PROPOSED PROGRAM - NEW ENGINEERING III BUILDING

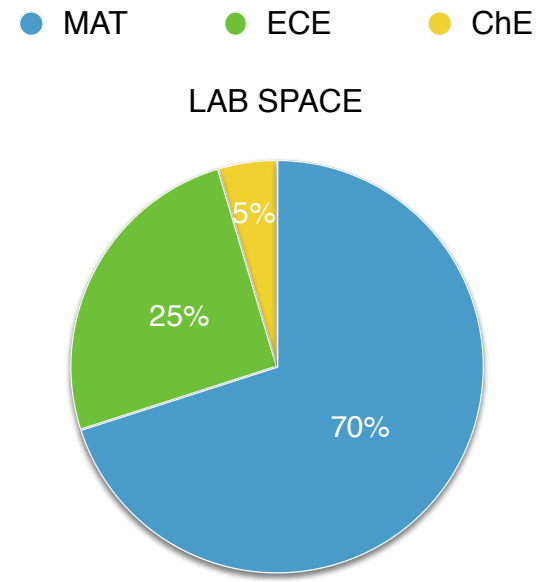
The new Engineering III building will house the most sensitive and high-performance programs in the College of Engineering, including a variety of research labs for the Materials (MAT), Electrical & Computer Engineering (ECE), and Chemical Engineering (ChE) departments. To support these labs, new non-lab space will also be required, including office space, community and conference space, seminar space, and administrative support. The proposed program prioritizes the much needed, high value laboratory space in a 60% lab to 40% non-lab ratio, with the Materials department allotted roughly 70% of the program. The remaining program space is shared between the Electrical & Computer Engineering (25%) and Chemical Engineering (5%) departments.

SPACE TYPE	ASF
Office	32,050
Lab	42,966
TOTAL	**75,016**



DEPARTMENT		BAYS	BAY SIZE	ASF
MAT	Non-Lab Space			21,330
ECE	Non-Lab Space			10,150
ChE	Non-Lab Space			570
MAT	Lab Space	91.20	330.00	30,096.00
ECE	Lab Space	33.00	330.00	10,890.00
ChE	Lab Space	6.00	330.00	1,980.00
Total		**130.20**		**75,016**

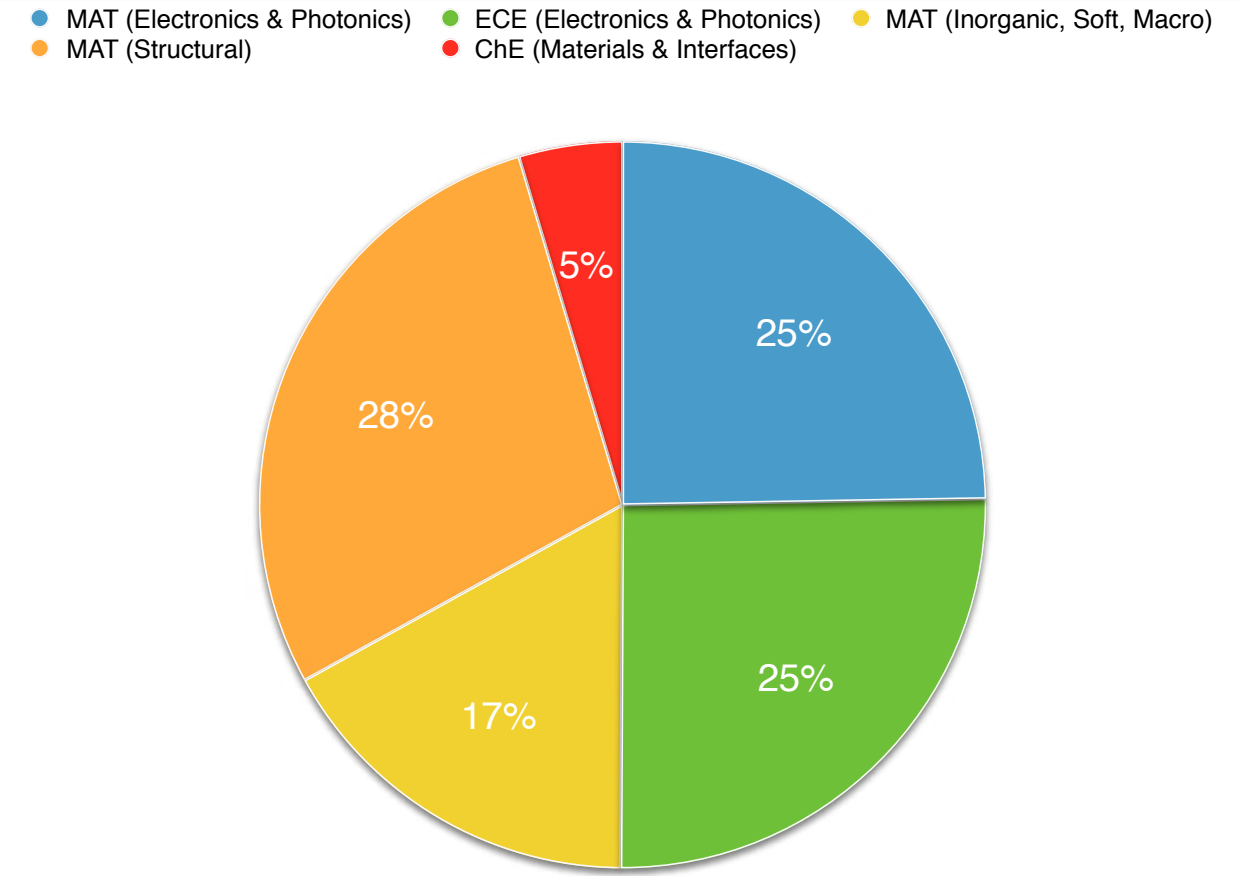




PROPOSED PROGRAM - NEW ENGINEERING III BUILDING

Within the proposed program, the new research laboratory space is organized into five major groups, spanning the three primary departments (Materials, Electrical & Computer Engineering, Chemical Engineering) that will occupy the new building. These groups include the Electronics & Photonics group, the Structural Materials group, and the Inorganic, Soft, and Macromolecular Materials groups within the Materials department; the Electronics & Photonics group within the Electrical & Computer Engineering department; and the Materials & Interfaces group within the Chemical Engineering department. The distribution of program space is summarized in the table below.

	DEPARTMENT	BAYS	ASF
MAT	Electronics & Photonics	32.2	10,626
ECE	Electronics & Photonics	33	10,890
MAT	Inorganic, Soft, Macro	22	7,260
MAT	Structural	37	12,210
ChE	Materials & Interfaces	6	1,980
	TOTAL	**130.2**	**42,966**



NOTE: Bay size is based on 330 assignable square feet. This bay size is derived from an 11ft by 30ft working grid for the purposes of this exercise.

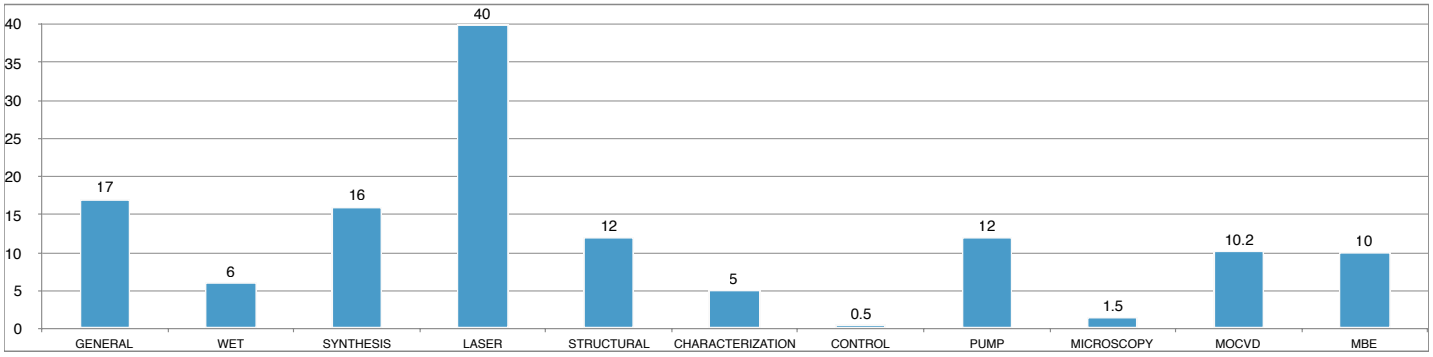
III. LABORATORY TYPES

PROPOSED PROGRAM - NEW ENGINEERING III BUILDING

The proposed research laboratory program for the new building is composed of several high-performance lab types. The lab types include: General Labs, Wet Labs, Synthesis Labs, Laser Labs, Structural Labs, Characterization Labs, High Resolution Electron Microscopy Labs, Metalorganic Chemical Vapor Deposition (MOCVD) Labs, Molecular Beam Epitaxy (MBE) Labs, Control Rooms, and Pump Closets. The distribution of these lab types across the five research groups is summarized in the table below. The following pages describe in detail the space allocations, architectural layouts in floor plan and in section, and the environmental room criteria for each laboratory type.

LABORATORY TYPES

		General Lab Bays	Wet Lab Bays	Synthesis Lab Bays	Laser Lab Bays	Structural Lab Bays	Characterization Lab Bays	Control Room Bays	Pump Closet Bays	Microscopy Lab Bays	MOCVD Lab Bays	MBE Lab Bays	TOTALS Bays
MAT	Electronics & Photonics	5	0	0	0	0	0	0	7	0	10.2	10	32.2
ECE	Electronics & Photonics	2	0	0	31	0	0	0	0	0	0	0	33
MAT	Inorganic Materials	0	0	16	0	0	5	0	1	0	0	0	22
ChE	Materials and Interfaces	0	6	0	0	0	0	0	0	0	0	0	6
MAT	Structural Materials	10	0	0	9	12	0	0.5	4.00	1.5	0	0	37
	Total	**17**	**6**	**16**	**40**	**12**	**5**	**0.5**	**12**	**1.5**	**10.2**	**10**	**130.2**

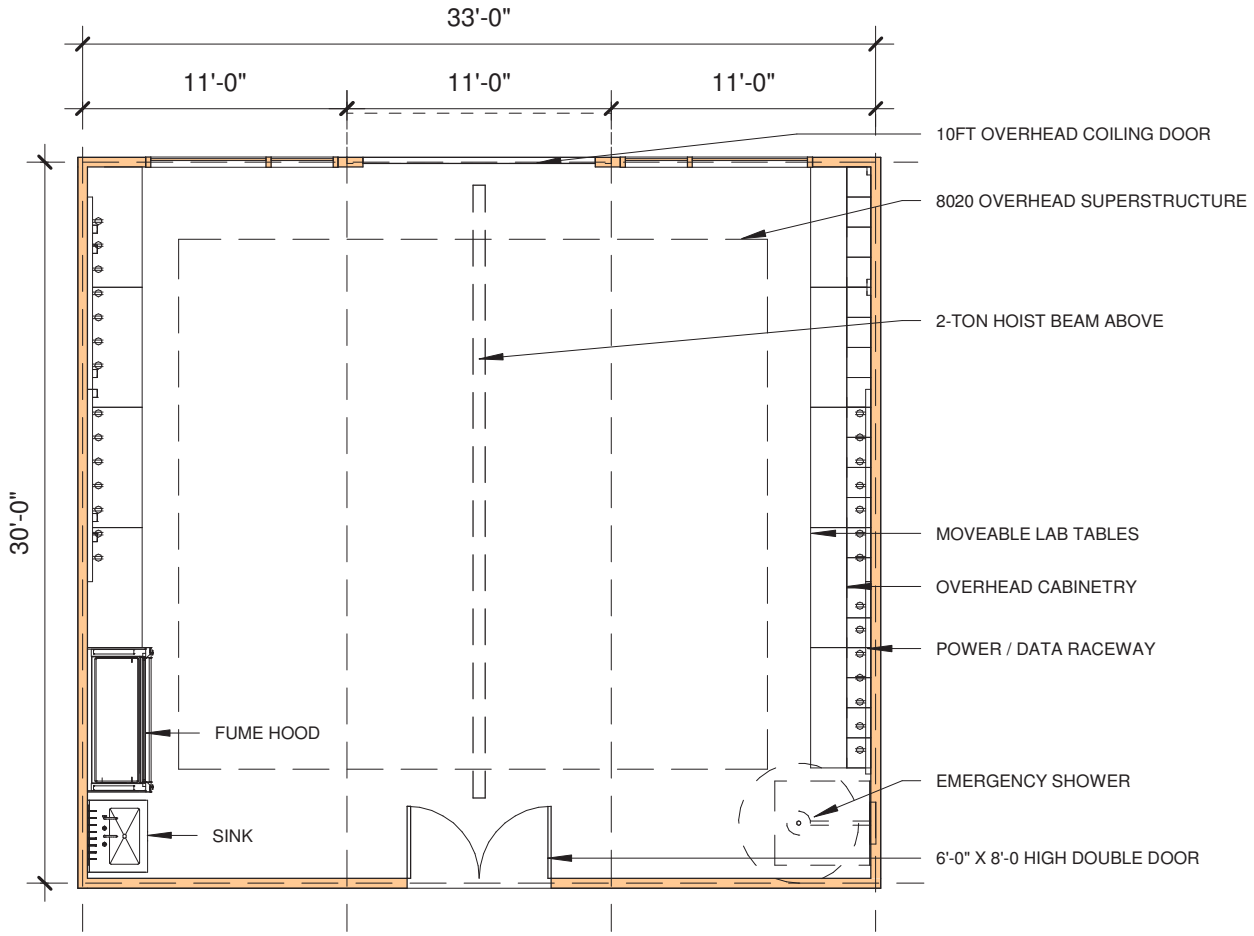


NOTE: Bay size is based on 330 assignable square feet. This bay size is derived from an 11ft by 30ft working grid for the purposes of this exercise.

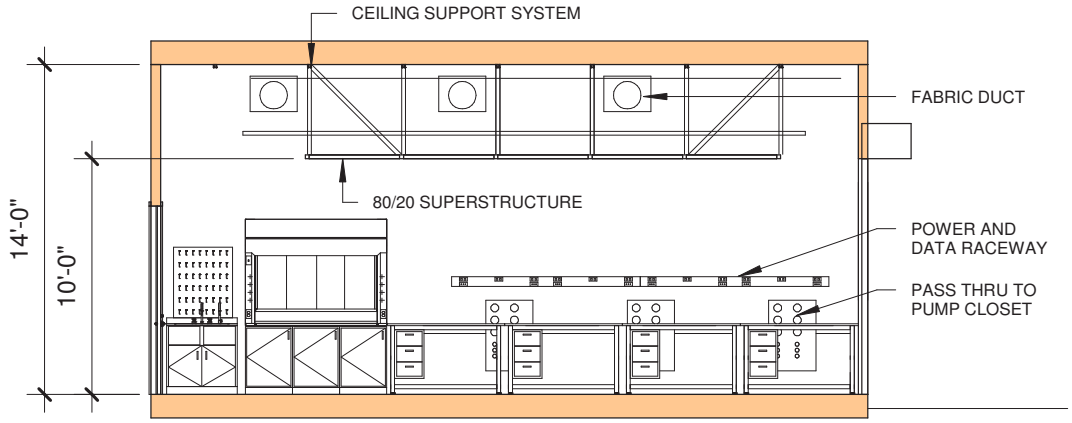
i. STRUCTURAL MATERIALS

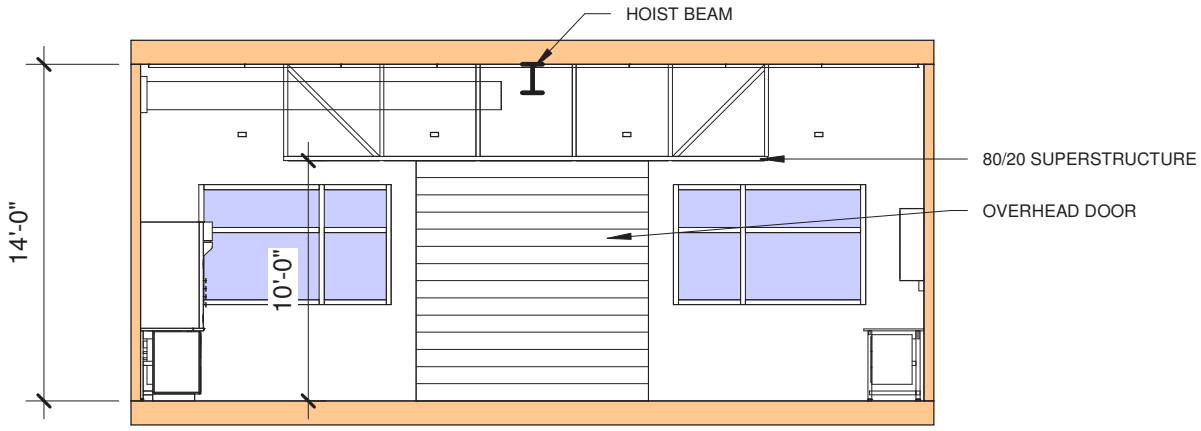
STRUCTURAL LAB

Structural materials research focuses on emerging high-temperature and lightweight materials (including advanced oxides, carbides, and metallic alloys along with protective coatings), biological and bio-inspired materials, as well as novel multilayered, fibrous and hybrid architectures. Novel synthesis and processing routes enable these classes of materials; these processing approaches generally require high power density furnaces, lasers or electron beam systems coupled physically large vacuum chambers. High temperature mechanical characterization is also an essential element of advancing these classes of materials.



STRUCTURAL LAB - (3) BAYS - 990 ASF



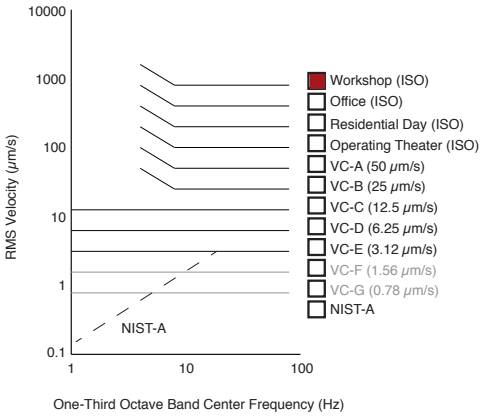


STRUCTURAL LAB - SECTIONS

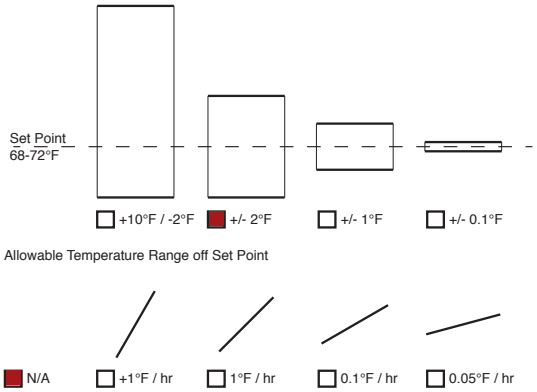
Laboratory Performance Criteria

Laboratory Type: Structural Lab
Laboratory Function: Heavy Processing
Description of Activities: Casting, Crystal Growth, Hot Press, Mechanical Behavior, Thin Films, Furnaces

Vibration Control



Temperature Control



Acoustic Control

- ☐ NC-15 TEM / Recording
- ☐ NC-20 SEM
- ☐ NC-25 Dil Fridge
- ☐ NC-30 High Perf Lab
- ☐ NC-35 Conference
- ☐ NC-40 Private Office
- ☐ NC-45 Open Office
- ■ NC-50 Laboratory
- ☐ No Requirement

Air Quality

- ☐ ISO 3 1
- ☐ ISO 4 10
- ☐ ISO 5 100
- ☐ ISO 6 1,000
- ☐ ISO 7 10,000
- ☐ ISO 8 100,000
- ■ No Classification
- ☐ Laminar Flow
- ☐ Moveable T-stat

Humidity Control

- ■ 30%-50% RH
- ☐ 30%-50% RH Settable
- ☐ No Humidification

- ☐ Return Air Allowed
- ☐ Local FCU (Remote)
- ☐ Positive Pressure
- ■ Negative Pressure
- ☐ +/-5% RH

Power Density

- ☐ 5 W/sf (2W/sf demand)
- ☐ 10 W/sf (5W/sf demand)
- ☐ 20 W/sf (10W/sf demand)
- ☐ 30 W/sf (15W/sf demand)
- ☐ 50 W/sf (25W/sf demand)
- ☐ 80 W/sf (40 W/sf demand)
- ☐ 100 W/sf (50W/sf demand) *300 W/sf
- ■ Pump Power
- ■ Instrument Power
- ■ Clean Ground
- ■ Emergency Power

Electromagnetic Interference (EMI) Control

- ■ 100 nT RMS (300 nTp-p): General High Performance Lab
- ☐ 35 nT RMS (100 nTp-p): Dilution Refrigerator Lab
- ☐ 18 nT RMS (50 nTp-p): E Beam / FIB
- ☐ 11 nT RMS (30 nTp-p): SEM / TEM
- ☐ 4 nT RMS (10nTp-p): FEI Titan / JEOL 2100F

Architectural

- ☐ ESD Flooring
- ☐ Seamless Flooring
- ☐ Cryo Safe Flooring
- ■ Chemical Resistant Flooring
- ☐ Wall Mounts
- ■ Ceiling Mounts
- ■ Double Door
- ■ Windows Allowed

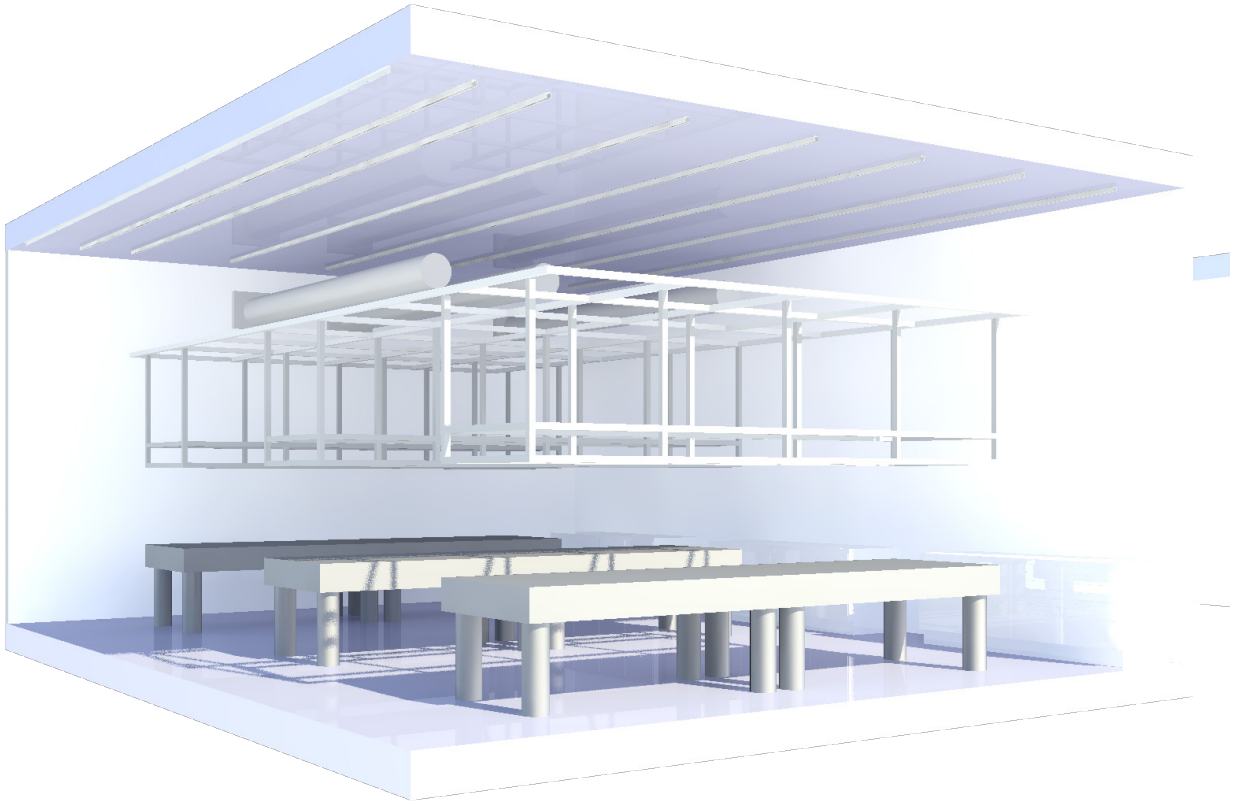
*10ft coiling door

Infrastructure

- ■ Clean Dry Air
- ■ House Vacuum
- ■ House Nitrogen (gas)
- ☐ House Helium (gas)
- ■ Cylinder Gas Manifolds Qty 2-6
- ☐ Helium Recovery (Vertical)
- ■ Other pump closet
- ■ 480V 3p Required

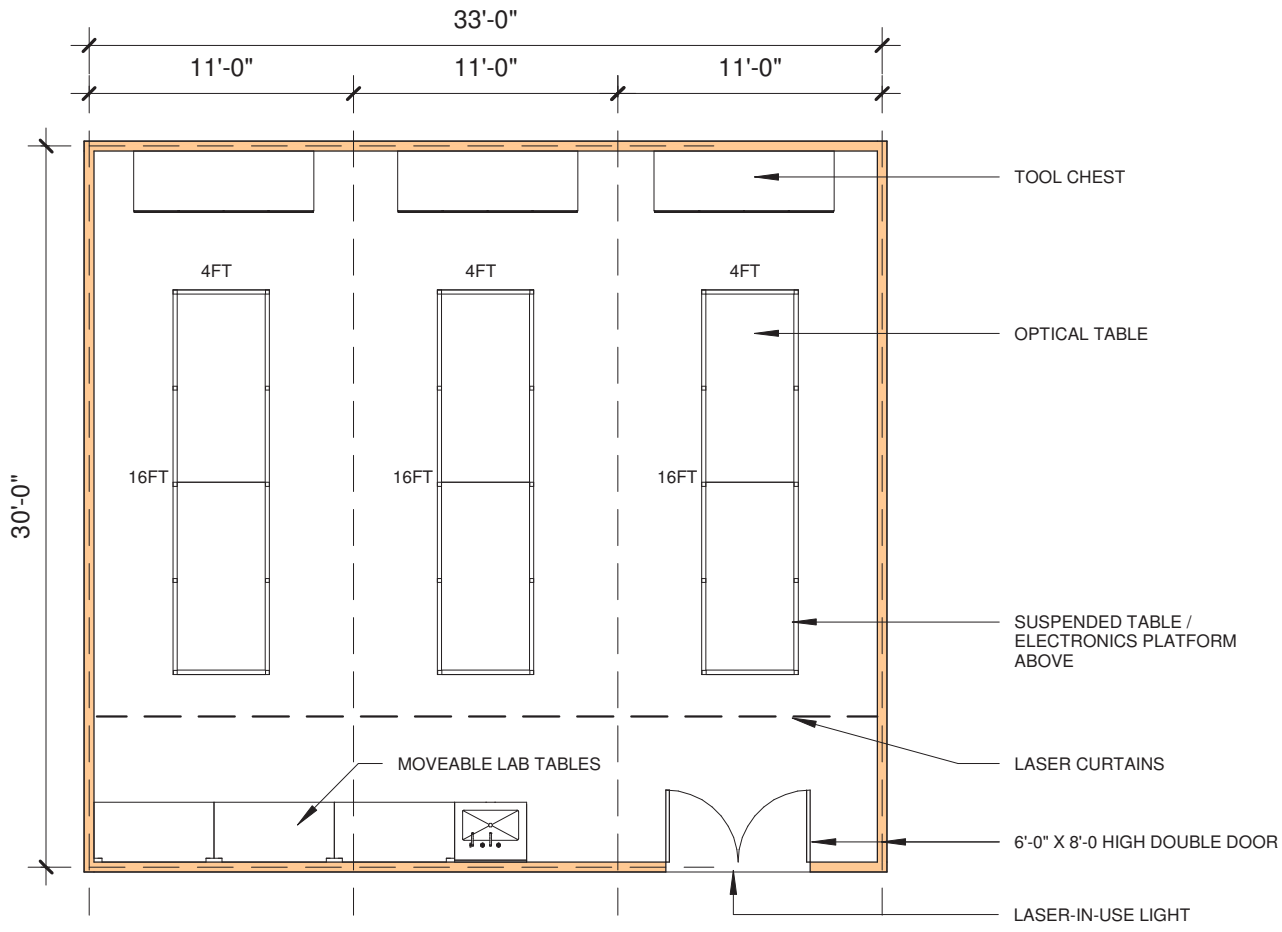
- ■ Hot Water
- ■ Cold Water
- ■ RODI 18 meg ohm
- ■ Eyewash (Tempered Water)
- ■ Safety Shower (Tempered Water)
- ☐ Other _____
- ☐ Data (Fiber)
- ■ Data (Copper)

- ■ Fume Hood
- ■ Snorkel Exhaust
- ☐ Biological Safety Cabinet
- ☐ HEPA Filter
- ☐ ULPA Filter
- ■ Process Chilled Water
  50-75 Percent of Power Demand
- ☐ 12V DC LED Lighting
- ■ Standard LED Lighting



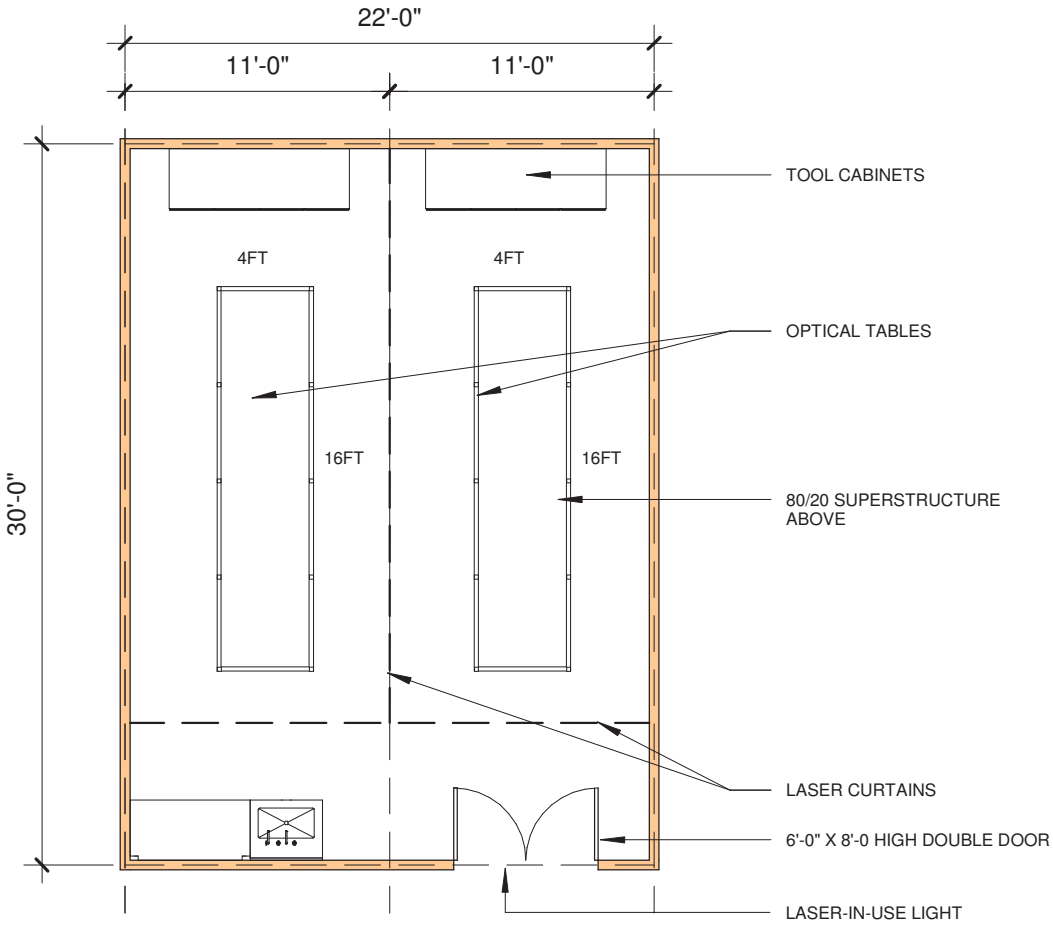
LASER LAB (STRUCTURAL)

The ability to print hierarchically complex materials layer-by-layer or voxel by voxel on demand will enable future innovations at the intersection of materials and structures. Emerging additive manufacturing and 3D printing approaches employ multiple classes of lasers and/or electron beams contained in vacuum or inert gas chambers. Flexible space for new system designs is an essential feature of this laboratory space. Capabilities for safe handling metallic and ceramic powders is an additional element of this laboratory space.



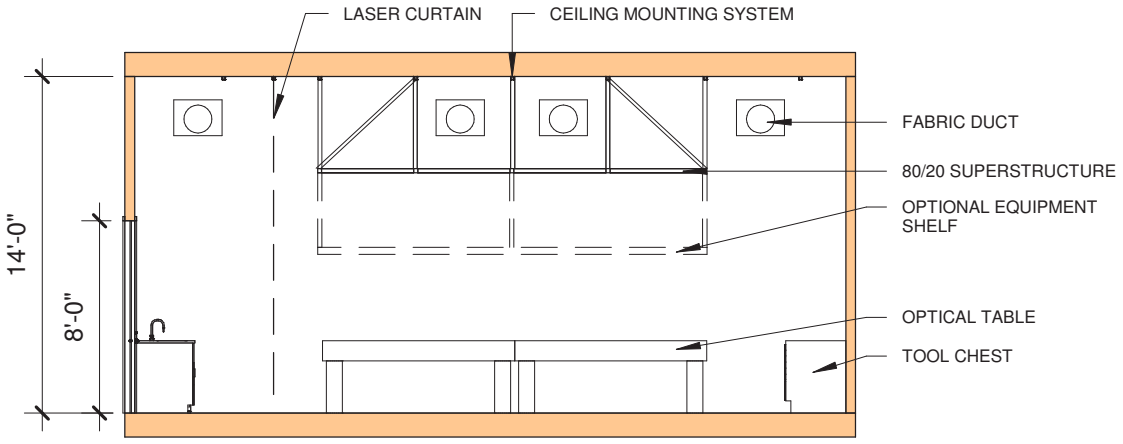
NOTE: CONFIGURATION OF CURTAINS AND LASER TABLES TO BE DETERMINED BY EACH RESEARCHER

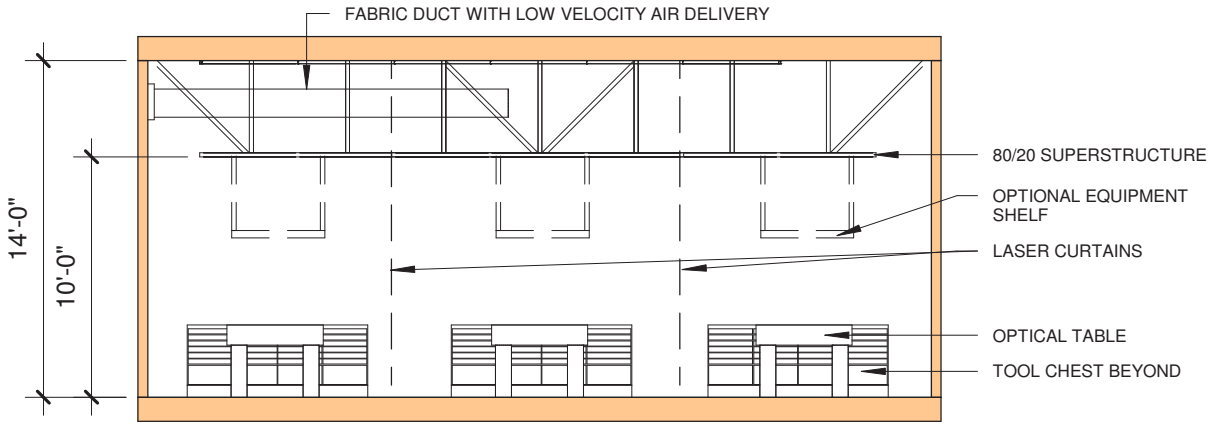
LASER LAB (STRUCTURAL) - (3) BAYS - 990 ASF



NOTE: CONFIGURATION OF CURTAINS AND LASER TABLES TO BE DETERMINED BY EACH RESEARCHER

LASER LAB (STRUCTURAL) - (2) BAYS - 660 ASF



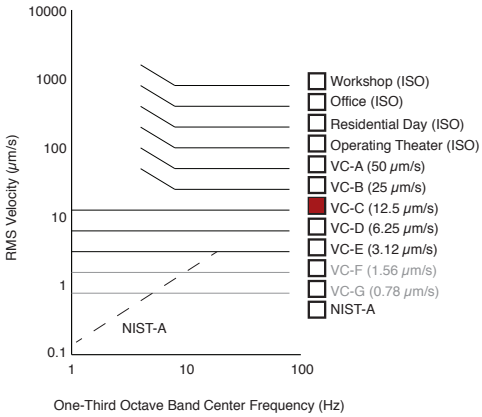


LASER LAB (STRUCTURAL) - SECTIONS

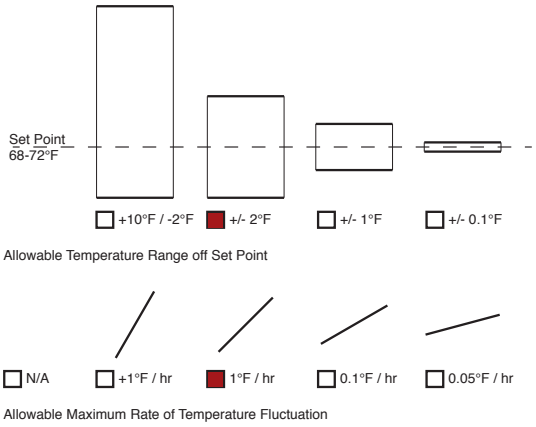
Laboratory Performance Criteria

Laboratory Type: Laser Lab (Structural)
Laboratory Function: Advanced Laser Optics
Description of Activities: Single Room with (3) Laser Curtain Areas & Prep Area

Vibration Control



Temperature Control



NOTE: Local Remote FCU to have 50% over-capacity, to be water based and controlled by user.

Acoustic Control

- ☐ NC-15 TEM / Recording
- ☐ NC-20 SEM
- ■ NC-25 Dil Fridge
- ☐ NC-30 High Perf Lab
- ☐ NC-35 Conference
- ☐ NC-40 Private Office
- ☐ NC-45 Open Office
- ☐ NC-50 Laboratory
- ☐ No Requirement

Air Quality

- ☐ ISO 3 1
- ☐ ISO 4 10
- ☐ ISO 5 100
- ☐ ISO 6 1,000
- ☐ ISO 7 10,000
- ☐ ISO 8 100,000
- ☐ No Classification
- ■ Laminar Flow
- ☐ Moveable T-stat

Humidity Control

- ☐ 30%-50% RH
- ■ 30%-50% RH Settable
- ☐ No Humidification

- ■ Return Air Allowed
- ■ Local FCU (Remote)
- ■ Positive Pressure
- ☐ Negative Pressure
- ■ +/- 2% RH

Power Density

- ☐ 5 W/sf (2W/sf demand)
- ☐ 10 W/sf (5W/sf demand)
- ☐ 20 W/sf (10W/sf demand)
- ☐ 30 W/sf (15W/sf demand)
- ☐ 50 W/sf (25W/sf demand)
- ■ 80 W/sf (40 W/sf demand)
- ☐ 100 W/sf (50W/sf demand)
- ■ Pump Power *in adjacent closet
- ■ Instrument Power
- ■ Clean Ground
- ☐ Emergency Power *UPS

Electromagnetic Interference (EMI) Control

- ☐ 100 nT RMS (300 nTp-p): General High Performance Lab
- ■ 35 nT RMS (100 nTp-p): Dilution Refrigerator Lab
- ☐ 18 nT RMS (50 nTp-p): E Beam / FIB
- ☐ 11 nT RMS (30 nTp-p): SEM / TEM
- ☐ 4 nT RMS (10nTp-p): FEI Titan / JEOL 2100F

Architectural

- ■ ESD Flooring
- ☐ Seamless Flooring
- ☐ Cryo Safe Flooring
- ☐ Chemical Resistant Flooring
- ■ Wall Mounts
- ■ Ceiling Mounts
- ■ Double Door
- ☐ Windows Allowed

Infrastructure

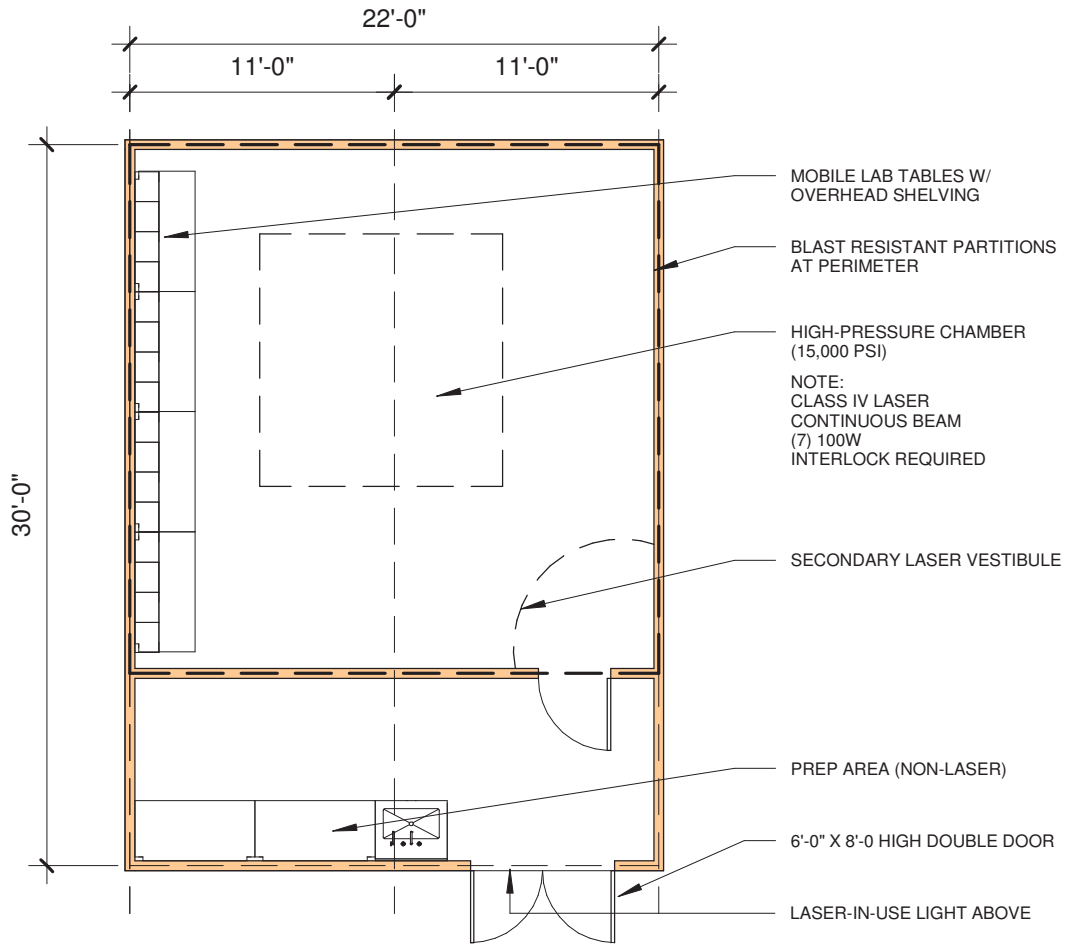
- ■ Clean Dry Air
- ■ House Vacuum
- ■ House Nitrogen (gas)
- ☐ House Helium (gas)
- ■ Cylinder Gas Manifolds Qty 2
- ☐ Helium Recovery (Vertical)
- ☐ Other _____
- ☐ 480V 3p Required

- ■ Hot Water
- ■ Cold Water
- ■ RODI
- ■ Eyewash (Tempered Water)
- ■ Safety Shower (Tempered Water)
- ■ Other Laser in use light
- ☐ Data (Fiber)
- ■ Data (Copper)

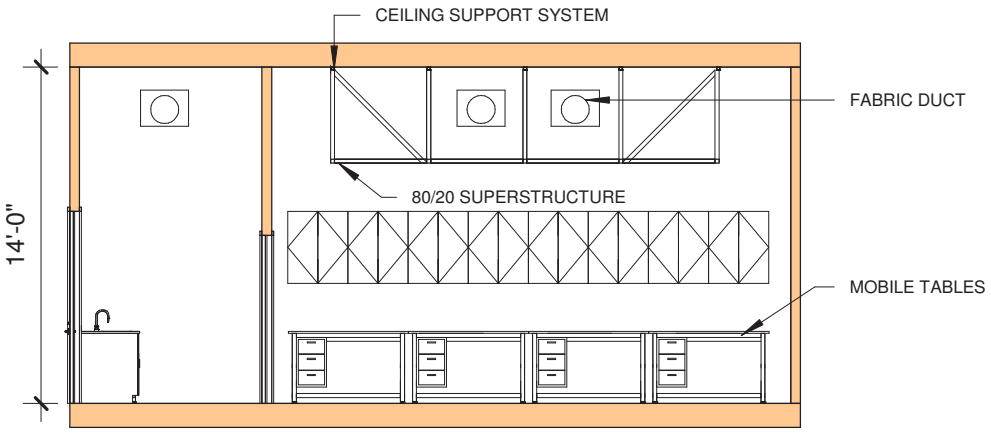
- ☐ Fume Hood
- ■ Snorkel Exhaust
- ☐ Biological Safety Cabinet
- ☐ HEPA Filter
- ■ ULPA Filter *at table
- ■ Process Chilled Water
  50 Percent of Power Demand
- ■ 12V DC LED Lighting
- ☐ Standard LED Lighting

BLAST LAB

Modern materials processing and crystal growth techniques often harness the active management of materials synthesis under extreme environments. Ultra high purity bulk crystal growth of quantum materials, refractory oxides, and functional electronic materials requires simultaneous access to high temperatures and high pressures in an actively monitored/ controlled growth environment. To achieve this, high power laser heating inside of high pressure vessels is required, and a lab environment capable of supporting high performance laser optics and blast shielding for user protection is needed. Killowat levels of laser power at a variety of wavelengths spanning from optical to infrared and pressures up to 15,000 psi may be used.



BLAST LAB - (2) BAYS - 660 ASF

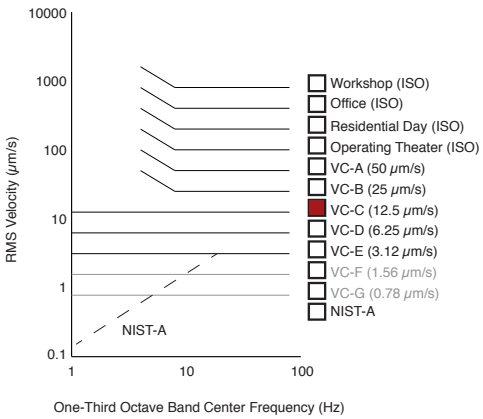


BLAST LAB - SECTION

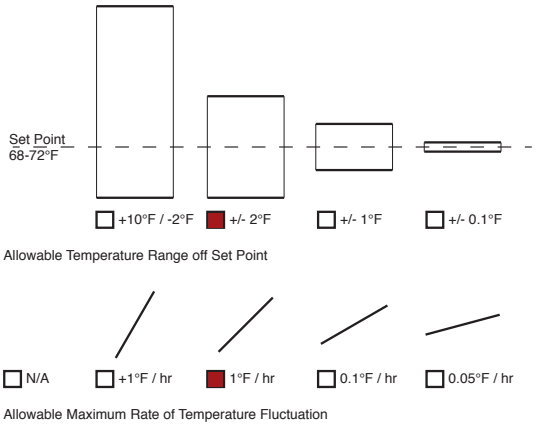
Laboratory Performance Criteria

Laboratory Type: Blast Lab (Structural)
Laboratory Function: Advanced Laser Optics (Blast Furnace)
Description of Activities: Single Room with Secondary Laser Protection & Prep Area

Vibration Control



Temperature Control



NOTE: Local Remote FCU to have 50% over-capacity, to be water based and controlled by user.

Acoustic Control

- ☐ NC-15 TEM / Recording
- ☐ NC-20 SEM
- ■ NC-25 Dil Fridge
- ☐ NC-30 High Perf Lab
- ☐ NC-35 Conference
- ☐ NC-40 Private Office
- ☐ NC-45 Open Office
- ☐ NC-50 Laboratory
- ☐ No Requirement

Air Quality

- ☐ ISO 3 1
- ☐ ISO 4 10
- ☐ ISO 5 100
- ☐ ISO 6 1,000
- ☐ ISO 7 10,000
- ☐ ISO 8 100,000
- ☐ No Classification
- ■ Laminar Flow
- ☐ Moveable T-stat

Humidity Control

- ☐ 30%-50% RH
- ■ 30%-50% RH Settable
- ☐ No Humidification

- ■ Return Air Allowed
- ■ Local FCU (Remote)
- ■ Positive Pressure
- ☐ Negative Pressure
- ■ +/- 2% RH

Power Density

- ☐ 5 W/sf (2W/sf demand)
- ☐ 10 W/sf (5W/sf demand)
- ☐ 20 W/sf (10W/sf demand)
- ☐ 30 W/sf (15W/sf demand)
- ☐ 50 W/sf (25W/sf demand)
- ■ 80 W/sf (40 W/sf demand)
- ☐ 100 W/sf (50W/sf demand)
- ■ Pump Power *in adjacent closet
- ■ Instrument Power
- ■ Clean Ground
- ☐ Emergency Power *UPS

Electromagnetic Interference (EMI) Control

- ☐ 100 nT RMS (300 nTp-p): General High Performance Lab
- ■ 35 nT RMS (100 nTp-p): Dilution Refrigerator Lab
- ☐ 18 nT RMS (50 nTp-p): E Beam / FIB
- ☐ 11 nT RMS (30 nTp-p): SEM / TEM
- ☐ 4 nT RMS (10nTp-p): FEI Titan / JEOL 2100F

Architectural

- ■ ESD Flooring
- ☐ Seamless Flooring
- ☐ Cryo Safe Flooring
- ☐ Chemical Resistant Flooring
- ■ Wall Mounts
- ■ Ceiling Mounts
- ■ Double Door
- ☐ Windows Allowed

*blast resistant perimeter walls

Infrastructure

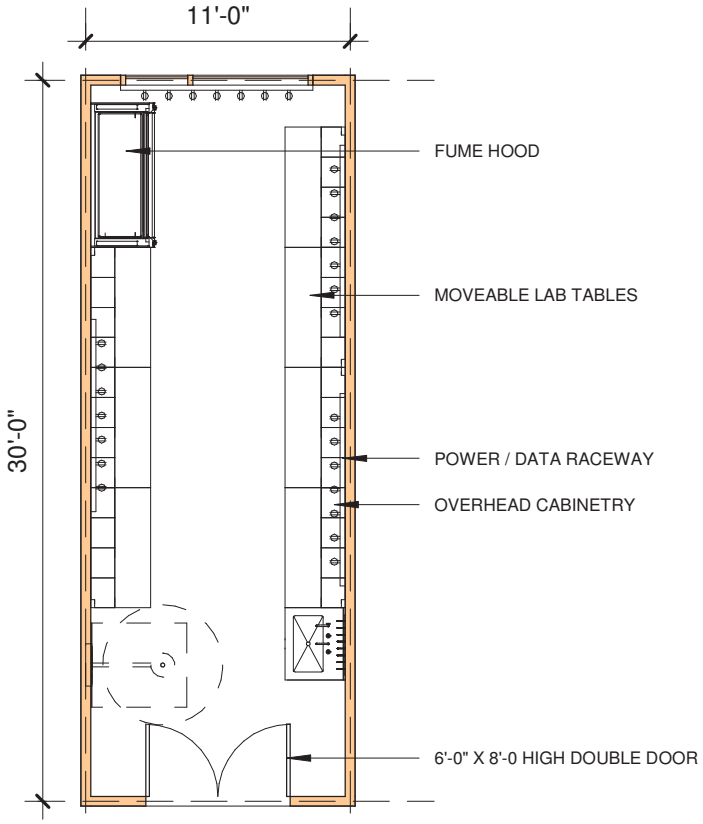
- ■ Clean Dry Air
- ■ House Vacuum
- ■ House Nitrogen (gas)
- ☐ House Helium (gas)
- ■ Cylinder Gas Manifolds Qty 2
- ☐ Helium Recovery (Vertical)
- ☐ Other _____
- ☐ 480V 3p Required

- ■ Hot Water
- ■ Cold Water
- ■ RODI
- ■ Eyewash (Tempered Water)
- ■ Safety Shower (Tempered Water)
- ■ Other Laser in use light
- ☐ Data (Fiber)
- ■ Data (Copper)

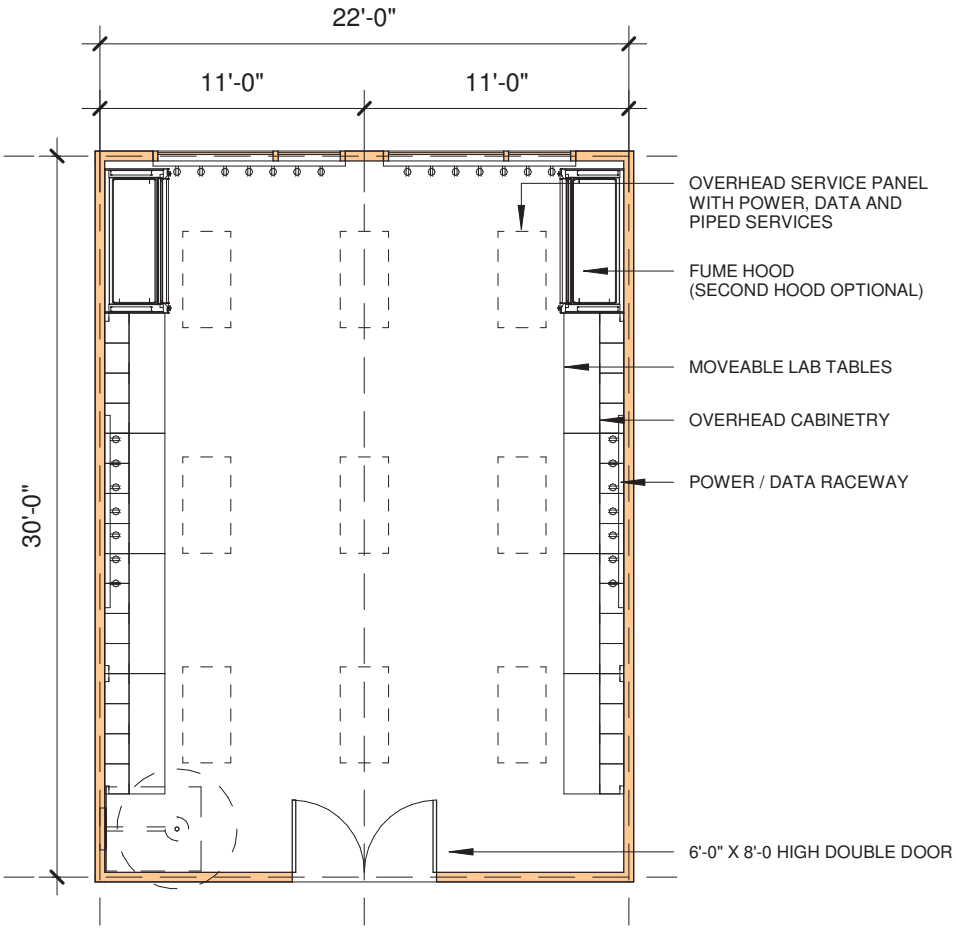
- ☐ Fume Hood
- ■ Snorkel Exhaust
- ☐ Biological Safety Cabinet
- ☐ HEPA Filter
- ■ ULPA Filter *at table
- ■ Process Chilled Water
  50 Percent of Power Demand
- ■ 12V DC LED Lighting
- ☐ Standard LED Lighting

GENERAL LAB (STRUCTURAL)

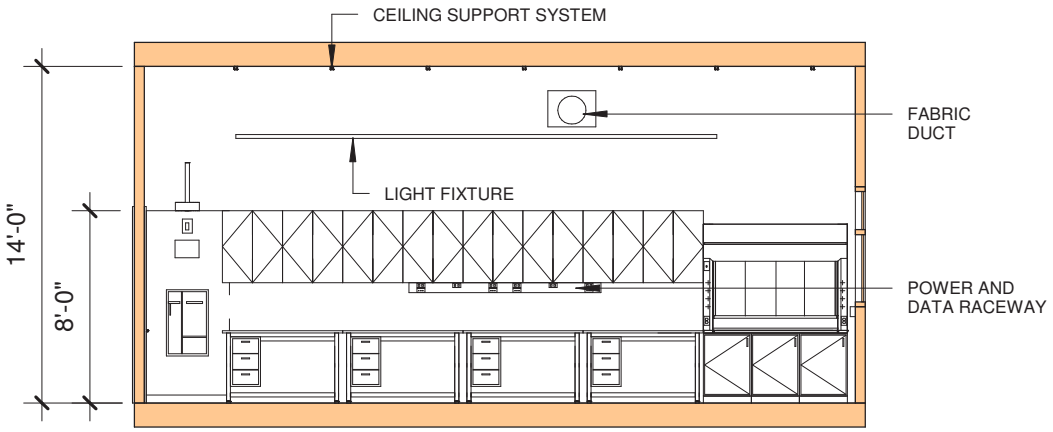
Emerging research areas in transportation, energy conversion, and nanotechnology demand structural materials that can withstand extreme environments of pressure, temperature, and radiation and heat fluxes. Central to these goals are methods and tools for the synthesis, fabrication, and characterization of materials. Synthesis approaches include wet processing, powder-based synthesis, and corresponding specimen preparation and fabrication including precision cutting, grinding, polishing and electro-discharge machining. Characterization methods need to provide multi-modal information using high-resolution optical microscopes and laser scanning imaging and spectroscopy equipment. One laboratory will house novel micro- and nanomechanical testing tools that measure nN forces and sub-nm displacements on materials with high-fidelity. To accommodate modern tools, the labs require house air and gas, vacuum, water, and relatively high power density.

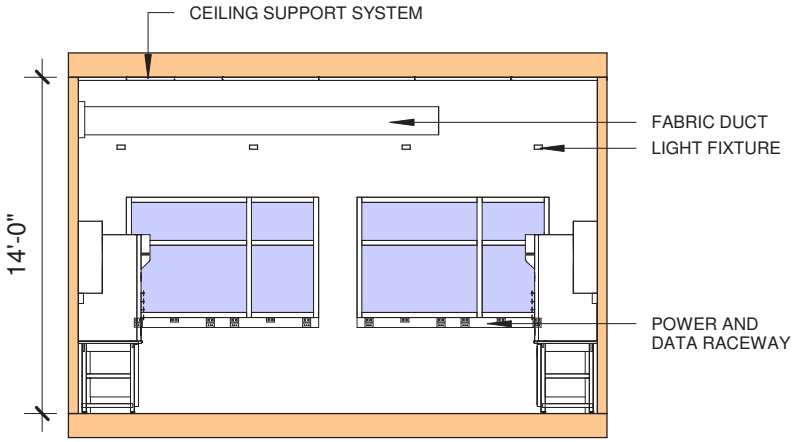


GENERAL LAB (STRUCTURAL) - (1) BAY - 330 ASF



GENERAL LAB (STRUCTURAL) - (2) BAYS - 660 ASF



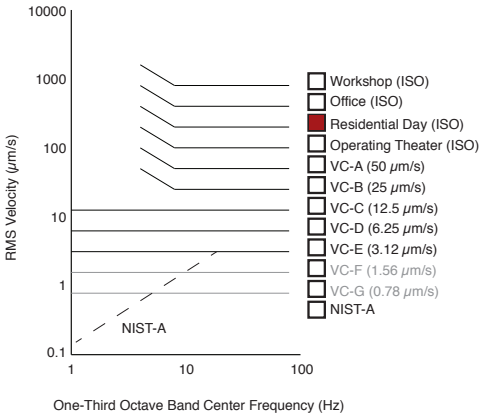


GENERAL LAB (STRUCTURAL) - SECTIONS

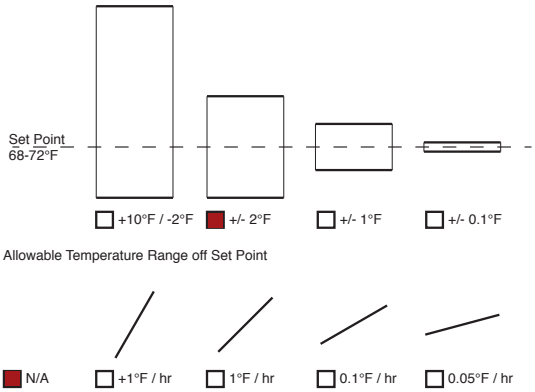
Laboratory Performance Criteria

Laboratory Type: General Lab (Structural)
Laboratory Function: Support Rooms
Description of Activities: Specimen Prep, Wet Process, Ceramic Process, Matl Characterization, EDM, 3D Printing

Vibration Control



Temperature Control



Acoustic Control

- ☐ NC-15 TEM / Recording
- ☐ NC-20 SEM
- ☐ NC-25 Dil Fridge
- ☐ NC-30 High Perf Lab
- ☐ NC-35 Conference
- ☐ NC-40 Private Office
- ☐ NC-45 Open Office
- ■ NC-50 Laboratory
- ☐ No Requirement

Air Quality

- ☐ ISO 3 1
- ☐ ISO 4 10
- ☐ ISO 5 100
- ☐ ISO 6 1,000
- ☐ ISO 7 10,000
- ☐ ISO 8 100,000
- ■ No Classification
- ☐ Laminar Flow
- ☐ Moveable T-stat

Humidity Control

- ■ 30%-50% RH
- ☐ 30%-50% RH Settable
- ☐ No Humidification

- ☐ Return Air Allowed
- ☐ Local FCU (Remote)
- ☐ Positive Pressure
- ■ Negative Pressure
- ■ +/- 2% RH

*settable humidity control at 3D printing

Power Density

- ☐ 5 W/sf (2W/sf demand)
- ☐ 10 W/sf (5W/sf demand)
- ☐ 20 W/sf (10W/sf demand)
- ☐ 30 W/sf (15W/sf demand)
- ☐ 50 W/sf (25W/sf demand)
- ■ 80 W/sf (40 W/sf demand)
- ☐ 100 W/sf (50W/sf demand)
- ■ Pump Power
- ■ Instrument Power
- ■ Clean Ground
- ■ Emergency Power

Electromagnetic Interference (EMI) Control

- ■ 100 nT RMS (300 nTp-p): General High Performance Lab
- ☐ 35 nT RMS (100 nTp-p): Dilution Refrigerator Lab
- ☐ 18 nT RMS (50 nTp-p): E Beam / FIB
- ☐ 11 nT RMS (30 nTp-p): SEM / TEM
- ☐ 4 nT RMS (10nTp-p): FEI Titan / JEOL 2100F

Architectural

- ☐ ESD Flooring
- ☐ Seamless Flooring
- ■ Cryo Safe Flooring *at specimen prep
- ■ Chemical Resistant Flooring
- ■ Wall Mounts
- ■ Ceiling Mounts
- ■ Double Door
- ■ Windows Allowed

Infrastructure

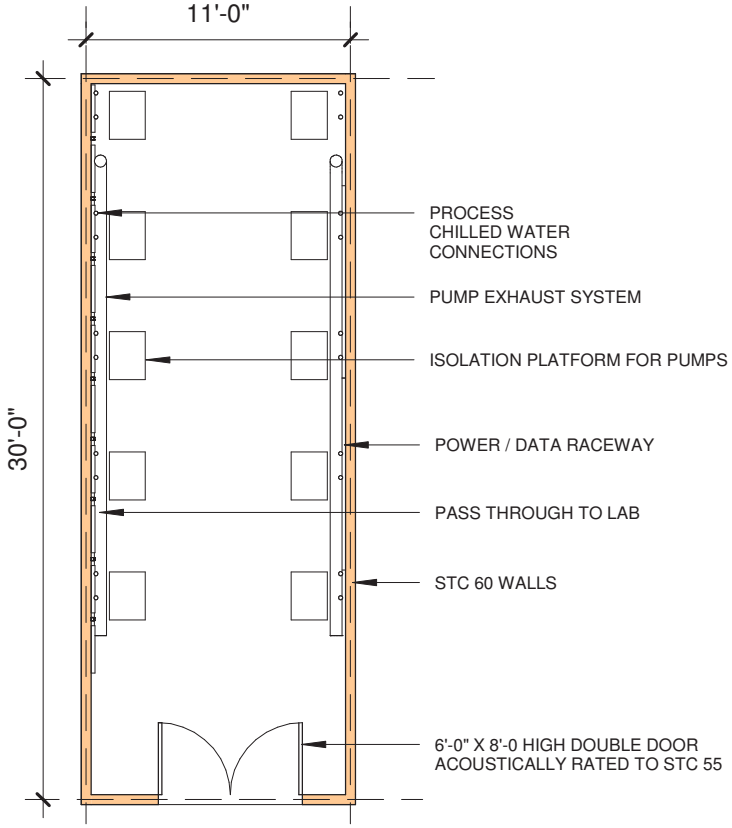
- ■ Clean Dry Air
- ■ House Vacuum
- ■ House Nitrogen (gas)
- ☐ House Helium (gas)
- ■ Cylinder Gas Manifolds Qty 2
- ☐ Helium Recovery (Vertical)
- ☐ Other _____
- ☐ 480V 3p Required

- ■ Hot Water
- ■ Cold Water
- ■ RODI
- ■ Eyewash (Tempered Water)
- ■ Safety Shower (Tempered Water)
- ☐ Other _____
- ☐ Data (Fiber)
- ■ Data (Copper)

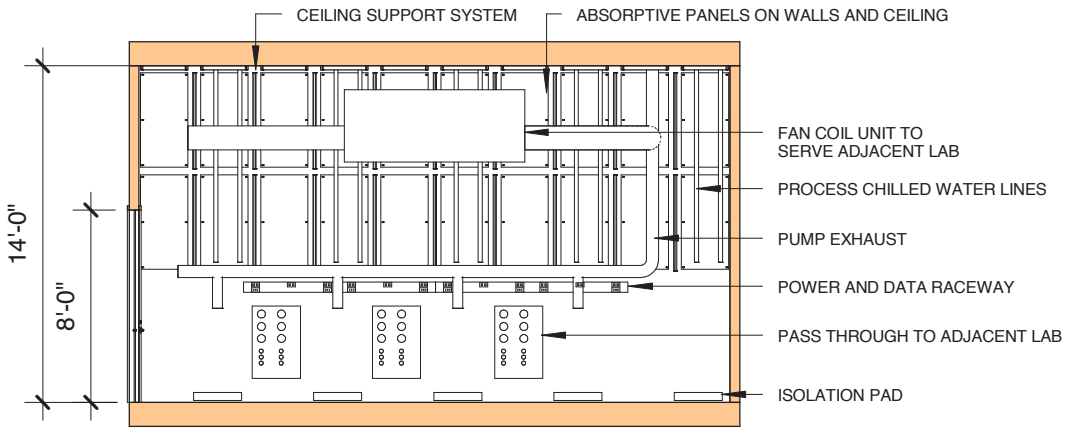
- ■ Fume Hood
- ■ Snorkel Exhaust
- ☐ Biological Safety Cabinet
- ☐ HEPA Filter
- ☐ ULPA Filter
- ■ Process Chilled Water
  25 Percent of Power Demand
- ☐ 12V DC LED Lighting
- ■ Standard LED Lighting

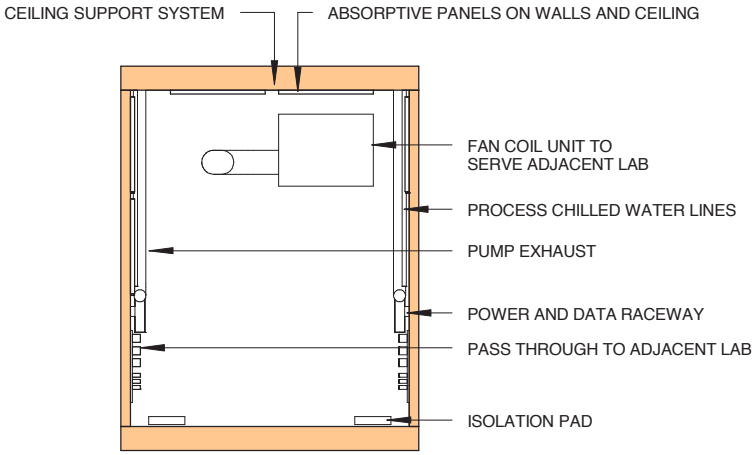
PUMP CLOSET

The pump closet supports many types of labs by providing segregated space for placement of noisy peripheral equipment.



PUMP CLOSET - (1) BAY - 330 ASF



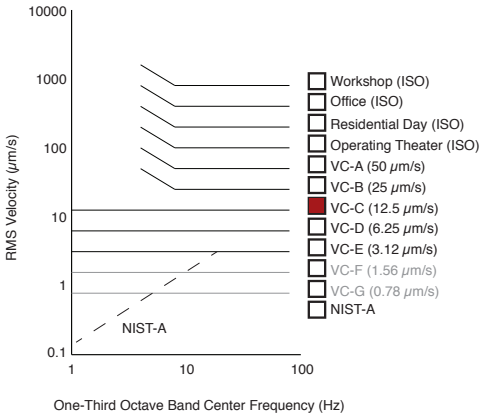


PUMP CLOSET - SECTIONS

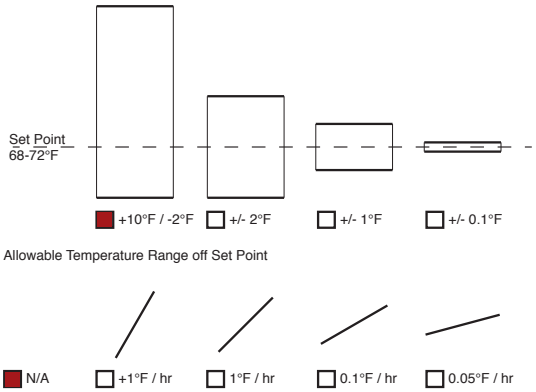
Laboratory Performance Criteria

Laboratory Type: Pump Closet
Laboratory Function: Support Room
Description of Activities: Vibration and acoustically isolated room for pumps and chillers and local FCU

Vibration Control



Temperature Control



Acoustic Control

- ☐ NC-15 TEM / Recording
- ☐ NC-20 SEM
- ☐ NC-25 Dil Fridge
- ☐ NC-30 High Perf Lab
- ☐ NC-35 Conference
- ☐ NC-40 Private Office
- ☐ NC-45 Open Office
- ■ NC-50 Laboratory
- ☐ No Requirement

Air Quality

- ☐ ISO 3 1
- ☐ ISO 4 10
- ☐ ISO 5 100
- ☐ ISO 6 1,000
- ☐ ISO 7 10,000
- ☐ ISO 8 100,000
- ■ No Classification
- ☐ Laminar Flow
- ☐ Moveable T-stat
- ■ Pump Exhaust

Humidity Control

- ☐ 30%-50% RH
- ☐ 30%-50% RH Settable
- ■ No Humidification

- ■ Return Air Allowed
- ■ Local FCU (Remote)
- ☐ Positive Pressure
- ■ Negative Pressure
- ☐ +/- 2% RH

Power Density

- ☐ 5 W/sf (2W/sf demand)
- ☐ 10 W/sf (5W/sf demand)
- ☐ 20 W/sf (10W/sf demand)
- ☐ 30 W/sf (15W/sf demand)
- ☐ 50 W/sf (25W/sf demand)
- ☐ 80 W/sf (40 W/sf demand)
- ■ 100 W/sf (50W/sf demand)
- ■ Pump Power
- ☐ Instrument Power
- ☐ Clean Ground
- ■ Emergency Power

Electromagnetic Interference (EMI) Control

- ■ 100 nT RMS (300 nTp-p): General High Performance Lab
- ☐ 35 nT RMS (100 nTp-p): Dilution Refrigerator Lab
- ☐ 18 nT RMS (50 nTp-p): E Beam / FIB
- ☐ 11 nT RMS (30 nTp-p): SEM / TEM
- ☐ 4 nT RMS (10nTp-p): FEI Titan / JEOL 2100F

Architectural

- ☐ ESD Flooring
- ☐ Seamless Flooring
- ☐ Cryo Safe Flooring
- ☐ Chemical Resistant Flooring
- ■ Wall Mounts
- ■ Ceiling Mounts
- ■ Double Door
- ■ Windows Allowed

Infrastructure

- ■ Clean Dry Air
- ☐ House Vacuum
- ■ House Nitrogen (gas)
- ☐ House Helium (gas)
- ■ Cylinder Gas Manifolds Qty 2
- ■ Helium Recovery (Vertical)
- ■ Other Pump Exhaust
- ■ 480V 3p Required

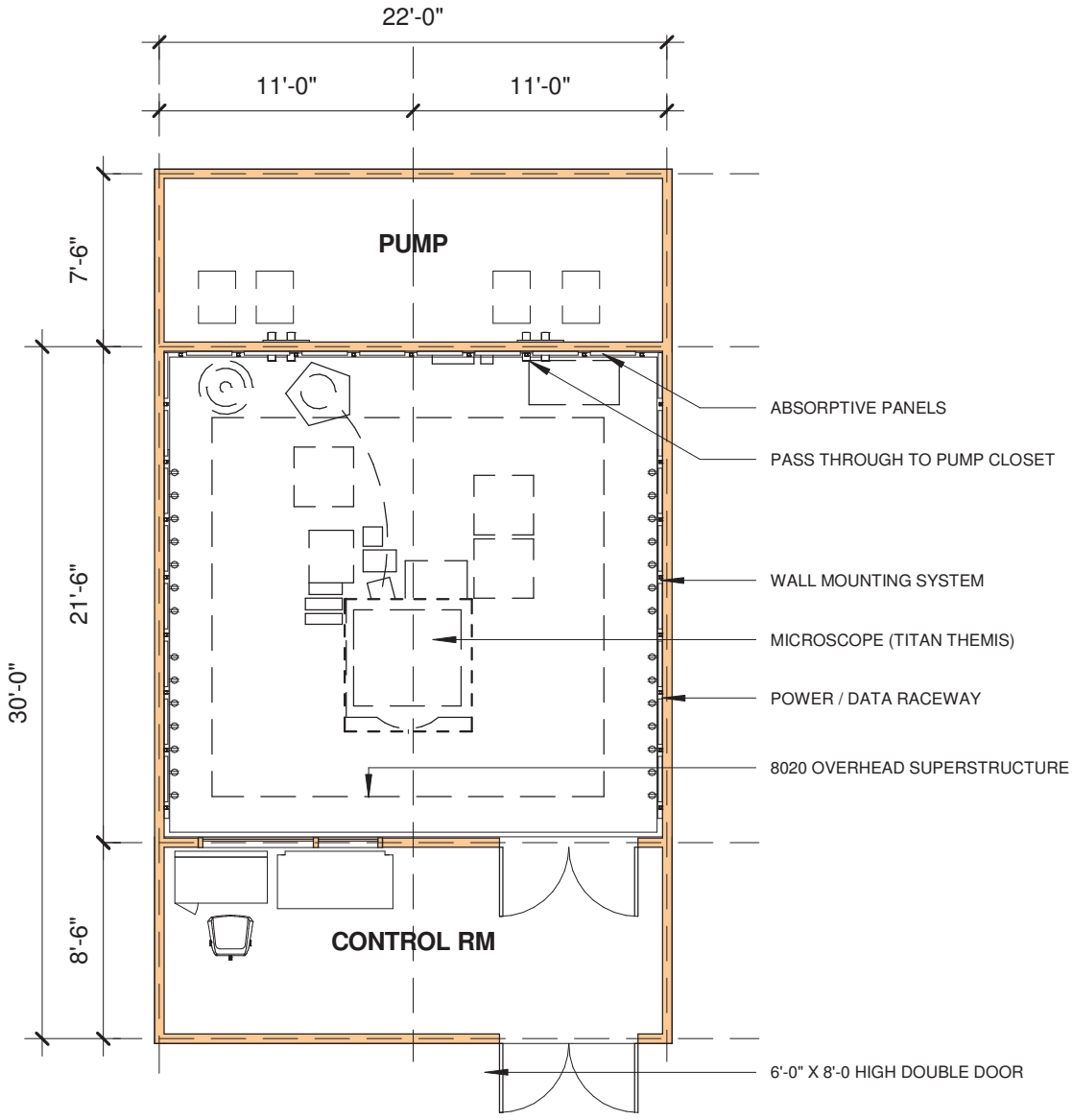
- ☐ Hot Water
- ☐ Cold Water
- ☐ RODI
- ☐ Eyewash (Tempered Water)
- ☐ Safety Shower (Tempered Water)
- ☐ Other _____
- ■ Data (Fiber)
- ■ Data (Copper)

- ☐ Fume Hood
- ☐ Snorkel Exhaust
- ☐ Biological Safety Cabinet
- ☐ HEPA Filter
- ☐ ULPA Filter
- ■ Process Chilled Water
  75% Percent of Power Demand
- ■ 12V DC LED Lighting
- ☐ Standard LED Lighting

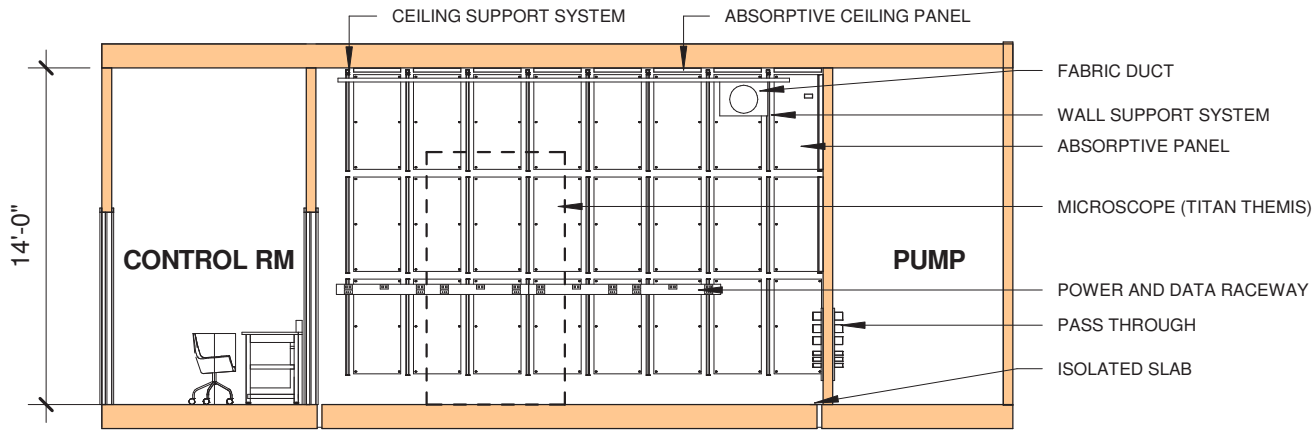
ii. HIGH RESOLUTION ELECTRON MICROSCOPY

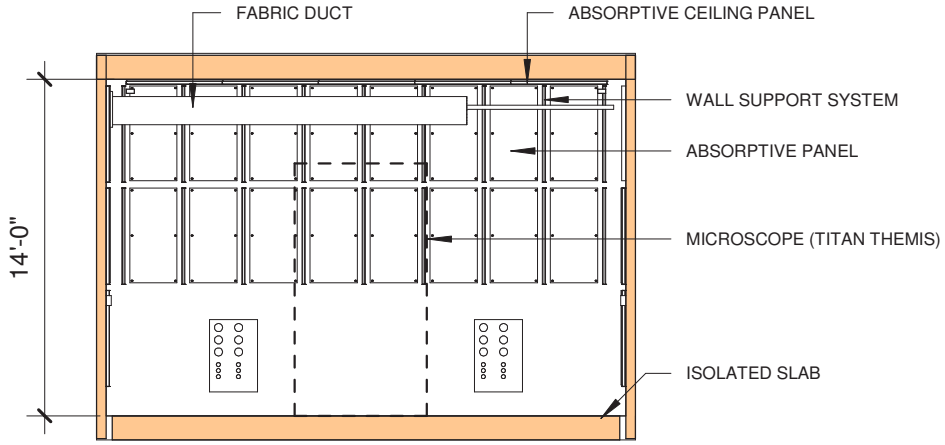
HIGH RESOLUTION ELECTRON MICROSCOPY LAB

The forefront of materials research centers on exquisite manipulation of matter at the atomic scale to elicit unprecedented electrical, magnetic, mechanical, and optical properties. Controlling the properties of materials with atomic fidelity requires the most modern electron microscopes with sub-atomic imaging wavelengths, but conventional microscopes, and thus progress on new materials, are hindered by lens aberrations. The High Resolution Electron Microscopy Lab will house the newest generation aberration-corrected scanning/transmission electron microscope for interrogating advanced materials. The lab demands exacting vibration control, temperature control and stability, cancellation of electromagnetic interference, clean air quality, humidity control, and functional room layout to house the microscope. Additional requirements include fiber-based data connectivity and 3-phase high voltage power with separate grounding.



HIGH RESOLUTION ELECTRON MICROSCOPY LAB - (2.5) BAYS - 825 ASF



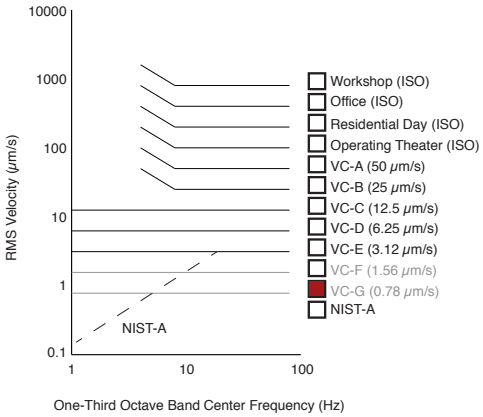


HIGH RESOLUTION ELECTRON MICROSCOPY LAB - SECTIONS

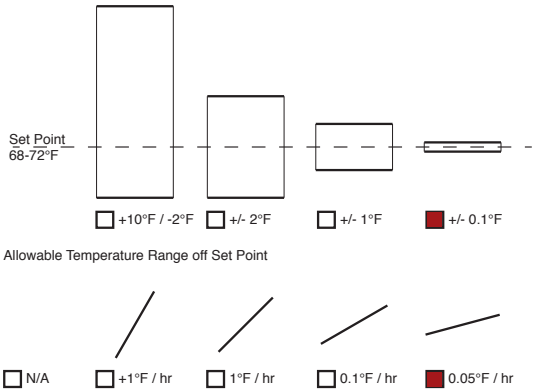
Laboratory Performance Criteria

Laboratory Type: High Performance Electron Microscopy Lab
Laboratory Function: Microscopy lab
Description of Activities: Aberration Correcting S/TEM (FEI Titan Cubed Themis)

Vibration Control



Temperature Control



Acoustic Control

- ■ NC-15 TEM / Recording
- ☐ NC-20 SEM
- ☐ NC-25 Dil Fridge
- ☐ NC-30 High Perf Lab
- ☐ NC-35 Conference
- ☐ NC-40 Private Office
- ☐ NC-45 Open Office
- ☐ NC-50 Laboratory
- ☐ No Requirement
- ☐

Air Quality

- ☐ ISO 3 1
- ☐ ISO 4 10
- ☐ ISO 5 100
- ☐ ISO 6 1,000
- ☐ ISO 7 10,000
- ■ ISO 8 100,000
- ☐ No Classification
- ☐ Laminar Flow
- ☐ Moveable T-stat

Humidity Control

- ■ 30%-50% RH
- ☐ 30%-50% RH Settable
- ☐ No Humidification

- ■ Return Air Allowed
- ■ Local FCU (Remote)
- ☐ Positive Pressure
- ■ Negative Pressure
- ☐ +/- 5% RH

Power Density

- ☐ 5 W/sf (2W/sf demand)
- ☐ 10 W/sf (5W/sf demand)
- ☐ 20 W/sf (10W/sf demand)
- ☐ 30 W/sf (15W/sf demand)
- ■ 50 W/sf (25W/sf demand)
- ☐ 80 W/sf (40 W/sf demand)
- ☐ 100 W/sf (50W/sf demand)
- ■ Pump Power
- ■ Instrument Power
- ■ Clean Ground
- ■ Emergency Power

Electromagnetic Interference (EMI) Control

- ☐ 100 nT RMS (300 nTp-p): General High Performance Lab
- ☐ 35 nT RMS (100 nTp-p): Dilution Refrigerator Lab
- ☐ 18 nT RMS (50 nTp-p): E Beam / FIB
- ☐ 11 nT RMS (30 nTp-p): SEM / TEM
- ■ 4 nT RMS (10nTp-p): FEI Titan / JEOL 2100F

*nonmagnetic ductwork & door hardware

Architectural

- ■ ESD Flooring
- ■ Seamless Flooring
- ☐ Cryo Safe Flooring
- ☐ Chemical Resistant Flooring
- ■ Wall Mounts
- ■ Ceiling Mounts
- ■ Double Door
- ☐ Windows Allowed

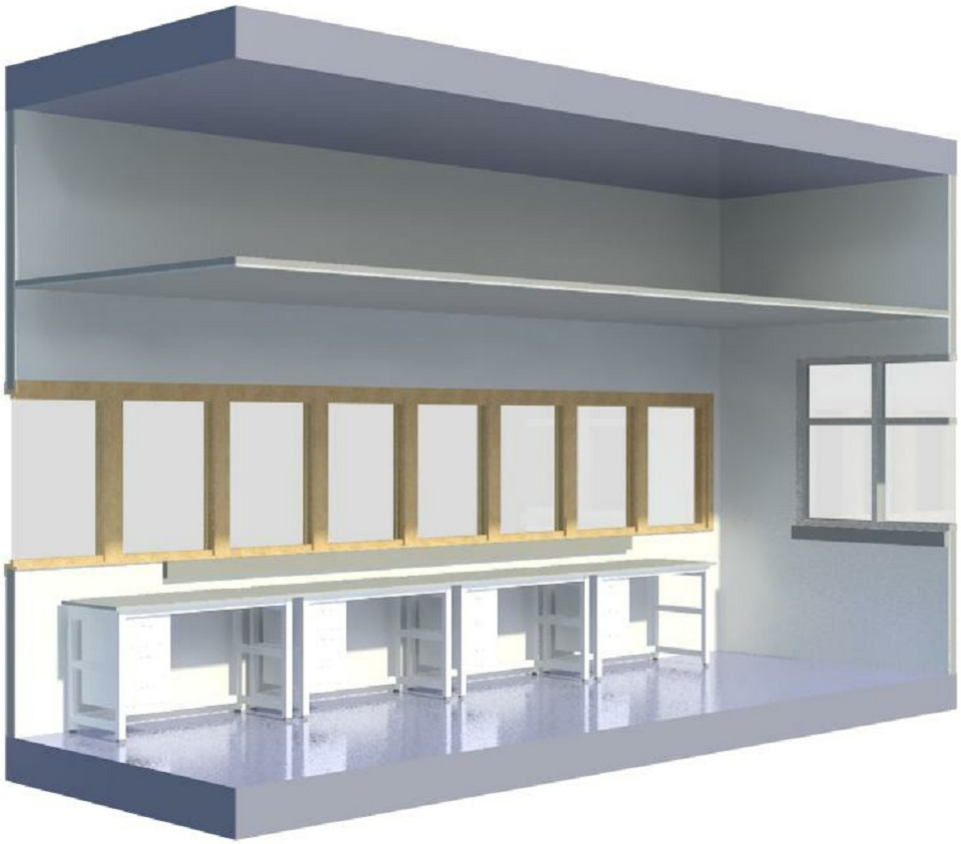
Infrastructure

- ■ Clean Dry Air
- ☐ House Vacuum
- ☐ House Nitrogen (gas)
- ☐ House Helium (gas)
- ☐ Cylinder Gas Manifolds Qty___
- ☐ Helium Recovery (Vertical)
- ■ Other Pump exhaust
- ☐ 480V 3p Required

*208V 3p 5wire

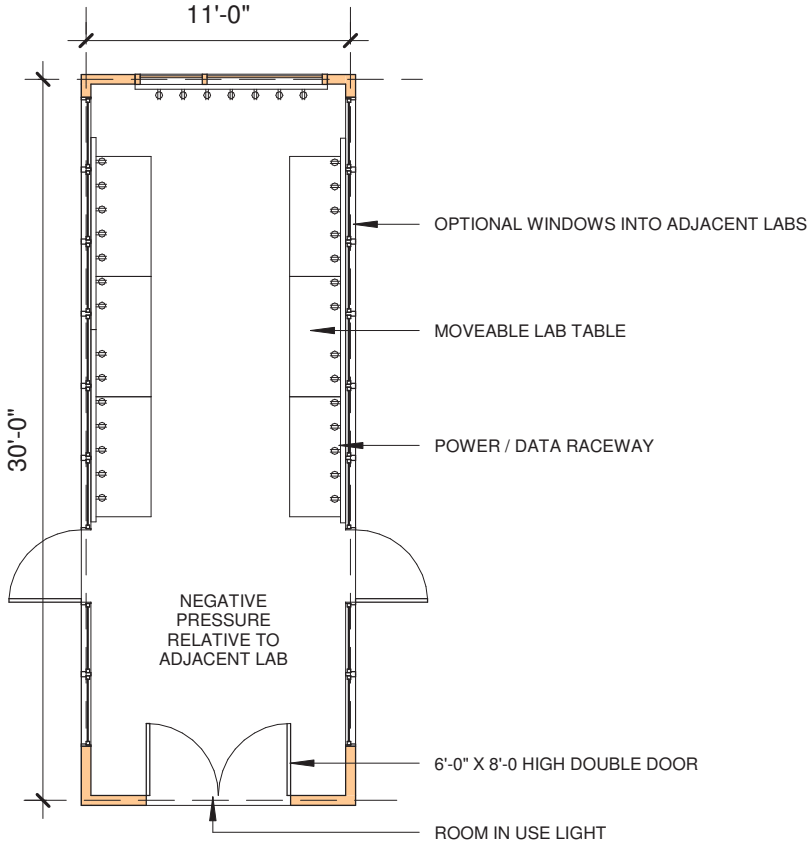
- ☐ Hot Water
- ☐ Cold Water
- ☐ RODI
- ☐ Eyewash (Tempered Water)
- ☐ Safety Shower (Tempered Water)
- ■ Other Room in use light
- ■ Data (Fiber)
- ■ Data (Copper)

- ☐ Fume Hood
- ☐ Snorkel Exhaust
- ☐ Biological Safety Cabinet
- ■ HEPA Filter
- ☐ ULPA Filter
- ■ Process Chilled Water
  75%Percent of Power Demand
- ■ 12V DC LED Lighting
- ☐ Standard LED Lighting

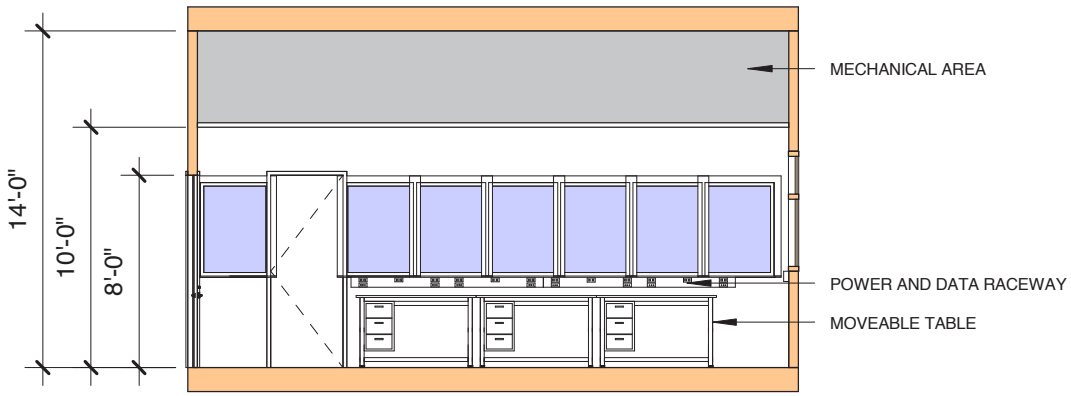


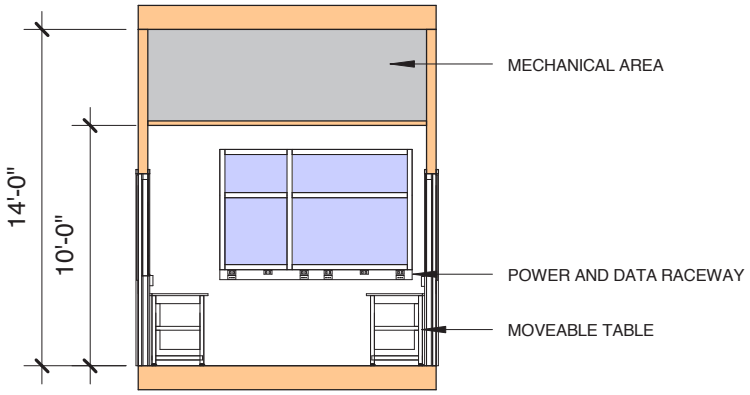
CONTROL ROOM

The Control Room is an ante-room within the High Resolution Electron Microscopy lab. This room allows for remote viewing, remote control and data acquisition without disturbing the performance criteria of the microscope.



CONTROL ROOM - (0.5) BAYS - 165 ASF



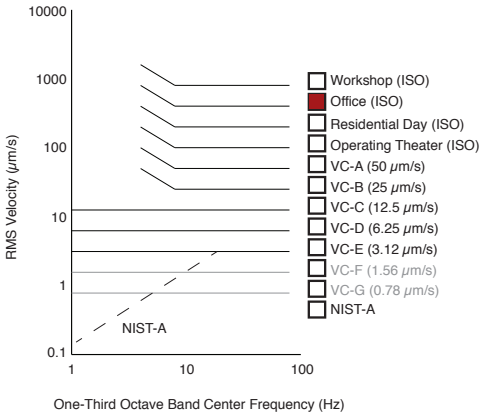


CONTROL ROOM - SECTIONS

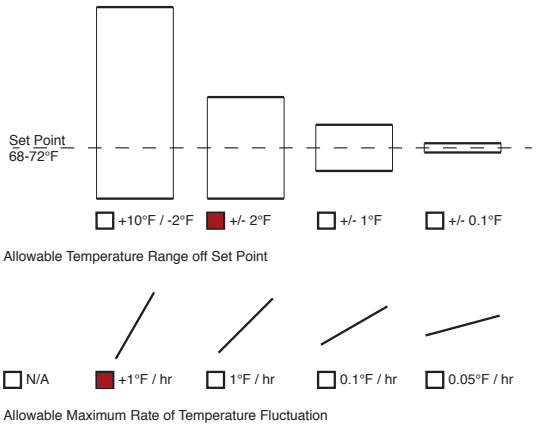
Laboratory Performance Criteria

Laboratory Type: Control Room
Laboratory Function: Support Room
Description of Activities: Remote Viewing, Data Analysis, Measurement, Computing

Vibration Control



Temperature Control



Acoustic Control

- ☐ NC-15 TEM / Recording
- ☐ NC-20 SEM
- ☐ NC-25 Dil Fridge
- ☐ NC-30 High Perf Lab
- ☐ NC-35 Conference
- ■ NC-40 Private Office
- ☐ NC-45 Open Office
- ☐ NC-50 Laboratory
- ☐ No Requirement

Air Quality

- ☐ ISO 3 1
- ☐ ISO 4 10
- ☐ ISO 5 100
- ☐ ISO 6 1,000
- ☐ ISO 7 10,000
- ☐ ISO 8 100,000
- ■ No Classification
- ☐ Laminar Flow
- ☐ Moveable T-stat

Humidity Control

- ☐ 30%-50% RH
- ☐ 30%-50% RH Settable
- ■ No Humidification

- ■ Return Air Allowed
- ☐ Local FCU (Remote)
- ■ Positive Pressure
- ☐ Negative Pressure
- ☐ +/- 2% RH

Power Density

- ☐ 5 W/sf (2W/sf demand)
- ☐ 10 W/sf (5W/sf demand)
- ☐ 20 W/sf (10W/sf demand)
- ■ 30 W/sf (15W/sf demand)
- ☐ 50 W/sf (25W/sf demand)
- ☐ 80 W/sf (40 W/sf demand)
- ☐ 100 W/sf (50W/sf demand)
- ☐ Pump Power
- ■ Instrument Power
- ☐ Clean Ground
- ■ Emergency Power

Electromagnetic Interference (EMI) Control

- ■ 100 nT RMS (300 nTp-p): General High Performance Lab
- ☐ 35 nT RMS (100 nTp-p): Dilution Refrigerator Lab
- ☐ 18 nT RMS (50 nTp-p): E Beam / FIB
- ☐ 11 nT RMS (30 nTp-p): SEM / TEM
- ☐ 4 nT RMS (10nTp-p): FEI Titan / JEOL 2100F

Architectural

- ☐ ESD Flooring
- ☐ Seamless Flooring
- ☐ Cryo Safe Flooring
- ☐ Chemical Resistant Flooring
- ☐ Wall Mounts
- ☐ Ceiling Mounts
- ☐ Double Door
- ■ Windows Allowed

Infrastructure

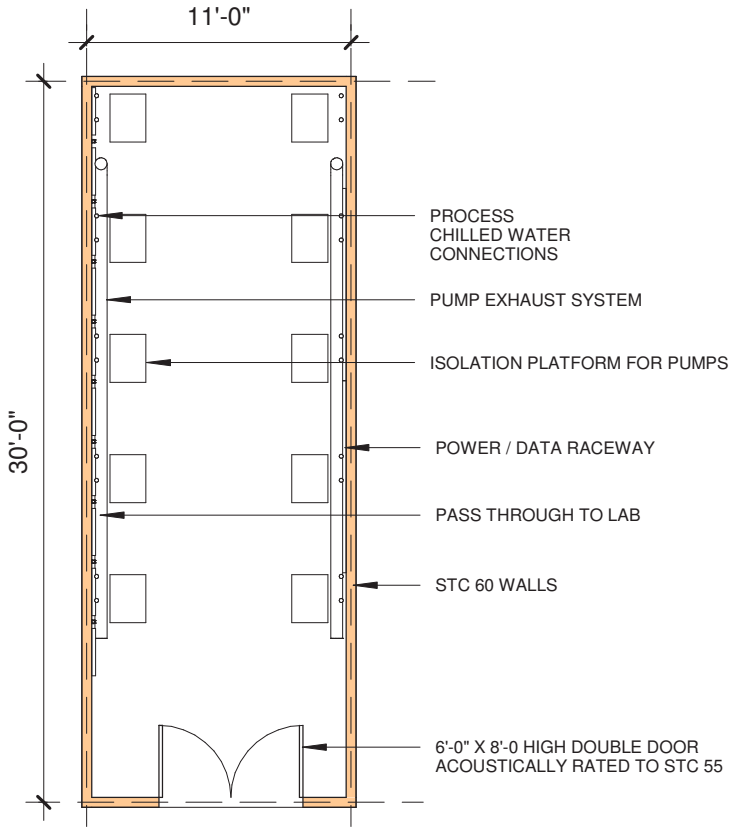
- ☐ Clean Dry Air
- ☐ House Vacuum
- ☐ House Nitrogen (gas)
- ☐ House Helium (gas)
- ☐ Cylinder Gas Manifolds Qty___
- ☐ Helium Recovery (Vertical)
- ☐ Other _____
- ☐ 480V 3p Required

- ☐ Hot Water
- ☐ Cold Water
- ☐ RODI
- ☐ Eyewash (Tempered Water)
- ☐ Safety Shower (Tempered Water)
- ☐ Other _____
- ■ Data (Fiber)
- ■ Data (Copper)

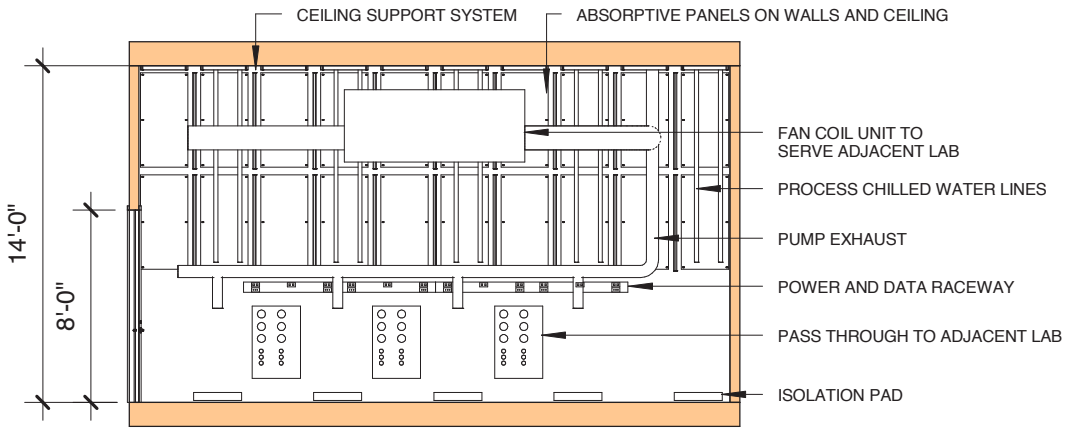
- ☐ Fume Hood
- ☐ Snorkel Exhaust
- ☐ Biological Safety Cabinet
- ☐ HEPA Filter
- ☐ ULPA Filter
- ☐ Process Chilled Water
  ____Percent of Power Demand
- ■ 12V DC LED Lighting
- ☐ Standard LED Lighting

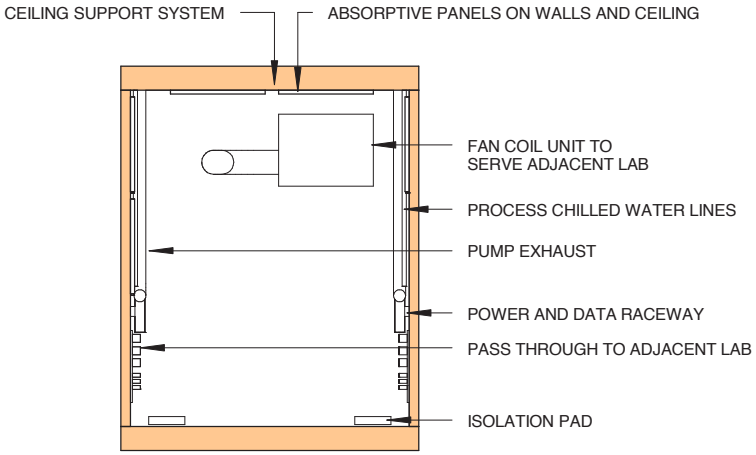
PUMP CLOSET

The pump closet supports many types of labs by providing segregated space for placement of noisy peripheral equipment.



PUMP CLOSET - (0.5) BAYS - 165 ASF



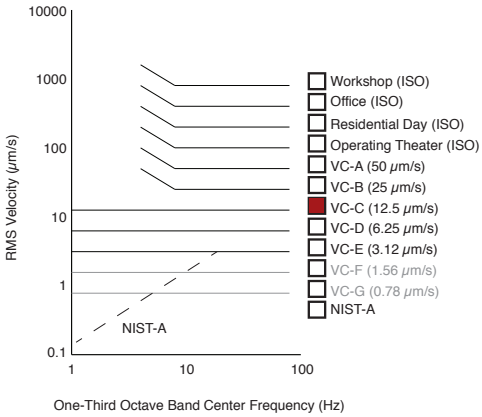


PUMP CLOSET - SECTIONS

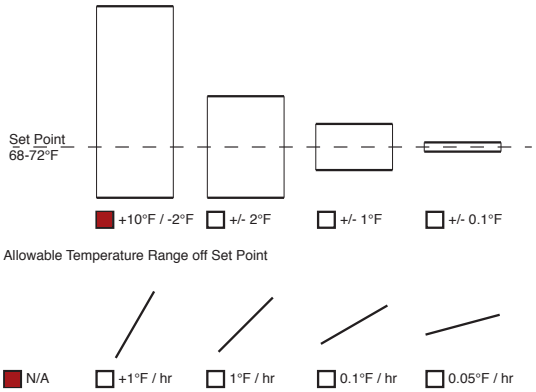
Laboratory Performance Criteria

Laboratory Type: Pump Closet
Laboratory Function: Support Room
Description of Activities: Vibration and acoustically isolated room for pumps and chillers and local FCU

Vibration Control



Temperature Control



Acoustic Control

- ☐ NC-15 TEM / Recording
- ☐ NC-20 SEM
- ☐ NC-25 Dil Fridge
- ☐ NC-30 High Perf Lab
- ☐ NC-35 Conference
- ☐ NC-40 Private Office
- ☐ NC-45 Open Office
- ■ NC-50 Laboratory
- ☐ No Requirement

Air Quality

- ☐ ISO 3 1
- ☐ ISO 4 10
- ☐ ISO 5 100
- ☐ ISO 6 1,000
- ☐ ISO 7 10,000
- ☐ ISO 8 100,000
- ■ No Classification
- ☐ Laminar Flow
- ☐ Moveable T-stat
- ■ Pump Exhaust

Humidity Control

- ☐ 30%-50% RH
- ☐ 30%-50% RH Settable
- ■ No Humidification

- ■ Return Air Allowed
- ■ Local FCU (Remote)
- ☐ Positive Pressure
- ■ Negative Pressure
- ☐ +/- 2% RH

Power Density

- ☐ 5 W/sf (2W/sf demand)
- ☐ 10 W/sf (5W/sf demand)
- ☐ 20 W/sf (10W/sf demand)
- ☐ 30 W/sf (15W/sf demand)
- ☐ 50 W/sf (25W/sf demand)
- ☐ 80 W/sf (40 W/sf demand)
- ■ 100 W/sf (50W/sf demand)
- ■ Pump Power
- ☐ Instrument Power
- ☐ Clean Ground
- ■ Emergency Power

Electromagnetic Interference (EMI) Control

- ■ 100 nT RMS (300 nTp-p): General High Performance Lab
- ☐ 35 nT RMS (100 nTp-p): Dilution Refrigerator Lab
- ☐ 18 nT RMS (50 nTp-p): E Beam / FIB
- ☐ 11 nT RMS (30 nTp-p): SEM / TEM
- ☐ 4 nT RMS (10nTp-p): FEI Titan / JEOL 2100F

Architectural

- ☐ ESD Flooring
- ☐ Seamless Flooring
- ☐ Cryo Safe Flooring
- ☐ Chemical Resistant Flooring
- ■ Wall Mounts
- ■ Ceiling Mounts
- ■ Double Door
- ■ Windows Allowed

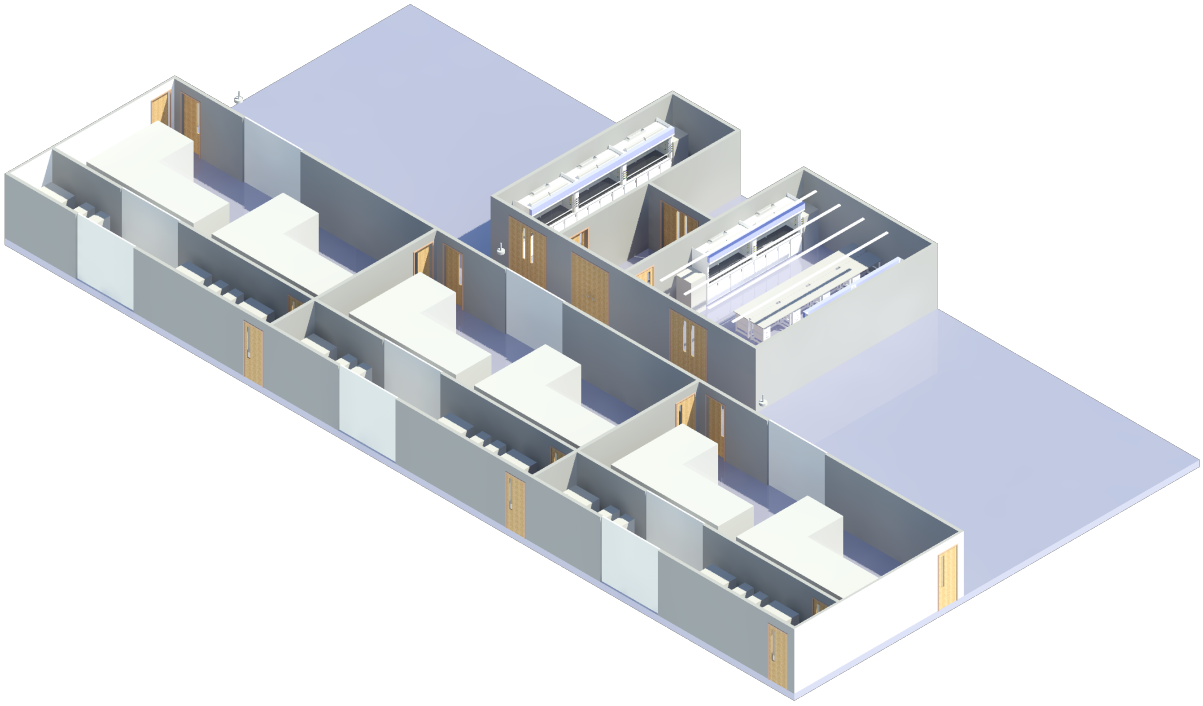
Infrastructure

- ■ Clean Dry Air
- ☐ House Vacuum
- ■ House Nitrogen (gas)
- ☐ House Helium (gas)
- ■ Cylinder Gas Manifolds Qty 2
- ■ Helium Recovery (Vertical)
- ■ Other Pump Exhaust
- ■ 480V 3p Required

- ☐ Hot Water
- ☐ Cold Water
- ☐ RODI
- ☐ Eyewash (Tempered Water)
- ☐ Safety Shower (Tempered Water)
- ☐ Other _____
- ■ Data (Fiber)
- ■ Data (Copper)

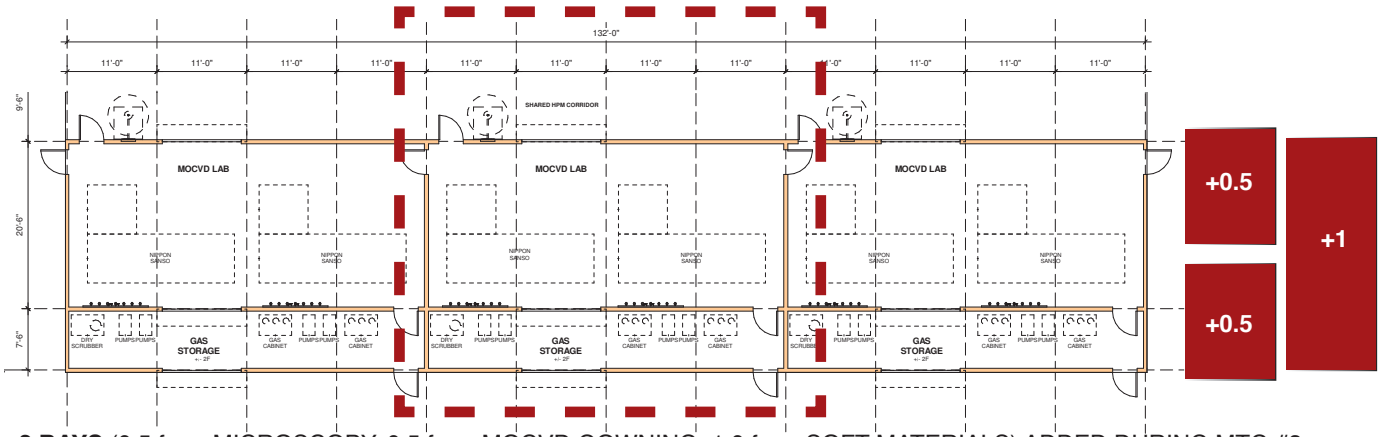
- ☐ Fume Hood
- ☐ Snorkel Exhaust
- ☐ Biological Safety Cabinet
- ☐ HEPA Filter
- ☐ ULPA Filter
- ■ Process Chilled Water
  75% Percent of Power Demand
- ■ 12V DC LED Lighting
- ☐ Standard LED Lighting

iii. METALORGANIC CHEMICAL VAPOR DEPOSITION (MOCVD)



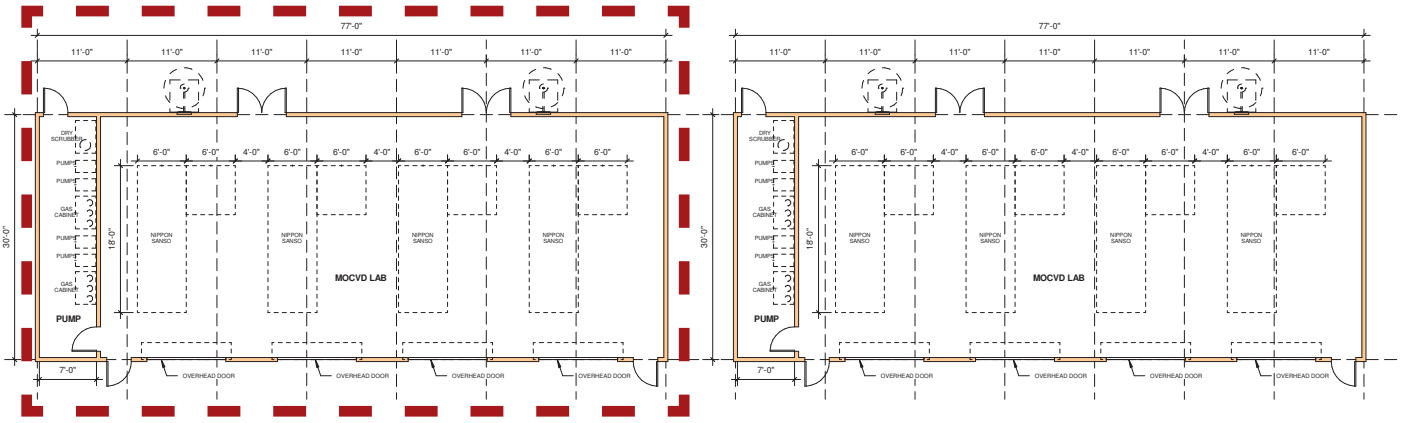
MOCVD LAB

The MOCVD Lab supports materials growth of semiconductor devices such as LEDs, lasers, and transistors, as well as synthesis of novel materials structures including nanowires. The MOCVD systems are capable of growing GaN and related materials, classical III-V semiconductors including InP and GaAs, III-Vs on silicon, and semiconducting oxides. In addition to the MOCVD systems themselves, support equipment includes gas scrubbing units, system pumps, toxic gas cabinets, fume hoods for sample preparation, fume hoods for parts cleaning, wafer cleaving and preparation, and UV ozone treatment.



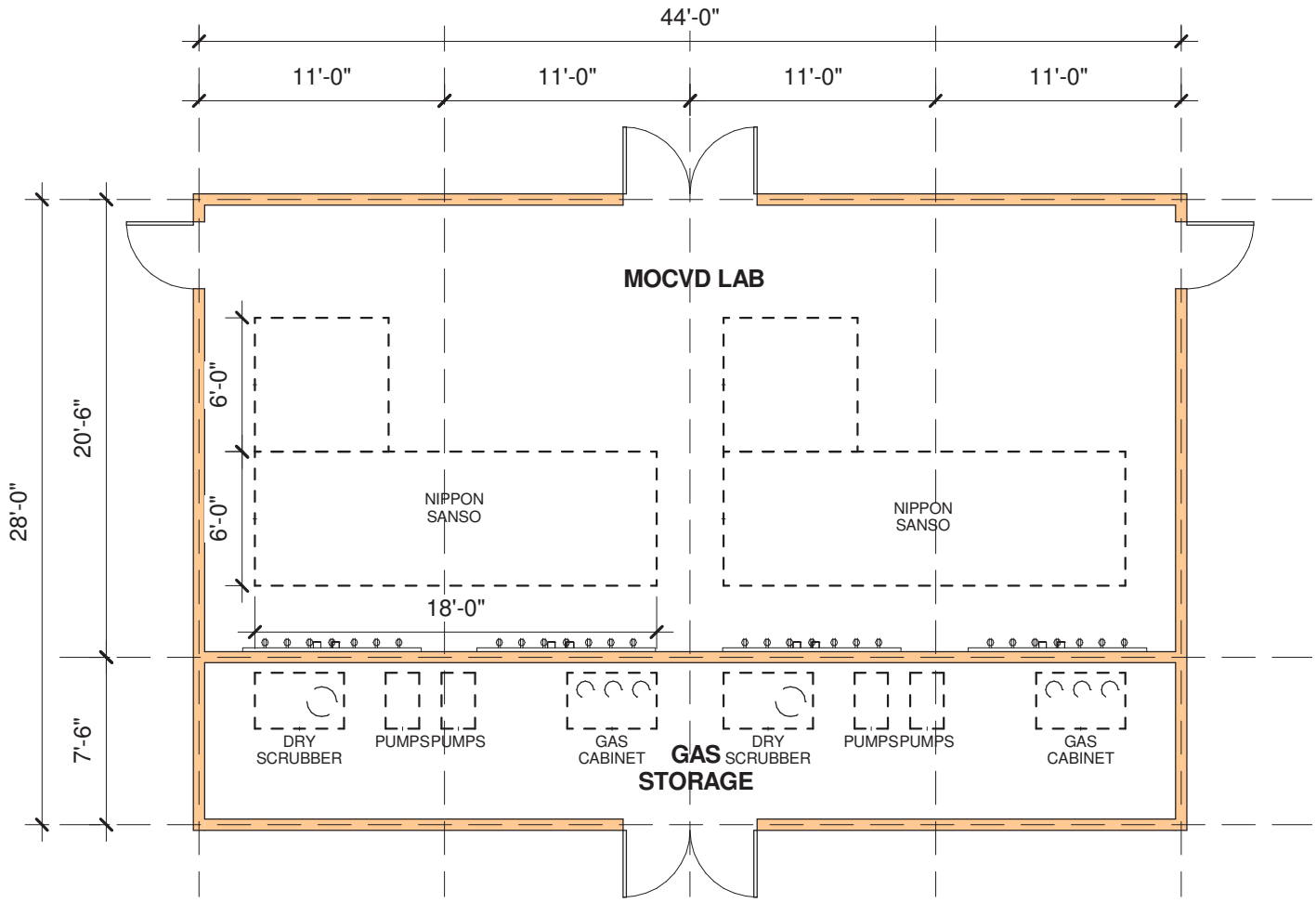
+2 BAYS (0.5 from MICROSCOPY, 0.5 from MOCVD GOWNING, 1.0 from SOFT MATERIALS) ADDED DURING MTG #3

MOCVD SUITE OPTION 1 - (6) TOOLS - (13.2) BAYS - 4,686 ASF

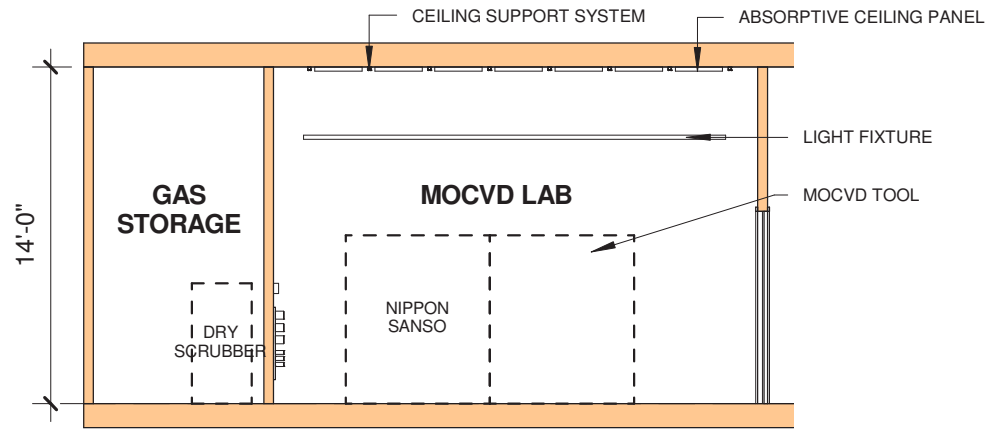


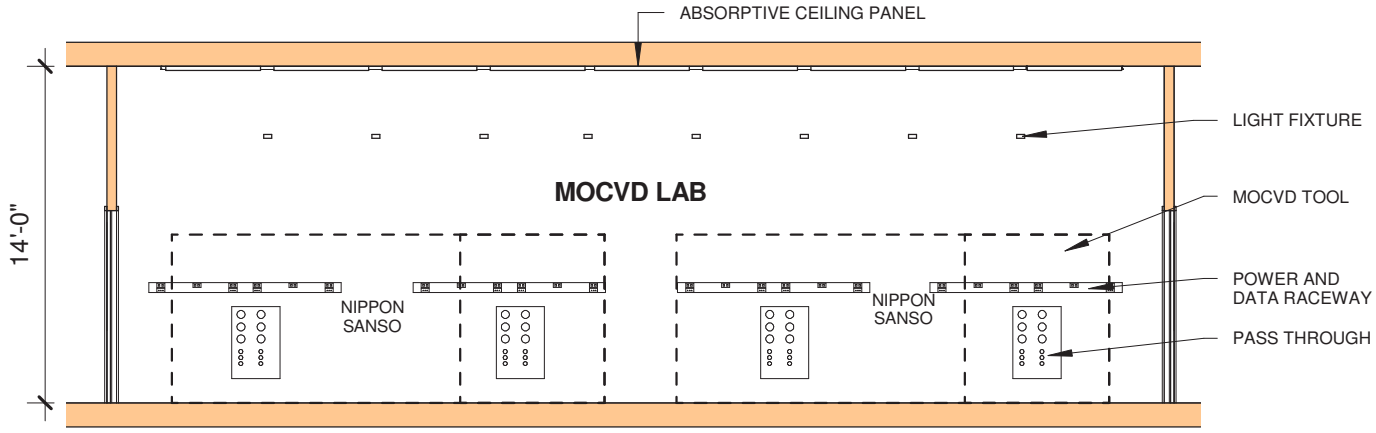
MOCVD SUITE OPTION 2 - (8) TOOLS - (14) BAYS - 4,620 ASF

NOTE: MOCVD LABS SHOULD BE LOCATED ON THE GROUND FLOOR WITH EXTERIOR ACCESS. MOCVD LABS SHOULD BE LOCATED ADJACENT TO FLEXIBLE STUDENT SPACE THAT COULD BE CONVERTED TO ADDITIONAL MOCVD LAB EXPANSION SPACE IN THE FUTURE.

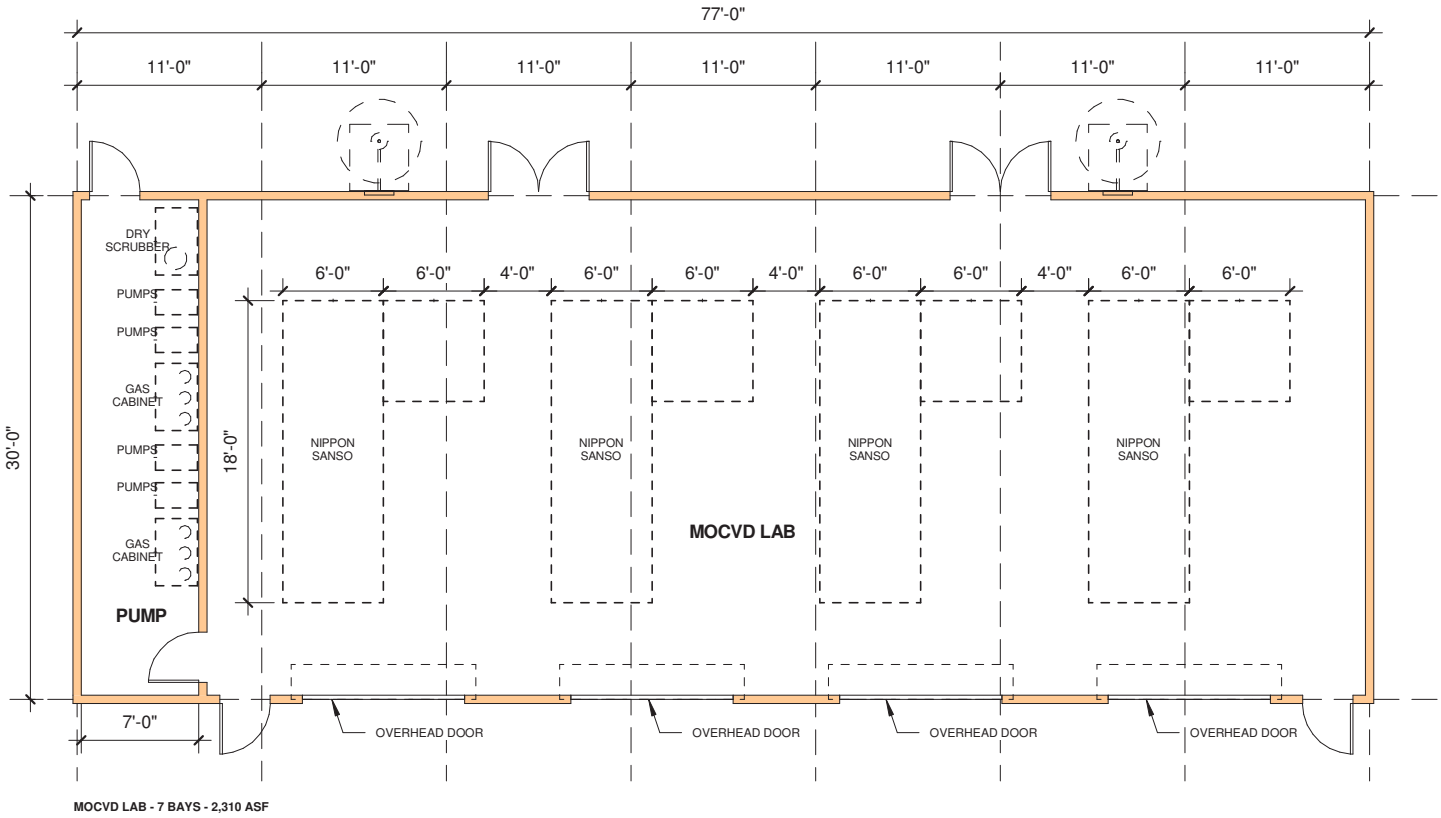


MOCVD LAB OPTION 1 - (2) TOOLS - (3.73) BAYS + GAS STORAGE - 1,232 ASF
(3x)





MOCVD LAB OPTION 1 - SECTIONS



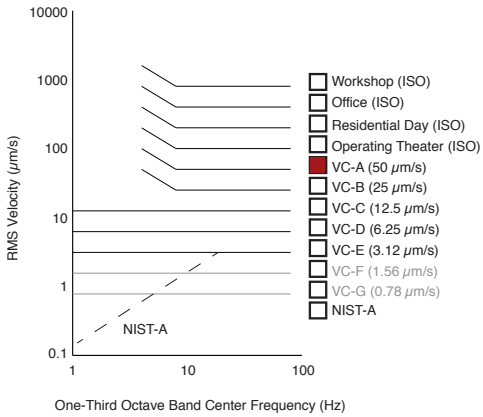
MOCVD LAB - 7 BAYS - 2,310 ASF

MOCVD LAB OPTION 2 - (4) TOOLS - (7) BAYS + GAS STORAGE - 2,310 ASF **(2x)**

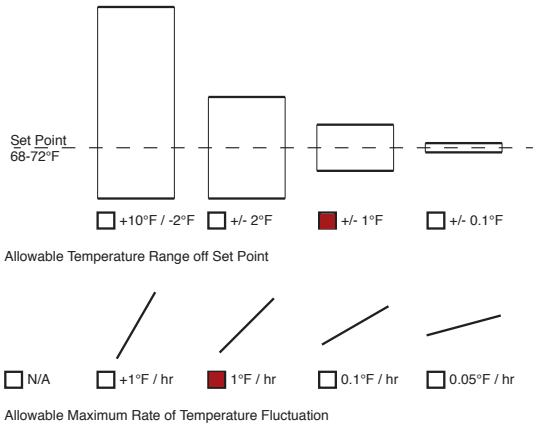
Laboratory Performance Criteria

Laboratory Type: MOCVD Lab
Laboratory Function: Metal Organic Chemical Vapor Deposition
Description of Activities: Materials Growth, Blue LEDs, Semiconductor Devices

Vibration Control



Temperature Control



Acoustic Control

- ☐ NC-15 TEM / Recording
- ☐ NC-20 SEM
- ☐ NC-25 Dil Fridge
- ☐ NC-30 High Perf Lab
- ☐ NC-35 Conference
- ☐ NC-40 Private Office
- ☐ NC-45 Open Office
- ■ NC-50 Laboratory
- ☐ No Requirement

Air Quality

- ☐ ISO 3 1
- ☐ ISO 4 10
- ☐ ISO 5 100
- ☐ ISO 6 1,000
- ☐ ISO 7 10,000
- ■ ISO 8 100,000
- ☐ No Classification
- ☐ Laminar Flow
- ☐ Moveable T-stat

Humidity Control

- ■ 30%-50% RH
- ☐ 30%-50% RH Settable
- ☐ No Humidification

- ☐ Return Air Allowed
- ☐ Local FCU (Remote)
- ☐ Positive Pressure
- ■ Negative Pressure
- ☐ +/- 2% RH

Power Density

- ☐ 5 W/sf (2W/sf demand)
- ☐ 10 W/sf (5W/sf demand)
- ☐ 20 W/sf (10W/sf demand)
- ☐ 30 W/sf (15W/sf demand)
- ☐ 50 W/sf (25W/sf demand)
- ☐ 80 W/sf (40 W/sf demand)
- ☐ 100 W/sf (50W/sf demand)
- ☐ Pump Power
- ☐ Instrument Power
- ☐ Clean Ground
- ■ Emergency Power *UPS central 20kW for computer, chillers

*100kW per system typical, 170kW for one Veeco system

Electromagnetic Interference (EMI) Control

- ■ 100 nT RMS (300 nTp-p): General High Performance Lab
- ☐ 35 nT RMS (100 nTp-p): Dilution Refrigerator Lab
- ☐ 18 nT RMS (50 nTp-p): E Beam / FIB
- ☐ 11 nT RMS (30 nTp-p): SEM / TEM
- ☐ 4 nT RMS (10nTp-p): FEI Titan / JEOL 2100F

Architectural

- ■ ESD Flooring
- ☐ Seamless Flooring
- ☐ Cryo Safe Flooring
- ☐ Chemical Resistant Flooring
- ☐ Wall Mounts
- ☐ Ceiling Mounts
- ■ Double Door
- ■ Windows Allowed

*overhead coiling door

Infrastructure

- ■ Clean Dry Air 150 psi
- ■ House Vacuum
- ■ House Nitrogen (gas) boil off
- ☐ House Helium (gas)
- ■ Cylinder Gas Manifolds Qty___
- ☐ Helium Recovery (Vertical)
- ☐ Other _____
- ■ 480V 3p Required

*for one system

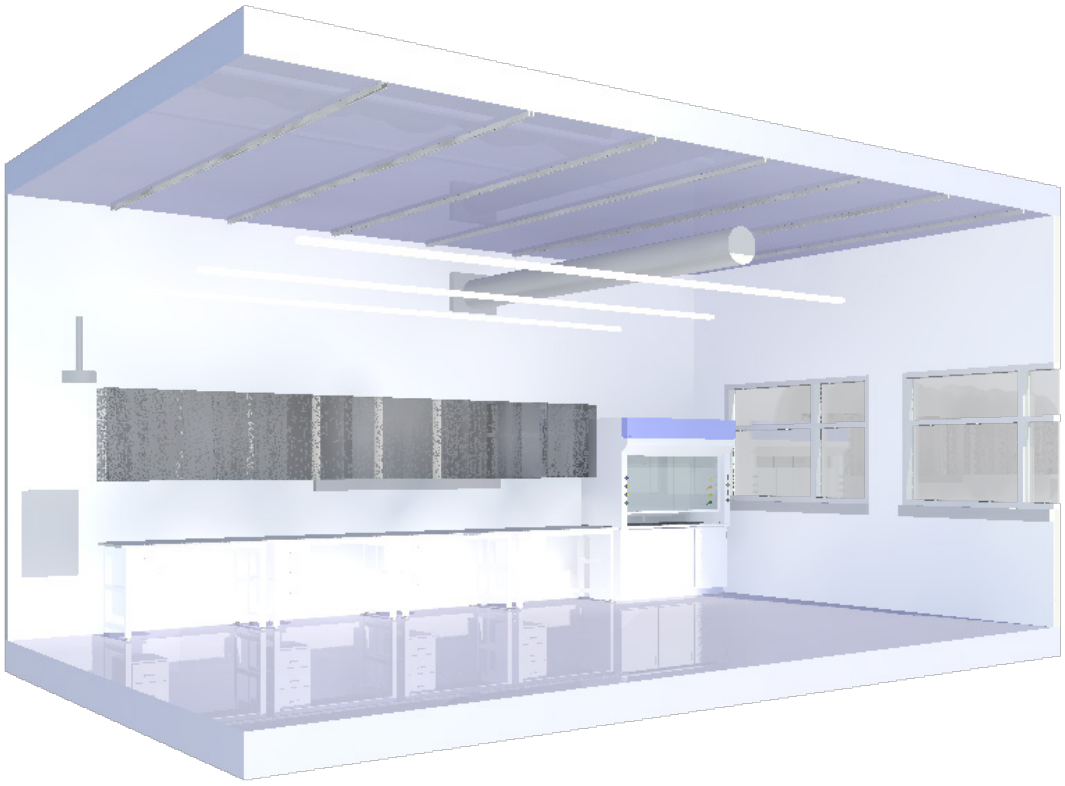
- ☐ Hot Water
- ☐ Cold Water
- ☐ RODI
- ■ Eyewash (Tempered Water)
- ■ Safety Shower (Tempered Water)
- ☐ Other _____
- ■ Data (Fiber)
- ■ Data (Copper)

*floor drain

**stainless steel piping from LN2 tank to tools

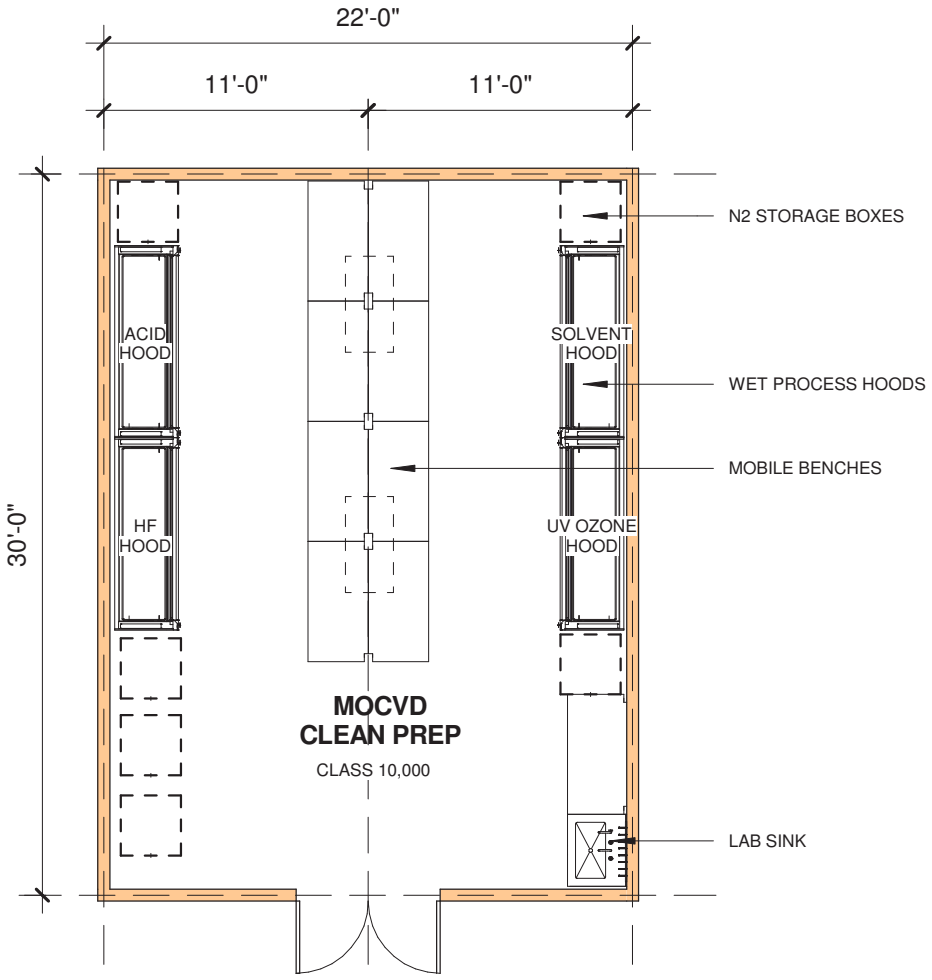
- ☐ Fume Hood
- ☐ Snorkel Exhaust
- ☐ Biological Safety Cabinet
- ■ HEPA Filter
- ☐ ULPA Filter
- ■ Process Chilled Water
  25% Percent of Power Demand
- ☐ 12V DC LED Lighting
- ■ Standard LED Lighting

*house chw needs cleanliness spec
**dedicated chillers (neslab) for process chw

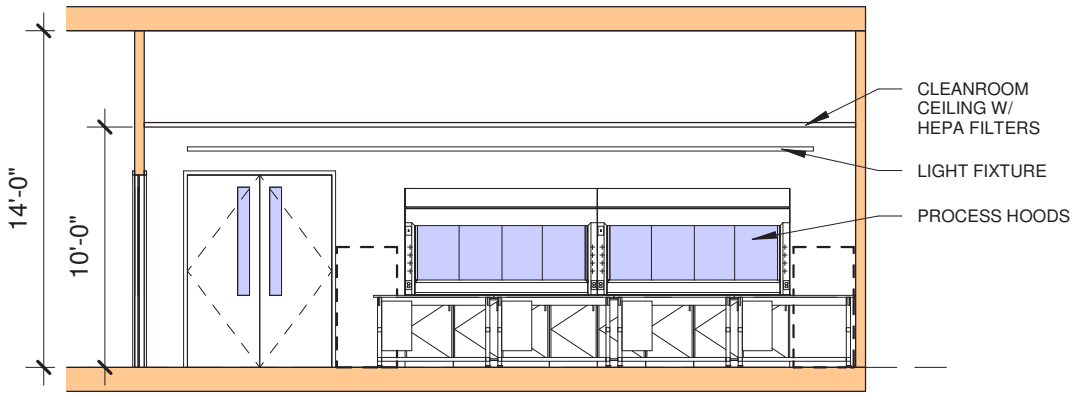


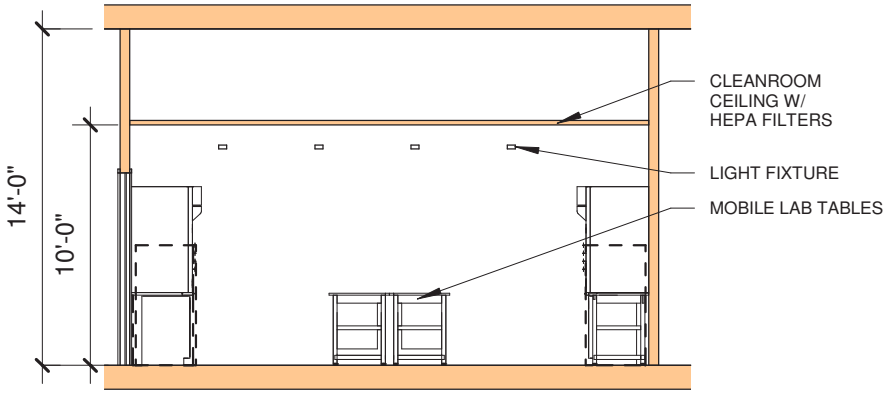
GENERAL LAB (MOCVD)

The MOCVD General Labs include support space for MOCVD Clean Prep and Parts Cleaning. The General Labs include wet process hoods, mobile bench space, and nitrogen storage boxes. MOCVD Gowning is also considered a General Lab.



MOCVD CLEAN PREP - (2) BAYS - 660 ASF



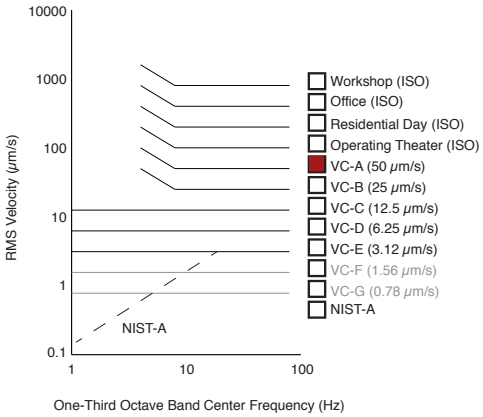


MOCVD CLEAN PREP - SECTIONS

Laboratory Performance Criteria

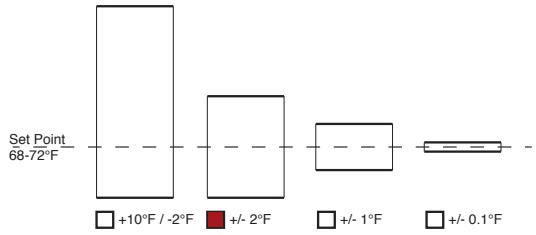
Laboratory Type: Clean Prep
Laboratory Function: Support Room
Description of Activities: Clean Prep for MOCVD

Vibration Control

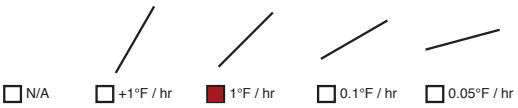


One-Third Octave Band Center Frequency (Hz)

Temperature Control



Allowable Temperature Range off Set Point



Allowable Maximum Rate of Temperature Fluctuation

Acoustic Control

- ☐ NC-15 TEM / Recording
- ☐ NC-20 SEM
- ☐ NC-25 Dil Fridge
- ☐ NC-30 High Perf Lab
- ☐ NC-35 Conference
- ☐ NC-40 Private Office
- ☐ NC-45 Open Office
- ■ NC-50 Laboratory
- ☐ No Requirement

Air Quality

- ☐ ISO 3 1
- ☐ ISO 4 10
- ☐ ISO 5 100
- ☐ ISO 6 1,000
- ■ ISO 7 10,000
- ☐ ISO 8 100,000
- ☐ No Classification
- ☐ Laminar Flow
- ☐ Moveable T-stat

Humidity Control

- ■ 30%-50% RH
- ☐ 30%-50% RH Settable
- ☐ No Humidification

- ☐ Return Air Allowed
- ☐ Local FCU (Remote)
- ■ Positive Pressure
- ☐ Negative Pressure
- ☐ +/- 2% RH

Power Density

- ☐ 5 W/sf (2W/sf demand)
- ☐ 10 W/sf (5W/sf demand)
- ☐ 20 W/sf (10W/sf demand)
- ■ 30 W/sf (15W/sf demand)
- ☐ 50 W/sf (25W/sf demand)
- ☐ 80 W/sf (40 W/sf demand)
- ☐ 100 W/sf (50W/sf demand)
- ■ Pump Power
- ■ Instrument Power
- ■ Clean Ground
- ☐ Emergency Power

Electromagnetic Interference (EMI) Control

- ☐ 100 nT RMS (300 nTp-p): General High Performance Lab
- ☐ 35 nT RMS (100 nTp-p): Dilution Refrigerator Lab
- ☐ 18 nT RMS (50 nTp-p): E Beam / FIB
- ☐ 11 nT RMS (30 nTp-p): SEM / TEM
- ☐ 4 nT RMS (10nTp-p): FEI Titan / JEOL 2100F

*no requirement

Architectural

- ■ ESD Flooring
- ☐ Seamless Flooring
- ☐ Cryo Safe Flooring
- ■ Chemical Resistant Flooring
- ☐ Wall Mounts
- ☐ Ceiling Mounts
- ■ Double Door
- ■ Windows Allowed

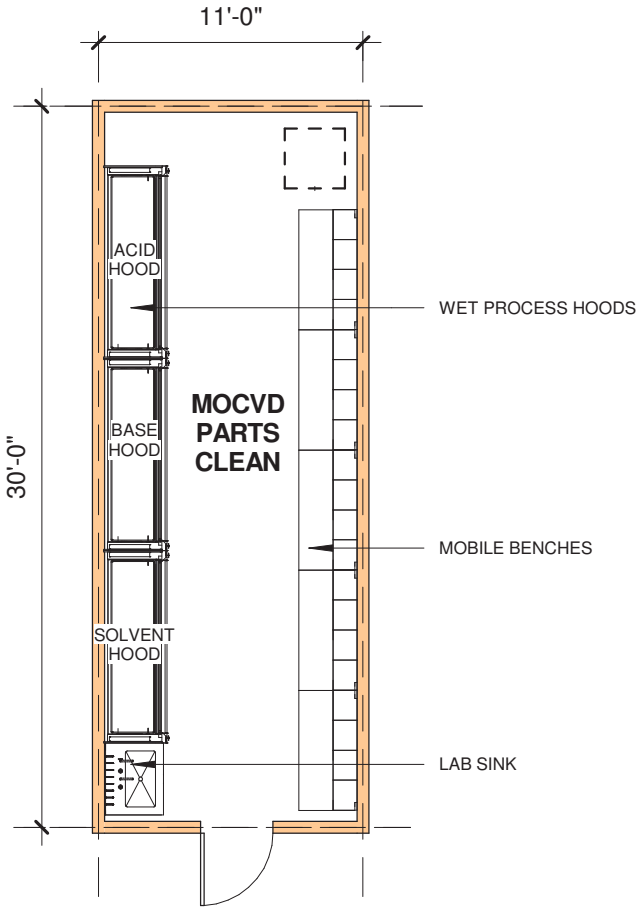
Infrastructure

- ■ Clean Dry Air
- ■ House Vacuum
- ■ House Nitrogen (gas)
- ☐ House Helium (gas)
- ☐ Cylinder Gas Manifolds Qty___
- ☐ Helium Recovery (Vertical)
- ☐ Other _____
- ☐ 480V 3p Required

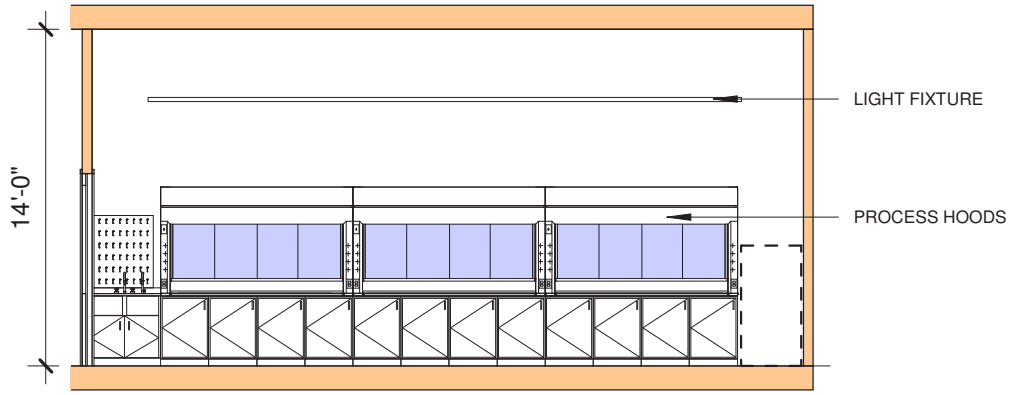
- ■ Hot Water
- ■ Cold Water
- ■ RODI
- ■ Eyewash (Tempered Water)
- ■ Safety Shower (Tempered Water)
- ☐ Other _____
- ■ Data (Fiber)
- ■ Data (Copper)

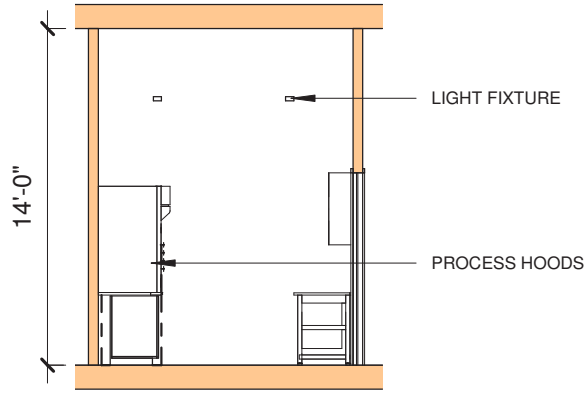
*floor drain

- ■ Fume Hood
- ☐ Snorkel Exhaust
- ☐ Biological Safety Cabinet
- ■ HEPA Filter
- ☐ ULPA Filter
- ☐ Process Chilled Water
  ____Percent of Power Demand
- ☐ 12V DC LED Lighting
- ■ Standard LED Lighting



MOCVD PARTS CLEAN - (1) BAY - 330 ASF



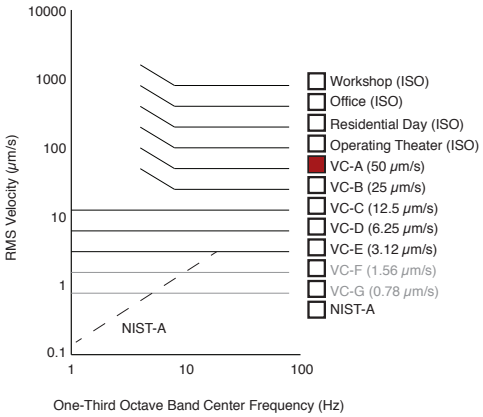


MOCVD PARTS CLEAN - SECTIONS

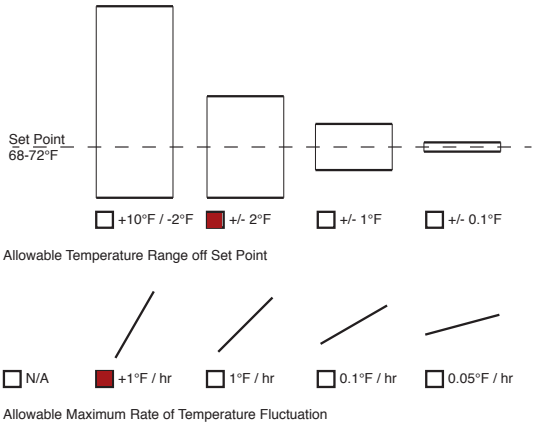
Laboratory Performance Criteria

Laboratory Type: Parts Clean
Laboratory Function: Support Room
Description of Activities: Parts Cleaning, Dirty Prep for MOCVD

Vibration Control



Temperature Control



Acoustic Control

- ☐ NC-15 TEM / Recording
- ☐ NC-20 SEM
- ☐ NC-25 Dil Fridge
- ☐ NC-30 High Perf Lab
- ☐ NC-35 Conference
- ☐ NC-40 Private Office
- ☐ NC-45 Open Office
- ■ NC-50 Laboratory
- ☐ No Requirement

Air Quality

- ☐ ISO 3 1
- ☐ ISO 4 10
- ☐ ISO 5 100
- ☐ ISO 6 1,000
- ☐ ISO 7 10,000
- ☐ ISO 8 100,000
- ■ No Classification
- ☐ Laminar Flow
- ☐ Moveable T-stat

Humidity Control

- ■ 30%-50% RH
- ☐ 30%-50% RH Settable
- ☐ No Humidification

- ☐ Return Air Allowed
- ☐ Local FCU (Remote)
- ☐ Positive Pressure
- ■ Negative Pressure
- ☐ +/- 2% RH

Power Density

- ☐ 5 W/sf (2W/sf demand)
- ☐ 10 W/sf (5W/sf demand)
- ■ 20 W/sf (10W/sf demand)
- ☐ 30 W/sf (15W/sf demand)
- ☐ 50 W/sf (25W/sf demand)
- ☐ 80 W/sf (40 W/sf demand)
- ☐ 100 W/sf (50W/sf demand)
- ■ Pump Power
- ■ Instrument Power
- ☐ Clean Ground
- ☐ Emergency Power

Electromagnetic Interference (EMI) Control

- ☐ 100 nT RMS (300 nTp-p): General High Performance Lab
- ☐ 35 nT RMS (100 nTp-p): Dilution Refrigerator Lab
- ☐ 18 nT RMS (50 nTp-p): E Beam / FIB
- ☐ 11 nT RMS (30 nTp-p): SEM / TEM
- ☐ 4 nT RMS (10nTp-p): FEI Titan / JEOL 2100F

*no requirement

Architectural

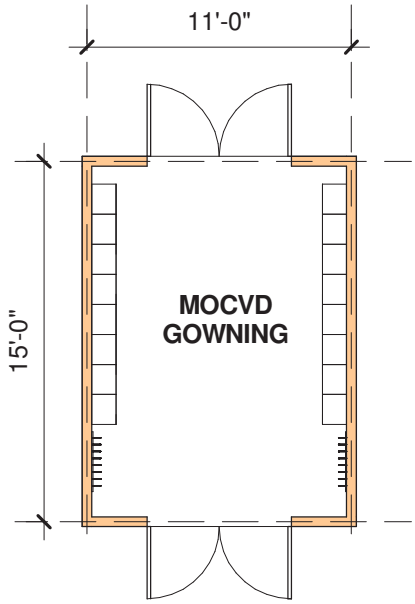
- ☐ ESD Flooring
- ☐ Seamless Flooring
- ☐ Cryo Safe Flooring
- ■ Chemical Resistant Flooring
- ☐ Wall Mounts
- ☐ Ceiling Mounts
- ■ Double Door
- ■ Windows Allowed

Infrastructure

- ■ Clean Dry Air
- ■ House Vacuum
- ■ House Nitrogen (gas)
- ☐ House Helium (gas)
- ■ Cylinder Gas Manifolds Qty___
- ☐ Helium Recovery (Vertical)
- ☐ Other _____
- ☐ 480V 3p Required

- ■ Hot Water *both lab and potable
- ■ Cold Water
- ■ RODI
- ■ Eyewash (Tempered Water)
- ■ Safety Shower (Tempered Water)
- ☐ Other _____
- ■ Data (Fiber)
- ■ Data (Copper)

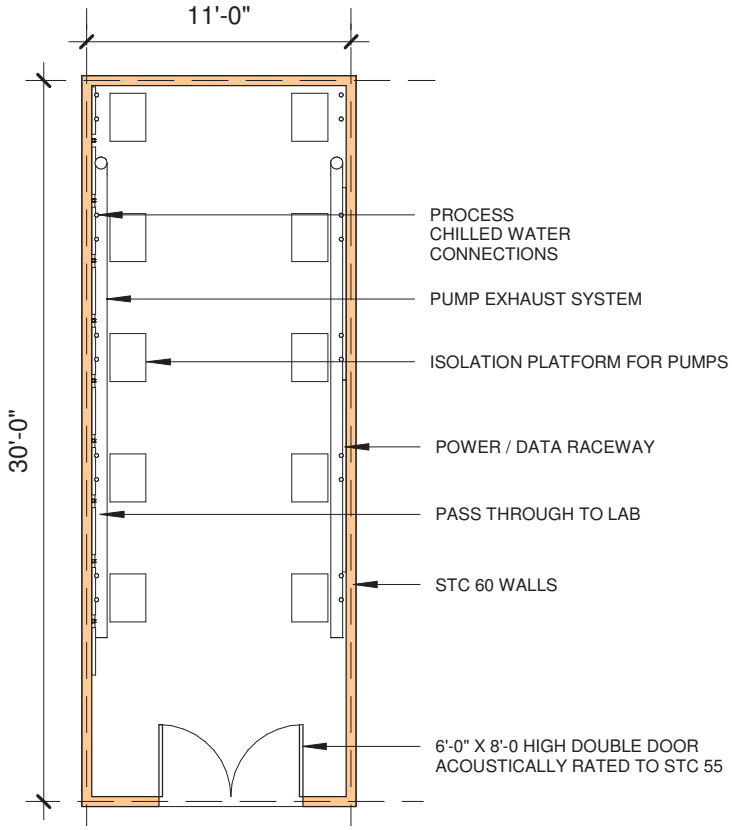
- ■ Fume Hood
- ■ Snorkel Exhaust
- ☐ Biological Safety Cabinet
- ☐ HEPA Filter
- ☐ ULPA Filter
- ☐ Process Chilled Water
  ____Percent of Power Demand
- ☐ 12V DC LED Lighting
- ■ Standard LED Lighting



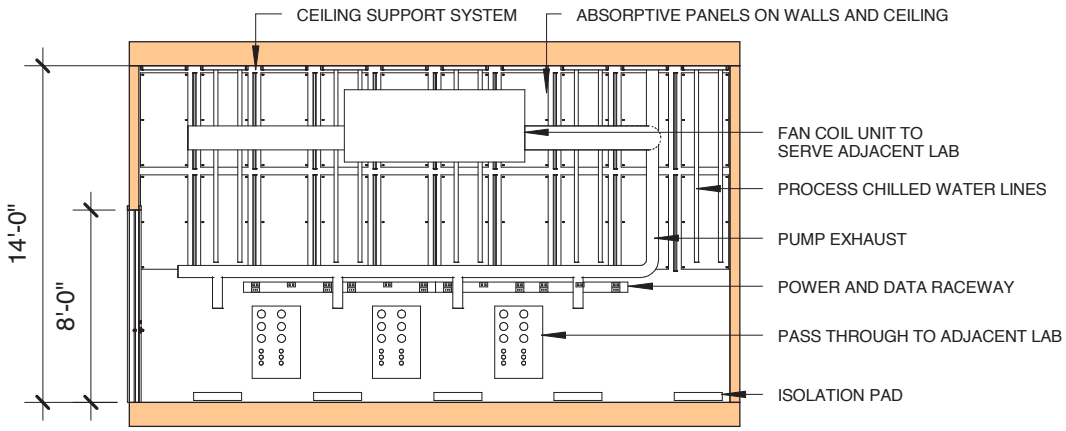
MOCVD GOWNING - (0.5) BAYS - 165 ASF

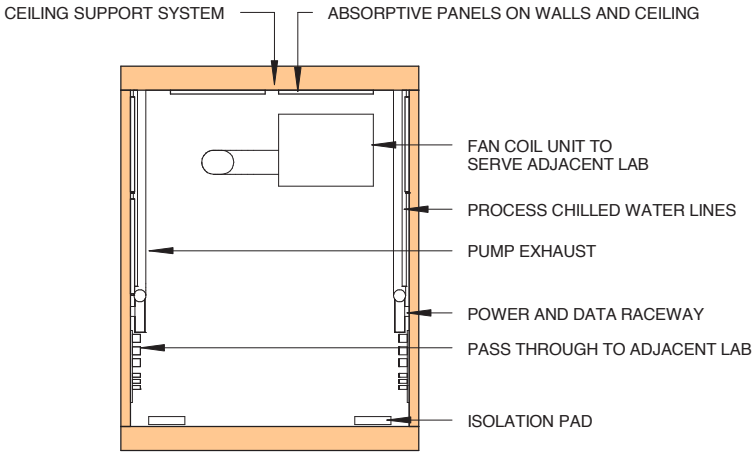
PUMP CLOSET

The pump closet supports many types of labs by providing segregated space for placement of noisy peripheral equipment.



PUMP CLOSET - (1) BAY - 330 ASF



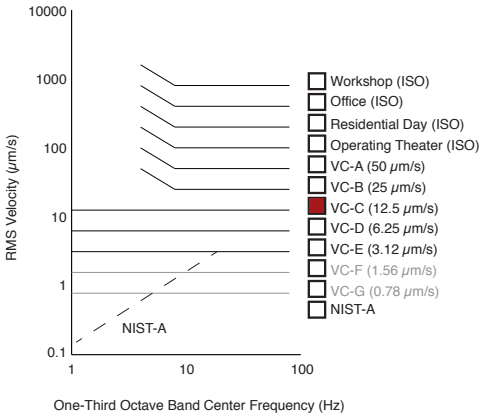


PUMP CLOSET - SECTIONS

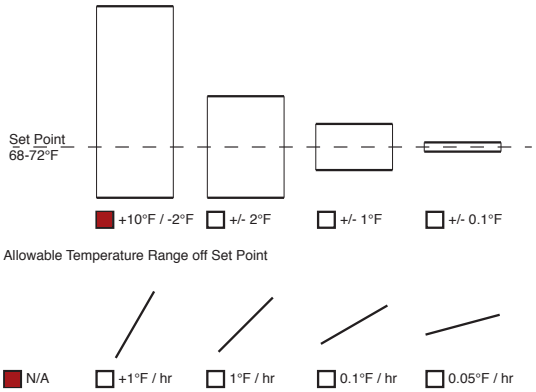
Laboratory Performance Criteria

Laboratory Type: Pump Closet
Laboratory Function: Support Room
Description of Activities: Vibration and acoustically isolated room for pumps and chillers and local FCU

Vibration Control



Temperature Control



Acoustic Control

- ☐ NC-15 TEM / Recording
- ☐ NC-20 SEM
- ☐ NC-25 Dil Fridge
- ☐ NC-30 High Perf Lab
- ☐ NC-35 Conference
- ☐ NC-40 Private Office
- ☐ NC-45 Open Office
- ■ NC-50 Laboratory
- ☐ No Requirement

Air Quality

- ☐ ISO 3 1
- ☐ ISO 4 10
- ☐ ISO 5 100
- ☐ ISO 6 1,000
- ☐ ISO 7 10,000
- ☐ ISO 8 100,000
- ■ No Classification
- ☐ Laminar Flow
- ☐ Moveable T-stat
- ■ Pump Exhaust

Humidity Control

- ☐ 30%-50% RH
- ☐ 30%-50% RH Settable
- ■ No Humidification

- ■ Return Air Allowed
- ■ Local FCU (Remote)
- ☐ Positive Pressure
- ■ Negative Pressure
- ☐ +/- 2% RH

Power Density

- ☐ 5 W/sf (2W/sf demand)
- ☐ 10 W/sf (5W/sf demand)
- ☐ 20 W/sf (10W/sf demand)
- ☐ 30 W/sf (15W/sf demand)
- ☐ 50 W/sf (25W/sf demand)
- ☐ 80 W/sf (40 W/sf demand)
- ■ 100 W/sf (50W/sf demand)
- ■ Pump Power
- ☐ Instrument Power
- ☐ Clean Ground
- ■ Emergency Power

Electromagnetic Interference (EMI) Control

- ■ 100 nT RMS (300 nTp-p): General High Performance Lab
- ☐ 35 nT RMS (100 nTp-p): Dilution Refrigerator Lab
- ☐ 18 nT RMS (50 nTp-p): E Beam / FIB
- ☐ 11 nT RMS (30 nTp-p): SEM / TEM
- ☐ 4 nT RMS (10nTp-p): FEI Titan / JEOL 2100F

Architectural

- ☐ ESD Flooring
- ☐ Seamless Flooring
- ☐ Cryo Safe Flooring
- ☐ Chemical Resistant Flooring
- ■ Wall Mounts
- ■ Ceiling Mounts
- ■ Double Door
- ■ Windows Allowed

Infrastructure

- ■ Clean Dry Air
- ☐ House Vacuum
- ■ House Nitrogen (gas)
- ☐ House Helium (gas)
- ■ Cylinder Gas Manifolds Qty 2
- ■ Helium Recovery (Vertical)
- ■ Other Pump Exhaust
- ■ 480V 3p Required

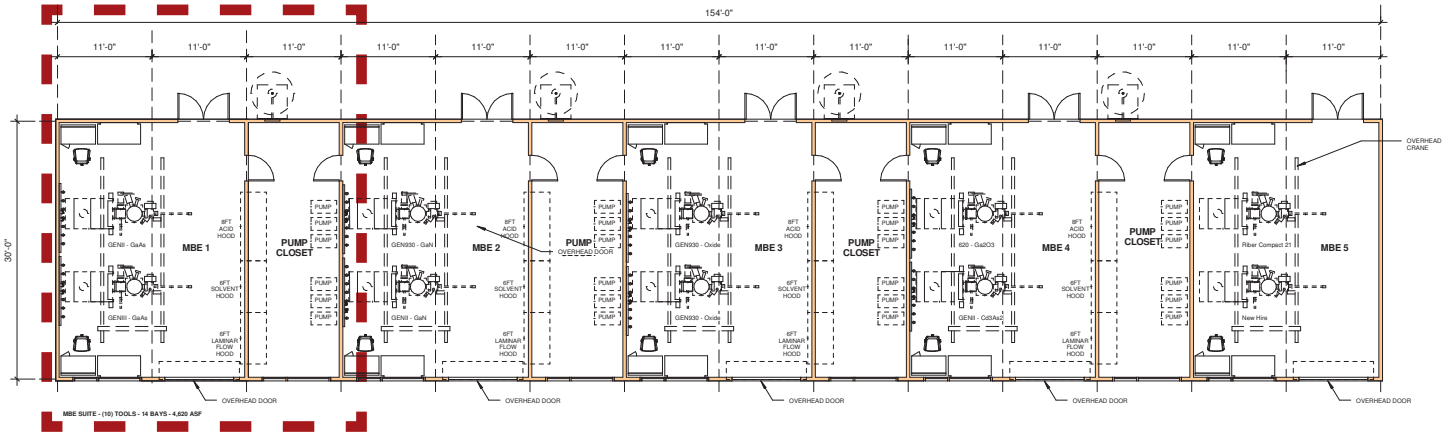
- ☐ Hot Water
- ☐ Cold Water
- ☐ RODI
- ☐ Eyewash (Tempered Water)
- ☐ Safety Shower (Tempered Water)
- ☐ Other _____
- ■ Data (Fiber)
- ■ Data (Copper)

- ☐ Fume Hood
- ☐ Snorkel Exhaust
- ☐ Biological Safety Cabinet
- ☐ HEPA Filter
- ☐ ULPA Filter
- ■ Process Chilled Water
  75% Percent of Power Demand
- ■ 12V DC LED Lighting
- ☐ Standard LED Lighting

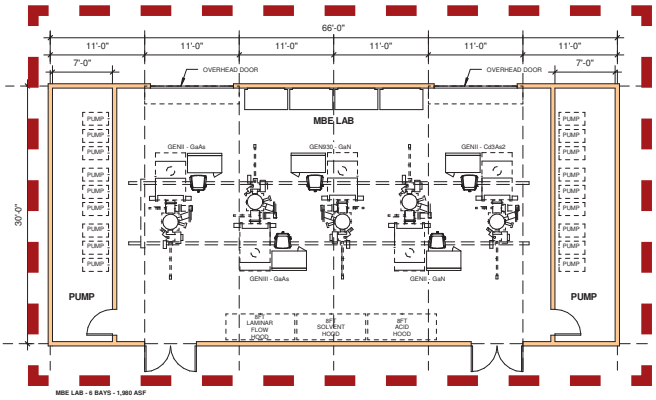
iv. MOLECULAR BEAM EPITAXY (MBE)

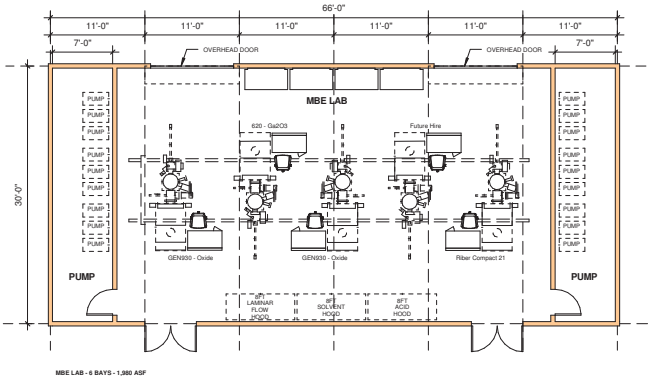
MBE LAB

Electronic and optical materials are at the core of many emerging technologies in the areas of high-speed electronic devices, optical computing, lasers, optical data storage and semiconductor lighting. Because of their superior electronic and optoelectronic properties, GaAs, GaN, InP, GaSb, specialized III-V materials and oxide-based semiconductors are of interest. These materials are grown by advanced molecular beam epitaxy (MBE) approaches.



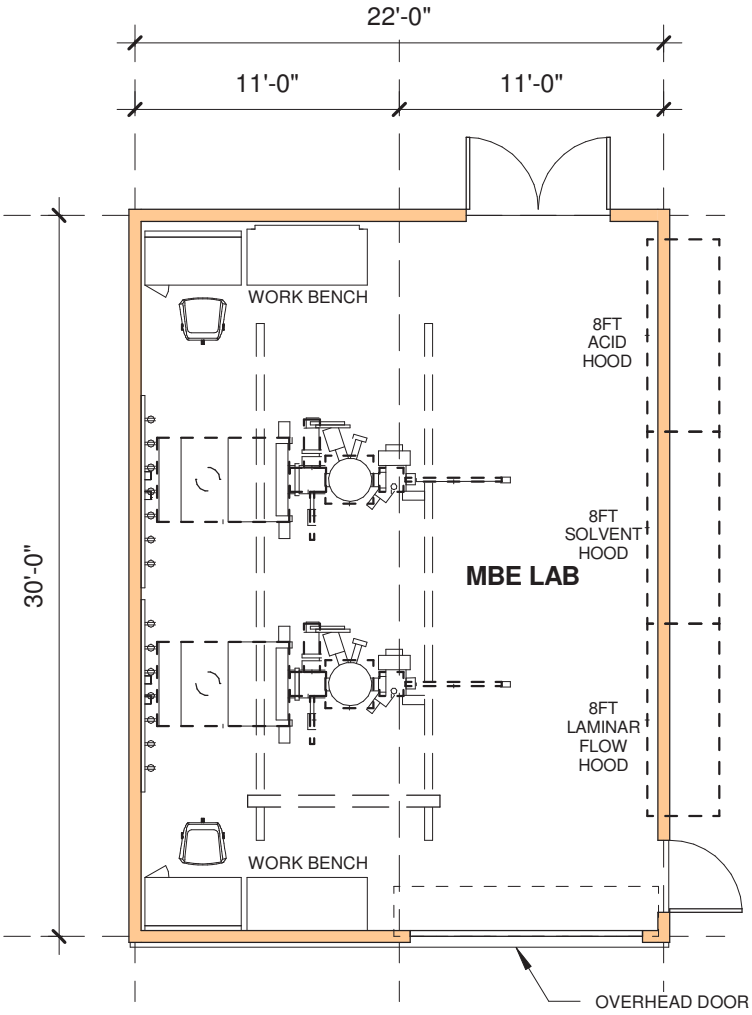
MBE SUITE OPTION 1 - (10) TOOLS - (14) BAYS - 4,620 ASF





MBE SUITE OPTION 2 - (10) TOOLS - (12) BAYS - 3,960 ASF

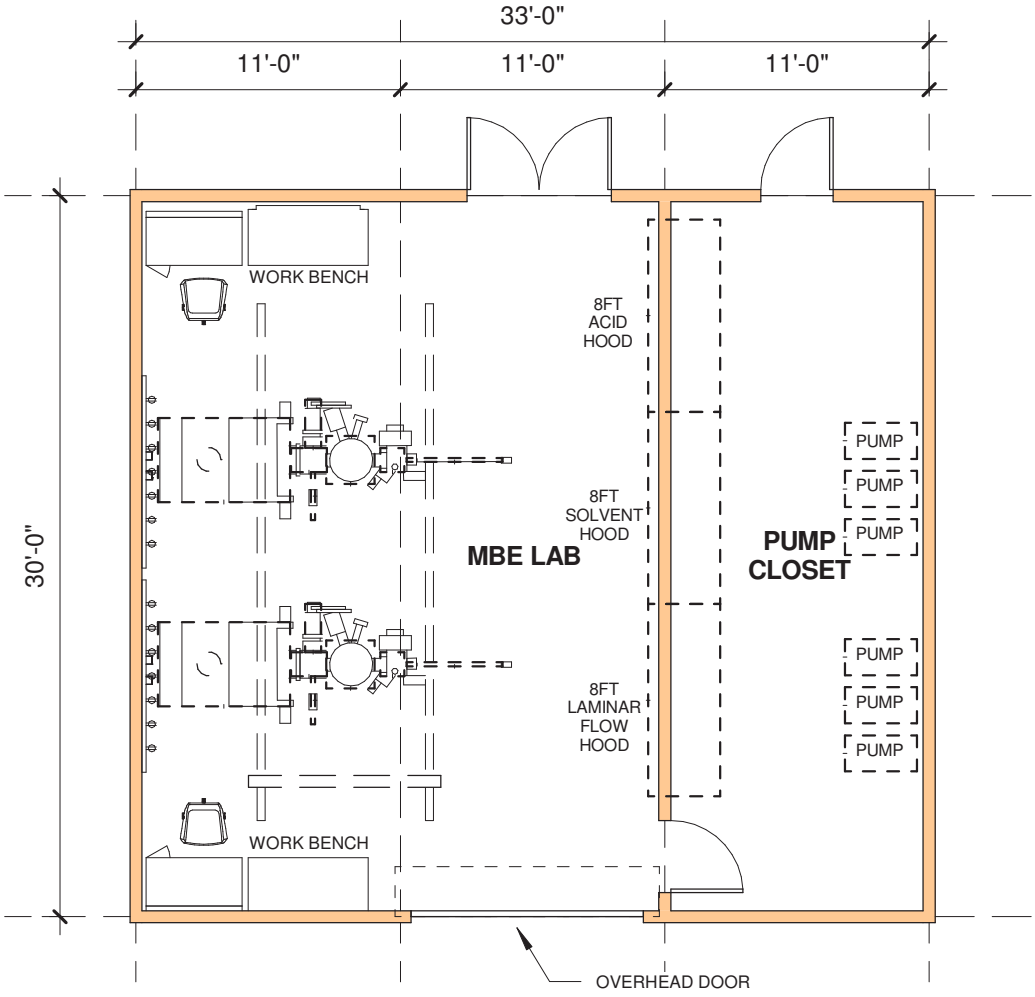
NOTE: MBE LABS SHOULD BE LOCATED ON THE GROUND FLOOR WITH EXTERIOR ACCESS.



MBE LAB OPTION 1 - (2) TOOLS - (2) BAYS - 660 ASF **(5x)**

(10) TOTAL TOOLS:

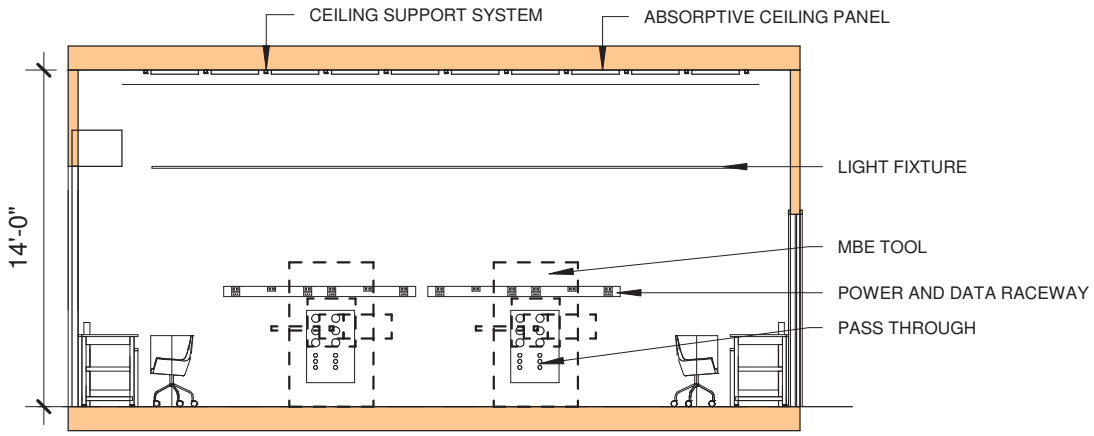
1. Veeco GENII - GaAs
2. Veeco GENIII - GaAs
3. Veeco GEN930 - GaN
4. Veeco GENII - GaN
5. Veeco GENII - Cd3As2
6. Veeco GEN930 - Oxide
7. Veeco 620 - Ga2O3
8. Veeco GEN930 - Oxide
9. Riber Compact 21
10. Future Hire

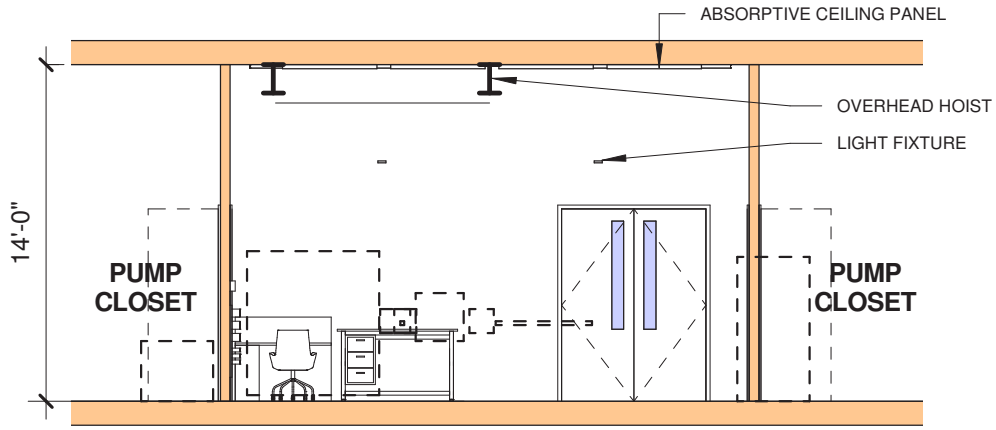


MBE LAB OPTION 1 - (2) TOOLS - (2) BAYS - 660 ASF + PUMP CLOSET **(5x)**

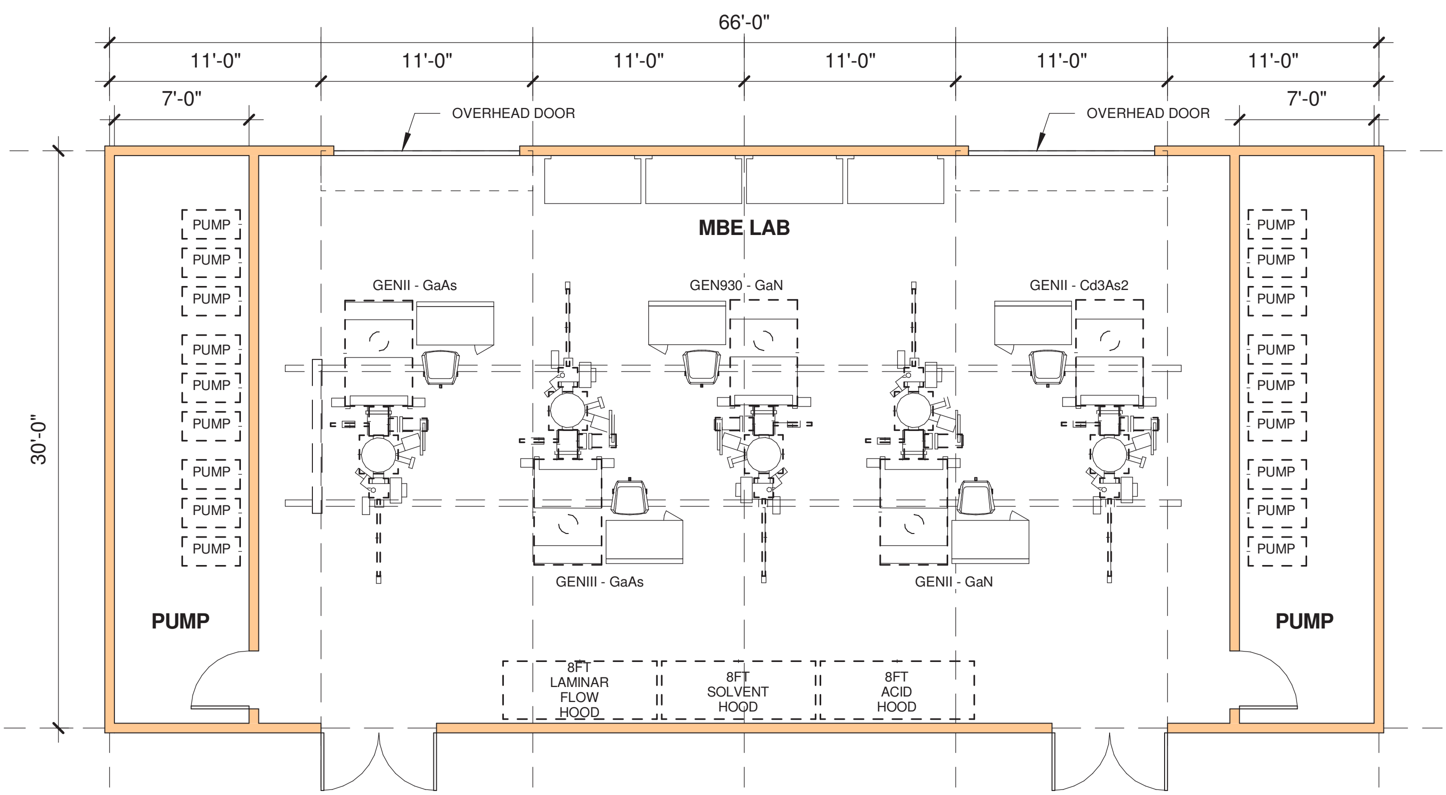
(10) TOTAL TOOLS:

1. Veeco GENII - GaAs
2. Veeco GENIII - GaAs
3. Veeco GEN930 - GaN
4. Veeco GENII - GaN
5. Veeco GENII -Cd3As2
6. Veeco GEN930 - Oxide
7. Veeco 620 - Ga2O3
8. Veeco GEN930 - Oxide
9. Riber Compact 21
10. Future Hire





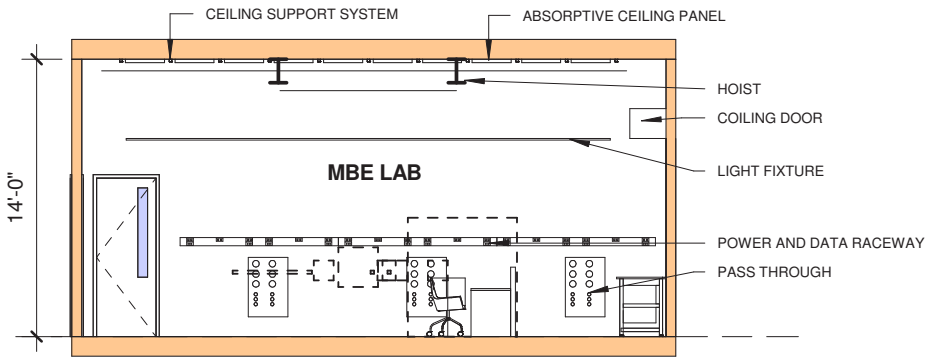
MBE LAB OPTION 1 - SECTIONS

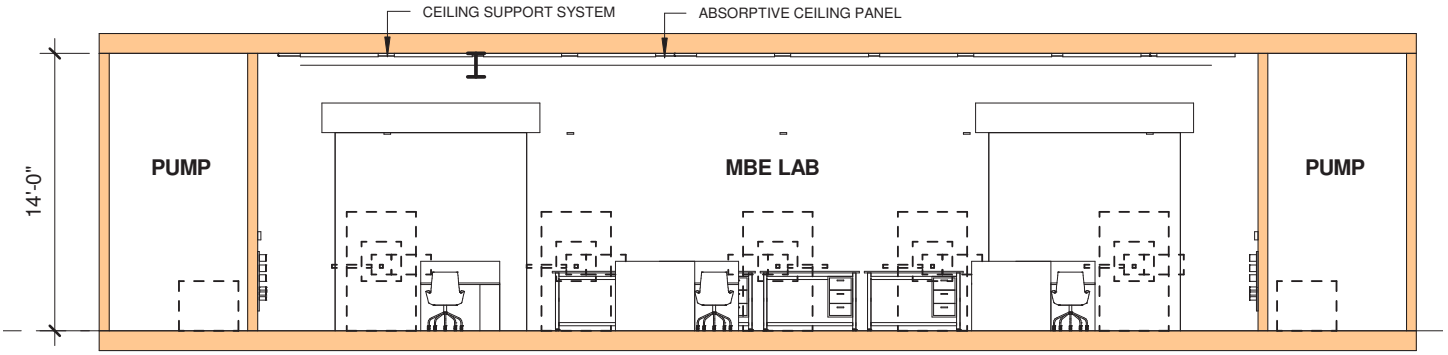


MBE LAB OPTION 2 - (5) TOOLS - (6) BAYS - 1,980 ASF + PUMP CLOSET **(2x)**

(10) TOTAL TOOLS:

1. Veeco GENII - GaAs
2. Veeco GENIII - GaAs
3. Veeco GEN930 - GaN
4. Veeco GENII - GaN
5. Veeco GENII -Cd3As2
6. Veeco GEN930 - Oxide
7. Veeco 620 - Ga2O3
8. Veeco GEN930 - Oxide
9. Riber Compact 21
10. Future Hire



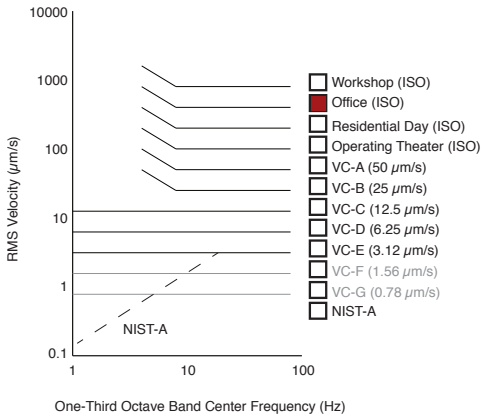


MBE LAB OPTION 2 - SECTIONS

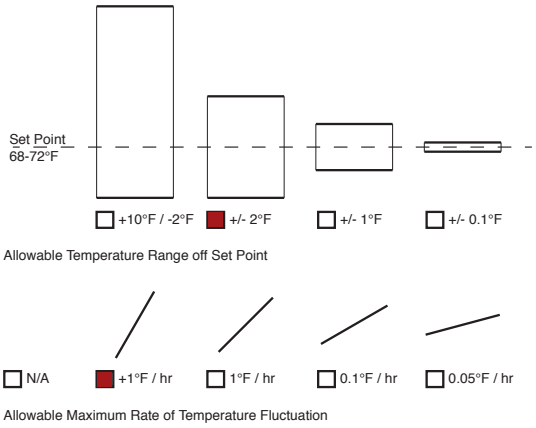
Laboratory Performance Criteria

Laboratory Type: MBE Lab
Laboratory Function: Materials Growth
Description of Activities: Molecular Beam Epitaxy, Oxides, Nitrides, Arsenides, Spintronics, Metals

Vibration Control



Temperature Control



Acoustic Control

- ☐ NC-15 TEM / Recording
- ☐ NC-20 SEM
- ☐ NC-25 Dil Fridge
- ☐ NC-30 High Perf Lab
- ☐ NC-35 Conference
- ☐ NC-40 Private Office
- ☐ NC-45 Open Office
- ■ NC-50 Laboratory
- ☐ No Requirement

Air Quality

- ☐ ISO 3 1
- ☐ ISO 4 10
- ☐ ISO 5 100
- ☐ ISO 6 1,000
- ☐ ISO 7 10,000
- ☐ ISO 8 100,000
- ■ No Classification
- ☐ Laminar Flow
- ☐ Moveable T-stat

Humidity Control

- ☐ 30%-50% RH
- ☐ 30%-50% RH Settable
- ■ No Humidification

- ☐ Return Air Allowed
- ☐ Local FCU (Remote)
- ☐ Positive Pressure
- ■ Negative Pressure
- ☐ +/- 2% RH

Power Density

- ☐ 5 W/sf (2W/sf demand)
- ☐ 10 W/sf (5W/sf demand)
- ☐ 20 W/sf (10W/sf demand)
- ☐ 30 W/sf (15W/sf demand)
- ☐ 50 W/sf (25W/sf demand)
- ☐ 80 W/sf (40 W/sf demand)
- ■ 100 W/sf (50W/sf demand)
- ■ Pump Power
- ■ Instrument Power
- ■ Clean Ground
- ■ Emergency Power *UPS

Electromagnetic Interference (EMI) Control

- ☐ 100 nT RMS (300 nTp-p): General High Performance Lab
- ☐ 35 nT RMS (100 nTp-p): Dilution Refrigerator Lab
- ■ 18 nT RMS (50 nTp-p): E Beam / FIB
- ☐ 11 nT RMS (30 nTp-p): SEM / TEM
- ☐ 4 nT RMS (10nTp-p): FEI Titan / JEOL 2100F

Architectural

- ☐ ESD Flooring
- ■ Seamless Flooring
- ■ Cryo Safe Flooring
- ■ Chemical Resistant Flooring
- ■ Wall Mounts
- ■ Ceiling Mounts
- ■ Double Door
- ■ Windows Allowed

*overhead coiling door

Infrastructure

- ■ Clean Dry Air
- ■ House Vacuum
- ■ House Nitrogen (gas)
- ☐ House Helium (gas)
- ■ Cylinder Gas Manifolds Qty___
- ☐ Helium Recovery (Vertical)
- ☐ Other _____
- ☐ 480V 3p Required

*LN2

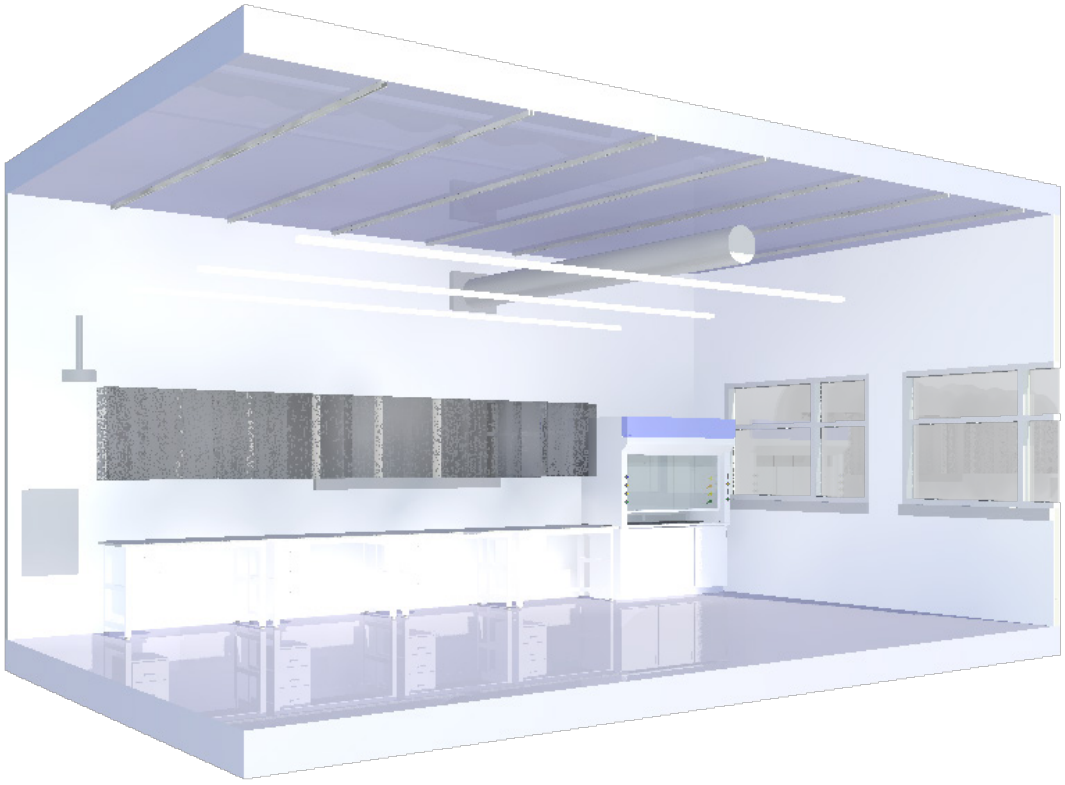
- ☐ Hot Water
- ☐ Cold Water
- ☐ RODI
- ■ Eyewash (Tempered Water)
- ■ Safety Shower (Tempered Water)
- ☐ Other _____
- ■ Data (Fiber)
- ■ Data (Copper)

*No Sink

- ■ Fume Hood (3) 8ft Process Hoods
- ■ Snorkel Exhaust
- ☐ Biological Safety Cabinet
- ■ HEPA Filter
- ☐ ULPA Filter
- ■ Process Chilled Water

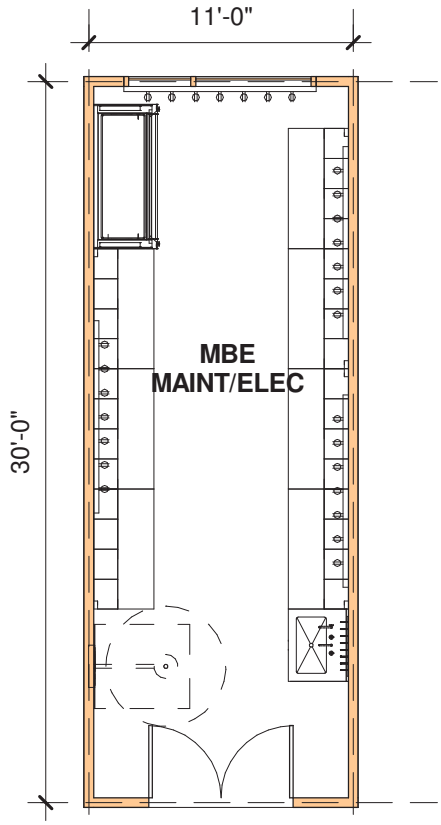
50-70 Percent of Power Demand

- ■ 12V DC LED Lighting
- ☐ Standard LED Lighting

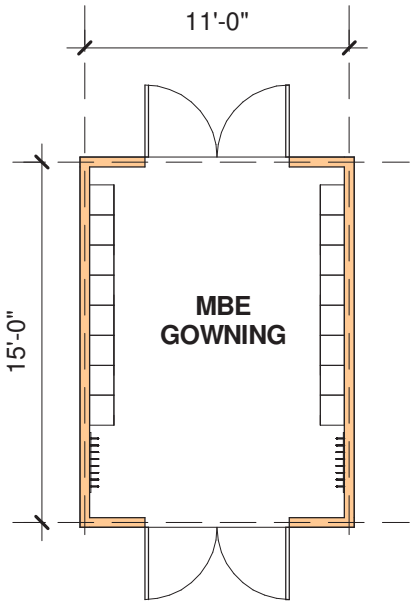


GENERAL LAB (MBE)

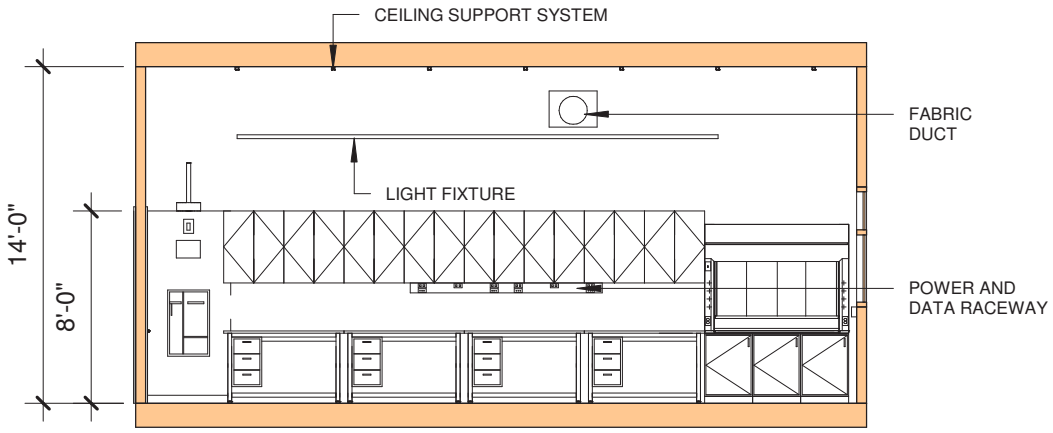
The MBE General Lab is a shared support facility for MBE Maintenance, Electrical, and Prep. The General Lab includes a chemical fume hood and mobile bench space. MBE Gowning is also considered a General Lab.



GENERAL LAB (MBE) - (1) BAY - 330 ASF



MBE GOWNING - (0.5) BAY - 165 ASF

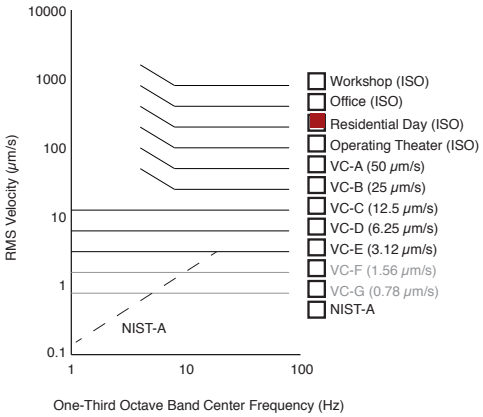


GENERAL LAB (MBE) - SECTION

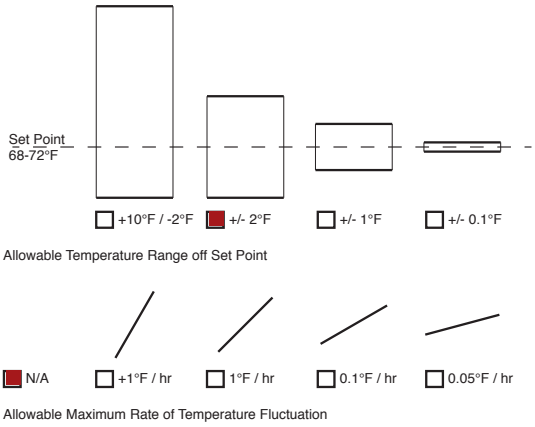
Laboratory Performance Criteria

Laboratory Type: General Lab (MBE)
Laboratory Function: Support Room
Description of Activities: Maintenance, Electrical Shop, Prep, Clean De-Gowning

Vibration Control



Temperature Control



Acoustic Control

- ☐ NC-15 TEM / Recording
- ☐ NC-20 SEM
- ☐ NC-25 Dil Fridge
- ☐ NC-30 High Perf Lab
- ☐ NC-35 Conference
- ☐ NC-40 Private Office
- ☐ NC-45 Open Office
- ■ NC-50 Laboratory
- ☐ No Requirement

Air Quality

- ☐ ISO 3 1
- ☐ ISO 4 10
- ☐ ISO 5 100
- ☐ ISO 6 1,000
- ☐ ISO 7 10,000
- ☐ ISO 8 100,000
- ■ No Classification
- ☐ Laminar Flow
- ☐ Moveable T-stat

*HEPA filters at Clean De-Gowning

Humidity Control

- ☐ 30%-50% RH
- ☐ 30%-50% RH Settable
- ■ No Humidification

- ☐ Return Air Allowed
- ☐ Local FCU (Remote)
- ☐ Positive Pressure
- ■ Negative Pressure
- ☐ +/- 2% RH

Power Density

- ☐ 5 W/sf (2W/sf demand)
- ☐ 10 W/sf (5W/sf demand)
- ☐ 20 W/sf (10W/sf demand)
- ☐ 30 W/sf (15W/sf demand)
- ■ 50 W/sf (25W/sf demand)
- ☐ 80 W/sf (40 W/sf demand)
- ☐ 100 W/sf (50W/sf demand)
- ■ Pump Power
- ■ Instrument Power
- ■ Clean Ground
- ■ Emergency Power

Electromagnetic Interference (EMI) Control

- ■ 100 nT RMS (300 nTp-p): General High Performance Lab
- ☐ 35 nT RMS (100 nTp-p): Dilution Refrigerator Lab
- ☐ 18 nT RMS (50 nTp-p): E Beam / FIB
- ☐ 11 nT RMS (30 nTp-p): SEM / TEM
- ☐ 4 nT RMS (10nTp-p): FEI Titan / JEOL 2100F

Architectural

- ☐ ESD Flooring
- ☐ Seamless Flooring
- ☐ Cryo Safe Flooring
- ■ Chemical Resistant Flooring
- ☐ Wall Mounts
- ■ Ceiling Mounts
- ■ Double Door
- ■ Windows Allowed

Infrastructure

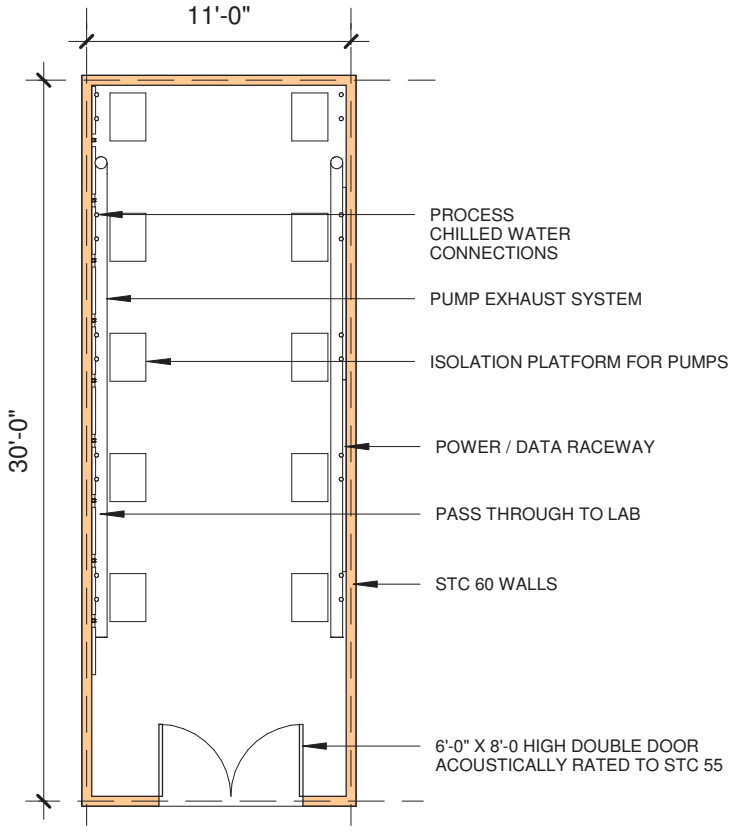
- ■ Clean Dry Air
- ■ House Vacuum
- ■ House Nitrogen (gas)
- ☐ House Helium (gas)
- ■ Cylinder Gas Manifolds Qty 2
- ☐ Helium Recovery (Vertical)
- ☐ Other _____
- ☐ 480V 3p Required

- ■ Hot Water
- ■ Cold Water
- ■ RODI
- ■ Eyewash (Tempered Water)
- ■ Safety Shower (Tempered Water)
- ☐ Other _____
- ☐ Data (Fiber)
- ■ Data (Copper)

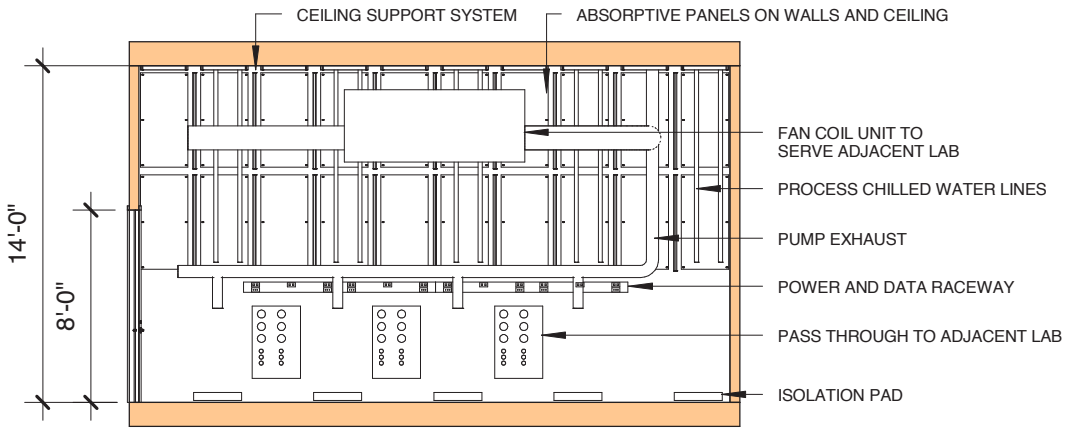
- ■ Fume Hood
- ■ Snorkel Exhaust
- ☐ Biological Safety Cabinet
- ☐ HEPA Filter
- ☐ ULPA Filter
- ■ Process Chilled Water
  25 Percent of Power Demand
- ☐ 12V DC LED Lighting
- ■ Standard LED Lighting

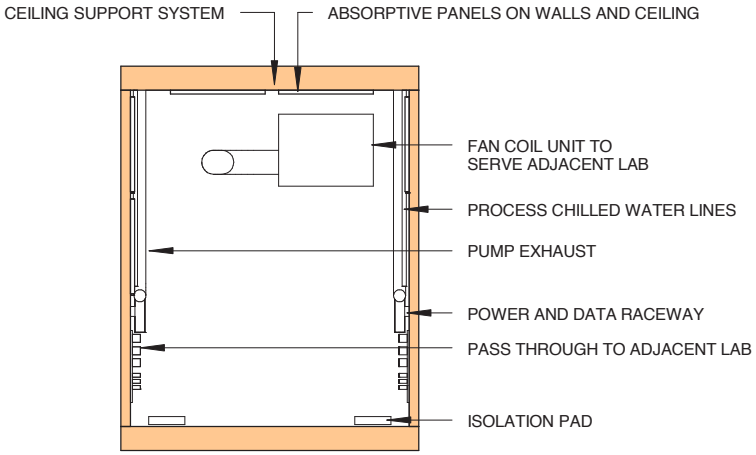
PUMP CLOSET

The pump closet supports many types of labs by providing segregated space for placement of noisy peripheral equipment.



PUMP CLOSET - (1) BAY - 330 ASF



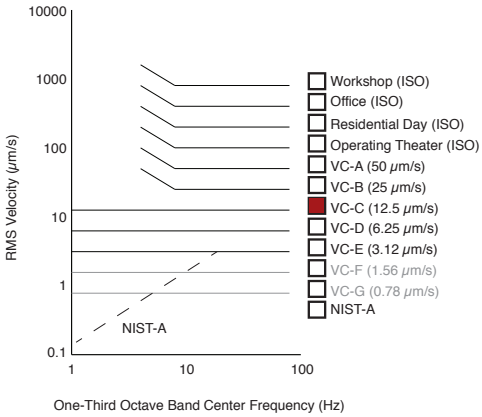


PUMP CLOSET - SECTIONS

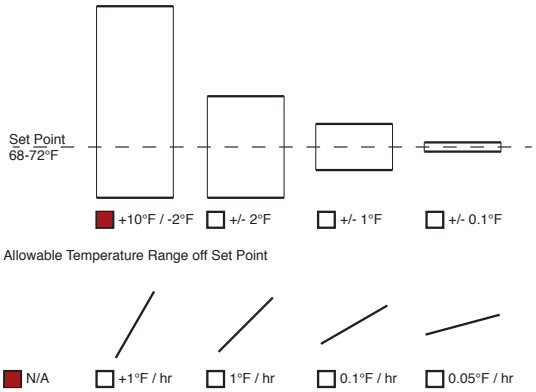
Laboratory Performance Criteria

Laboratory Type: Pump Closet
Laboratory Function: Support Room
Description of Activities: Vibration and acoustically isolated room for pumps and chillers and local FCU

Vibration Control



Temperature Control



Acoustic Control

- ☐ NC-15 TEM / Recording
- ☐ NC-20 SEM
- ☐ NC-25 Dil Fridge
- ☐ NC-30 High Perf Lab
- ☐ NC-35 Conference
- ☐ NC-40 Private Office
- ☐ NC-45 Open Office
- ■ NC-50 Laboratory
- ☐ No Requirement

Air Quality

- ☐ ISO 3 1
- ☐ ISO 4 10
- ☐ ISO 5 100
- ☐ ISO 6 1,000
- ☐ ISO 7 10,000
- ☐ ISO 8 100,000
- ■ No Classification
- ☐ Laminar Flow
- ☐ Moveable T-stat
- ■ Pump Exhaust

Humidity Control

- ☐ 30%-50% RH
- ☐ 30%-50% RH Settable
- ■ No Humidification

- ■ Return Air Allowed
- ■ Local FCU (Remote)
- ☐ Positive Pressure
- ■ Negative Pressure
- ☐ +/- 2% RH

Power Density

- ☐ 5 W/sf (2W/sf demand)
- ☐ 10 W/sf (5W/sf demand)
- ☐ 20 W/sf (10W/sf demand)
- ☐ 30 W/sf (15W/sf demand)
- ☐ 50 W/sf (25W/sf demand)
- ☐ 80 W/sf (40 W/sf demand)
- ■ 100 W/sf (50W/sf demand)
- ■ Pump Power
- ☐ Instrument Power
- ☐ Clean Ground
- ■ Emergency Power

Electromagnetic Interference (EMI) Control

- ■ 100 nT RMS (300 nTp-p): General High Performance Lab
- ☐ 35 nT RMS (100 nTp-p): Dilution Refrigerator Lab
- ☐ 18 nT RMS (50 nTp-p): E Beam / FIB
- ☐ 11 nT RMS (30 nTp-p): SEM / TEM
- ☐ 4 nT RMS (10nTp-p): FEI Titan / JEOL 2100F

Architectural

- ☐ ESD Flooring
- ☐ Seamless Flooring
- ☐ Cryo Safe Flooring
- ☐ Chemical Resistant Flooring
- ■ Wall Mounts
- ■ Ceiling Mounts
- ■ Double Door
- ■ Windows Allowed

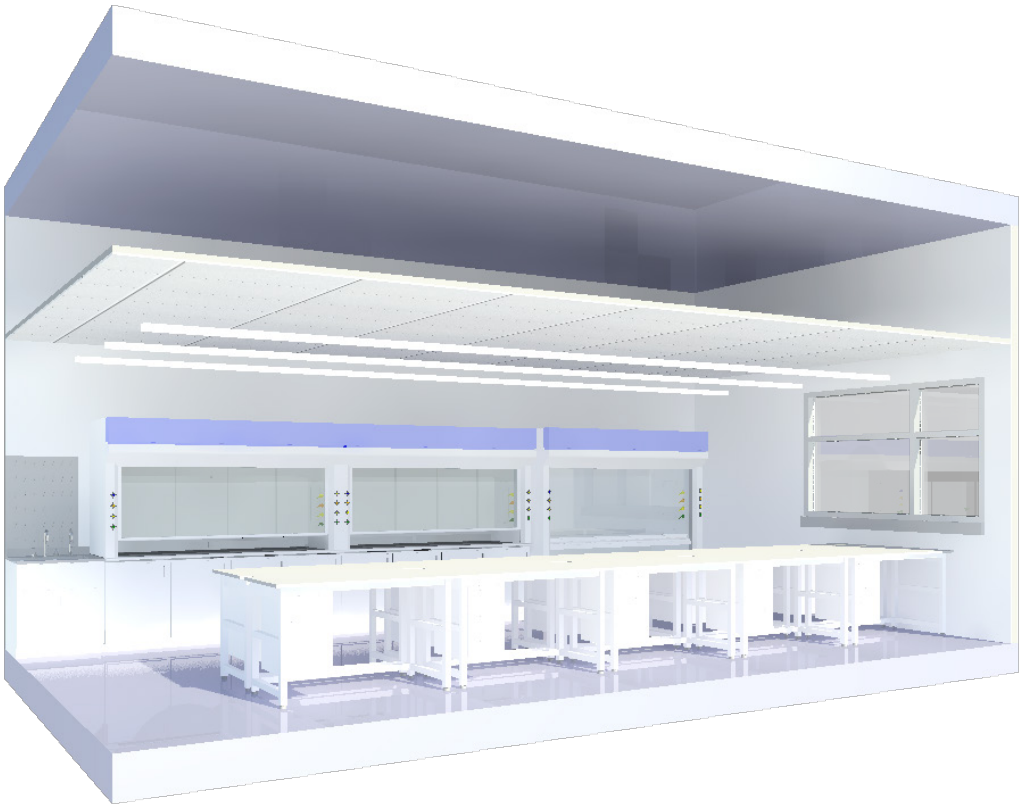
Infrastructure

- ■ Clean Dry Air
- ☐ House Vacuum
- ■ House Nitrogen (gas)
- ☐ House Helium (gas)
- ■ Cylinder Gas Manifolds Qty 2
- ■ Helium Recovery (Vertical)
- ■ Other Pump Exhaust
- ■ 480V 3p Required

- ☐ Hot Water
- ☐ Cold Water
- ☐ RODI
- ☐ Eyewash (Tempered Water)
- ☐ Safety Shower (Tempered Water)
- ☐ Other _____
- ■ Data (Fiber)
- ■ Data (Copper)

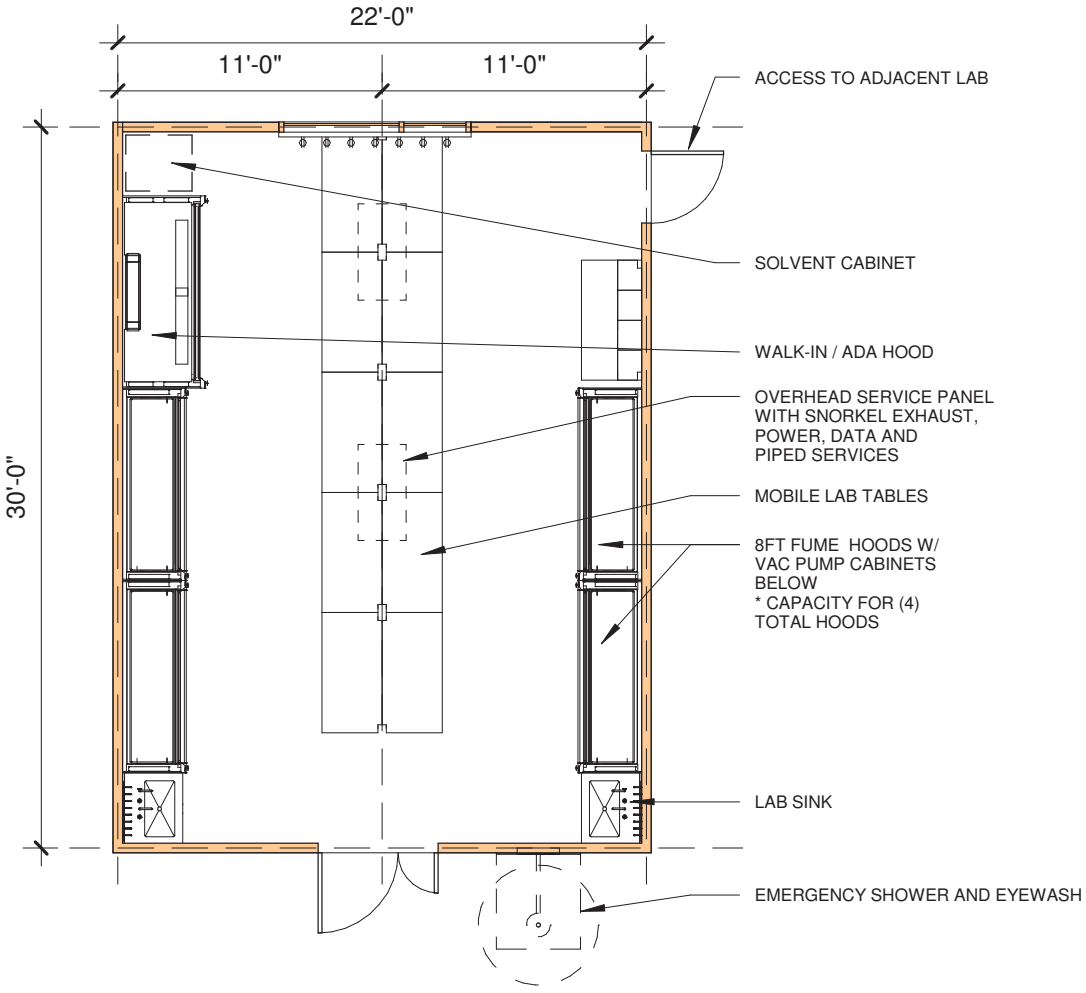
- ☐ Fume Hood
- ☐ Snorkel Exhaust
- ☐ Biological Safety Cabinet
- ☐ HEPA Filter
- ☐ ULPA Filter
- ■ Process Chilled Water
  75% Percent of Power Demand
- ■ 12V DC LED Lighting
- ☐ Standard LED Lighting

v. INORGANIC, SOFT, MACROMOLECULAR MATERIALS

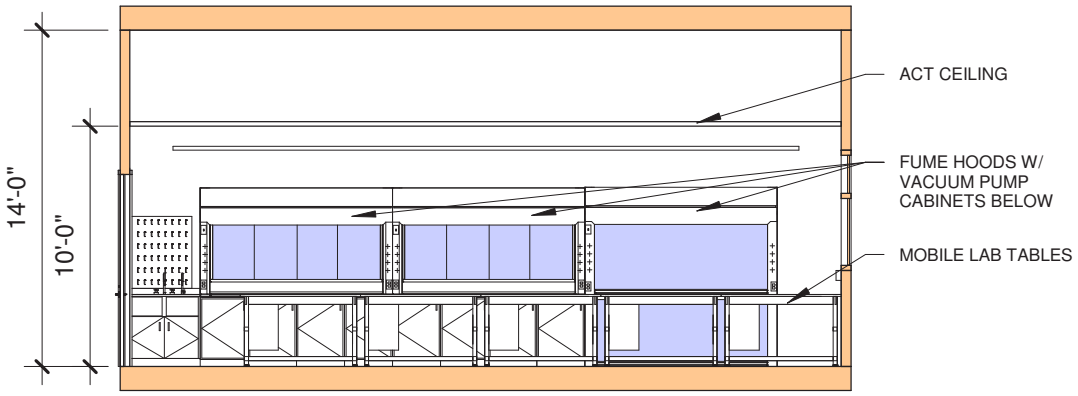


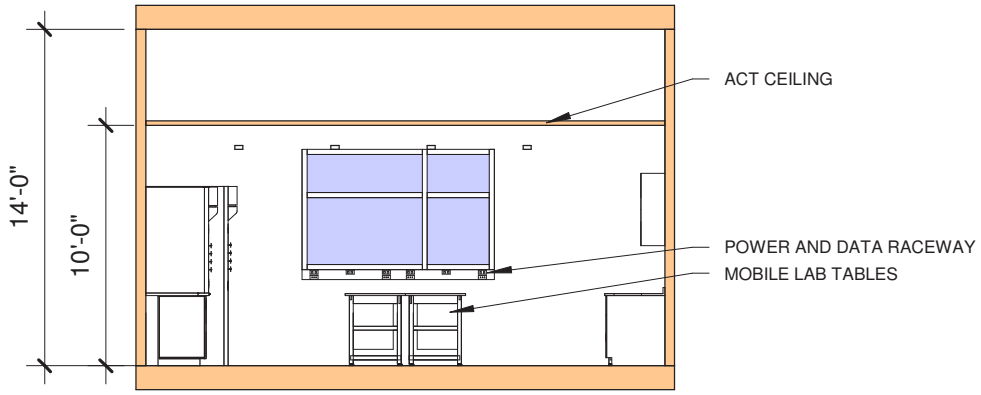
WET SYNTHESIS LAB

The wet synthesis lab supports work on synthesis of macromolecular and bimolecular materials and on processing soft materials to study their self-assembly, intermolecular and interfacial interactions, and electronic properties. These experiments require fume hoods for safe synthesis of materials and storage space for solvents, chemical reagents, and chemical waste. Vacuum pumps and gas cylinders are required for synthetic reactions, solvent purification systems, and other small equipment. In some variations of the lab design, a controlled atmosphere glove box will be included also requiring gases and vacuum equipment. Bench space is required for preparatory work on samples, solvent purification systems, and documentation of research by lab workers. Snorkel-type exhaust is provided for table-top equipment requiring local exhaust. Cabinet space is required for storage of reagents and basic scientific apparatus and glassware. A door to an adjacent characterization laboratory allows access for analysis of materials synthesized in the laboratory.



WET SYNTHESIS LAB - (2) BAYS - 660 ASF



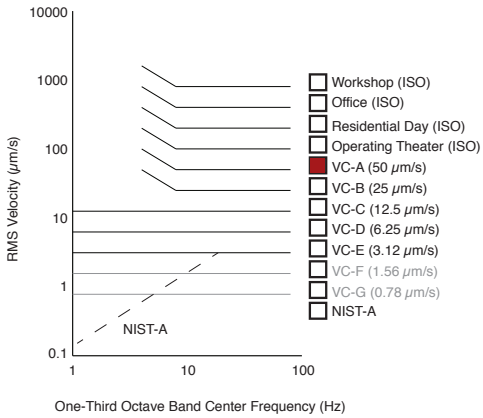


WET SYNTHESIS LAB - SECTIONS

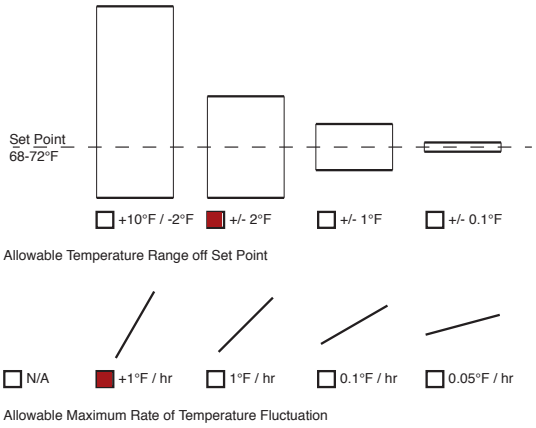
Laboratory Performance Criteria

Laboratory Type: Wet Synthesis Lab
Laboratory Function: Soft Materials, Inorganic Materials, Biomolecular & Macromolecular
Description of Activities: Wet Synthesis

Vibration Control



Temperature Control



Acoustic Control

- ☐ NC-15 TEM / Recording
- ☐ NC-20 SEM
- ☐ NC-25 Dil Fridge
- ☐ NC-30 High Perf Lab
- ☐ NC-35 Conference
- ☐ NC-40 Private Office
- ☐ NC-45 Open Office
- ■ NC-50 Laboratory
- ☐ No Requirement

Air Quality

- ☐ ISO 3 1
- ☐ ISO 4 10
- ☐ ISO 5 100
- ☐ ISO 6 1,000
- ☐ ISO 7 10,000
- ☐ ISO 8 100,000
- ■ No Classification
- ☐ Laminar Flow
- ☐ Moveable T-stat

Humidity Control

- ■ 30%-50% RH
- ☐ 30%-50% RH Settable
- ☐ No Humidification

- ☐ Return Air Allowed
- ☐ Local FCU (Remote)
- ☐ Positive Pressure
- ■ Negative Pressure
- ☐ +/- 2% RH

Power Density

- ☐ 5 W/sf (2W/sf demand)
- ☐ 10 W/sf (5W/sf demand)
- ☐ 20 W/sf (10W/sf demand)
- ■ 30 W/sf (15W/sf demand)
- ☐ 50 W/sf (25W/sf demand)
- ☐ 80 W/sf (40 W/sf demand)
- ☐ 100 W/sf (50W/sf demand)
- ■ Pump Power
- ■ Instrument Power
- ☐ Clean Ground
- ■ Emergency Power

Electromagnetic Interference (EMI) Control

- ■ 100 nT RMS (300 nTp-p): General High Performance Lab
- ☐ 35 nT RMS (100 nTp-p): Dilution Refrigerator Lab
- ☐ 18 nT RMS (50 nTp-p): E Beam / FIB
- ☐ 11 nT RMS (30 nTp-p): SEM / TEM
- ☐ 4 nT RMS (10nTp-p): FEI Titan / JEOL 2100F

Architectural

- ☐ ESD Flooring
- ☐ Seamless Flooring
- ☐ Cryo Safe Flooring
- ■ Chemical Resistant Flooring
- ☐ Wall Mounts
- ☐ Ceiling Mounts
- ■ Double Door
- ■ Windows Allowed

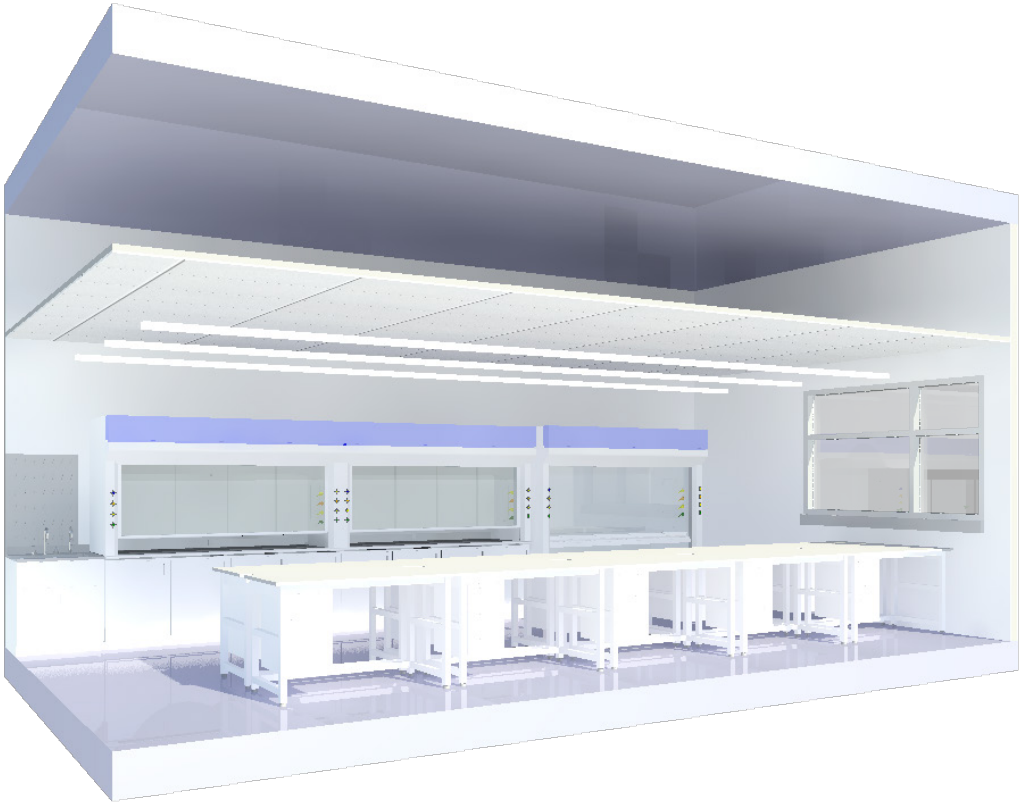
Infrastructure

- ■ Clean Dry Air
- ■ House Vacuum
- ■ House Nitrogen (gas)
- ☐ House Helium (gas)
- ■ Cylinder Gas Manifolds Qty 6
- ☐ Helium Recovery (Vertical)
- ☐ Other _____
- ☐ 480V 3p Required

- ■ Hot Water
- ■ Cold Water
- ■ RODI
- ■ Eyewash (Tempered Water)
- ■ Safety Shower (Tempered Water)
- ☐ Other _____
- ☐ Data (Fiber)
- ■ Data (Copper)

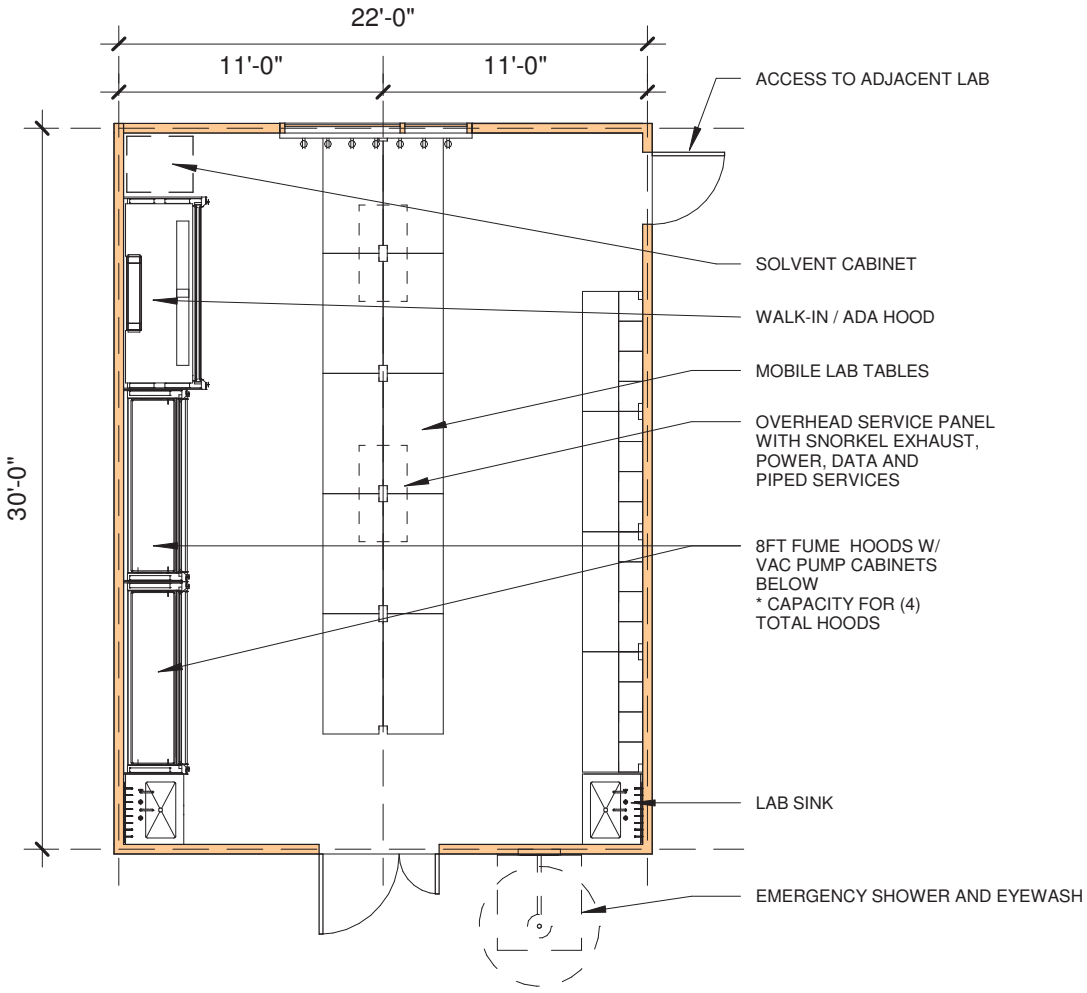
*floor drain

- ■ Fume Hood*(4) 8ft hoods + (1) walk-in
- ■ Snorkel Exhaust
- ☐ Biological Safety Cabinet
- ☐ HEPA Filter
- ☐ ULPA Filter
- ☐ Process Chilled Water
  ____Percent of Power Demand
- ☐ 12V DC LED Lighting
- ■ Standard LED Lighting

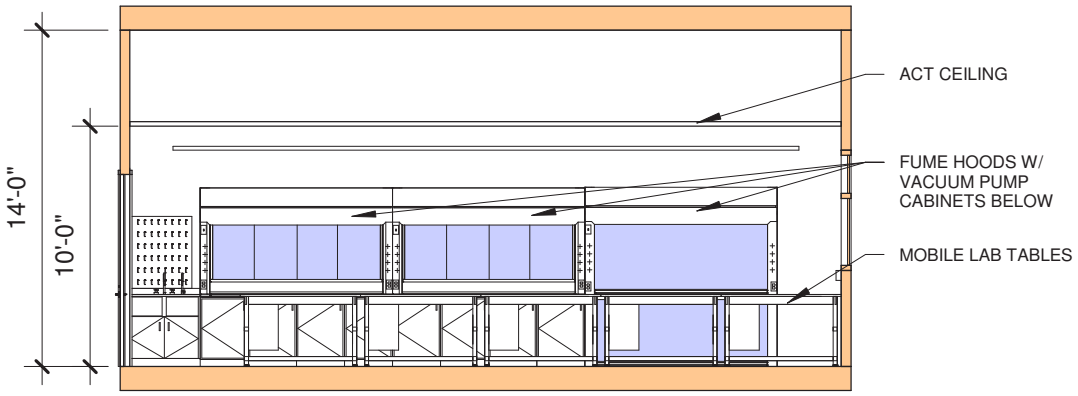


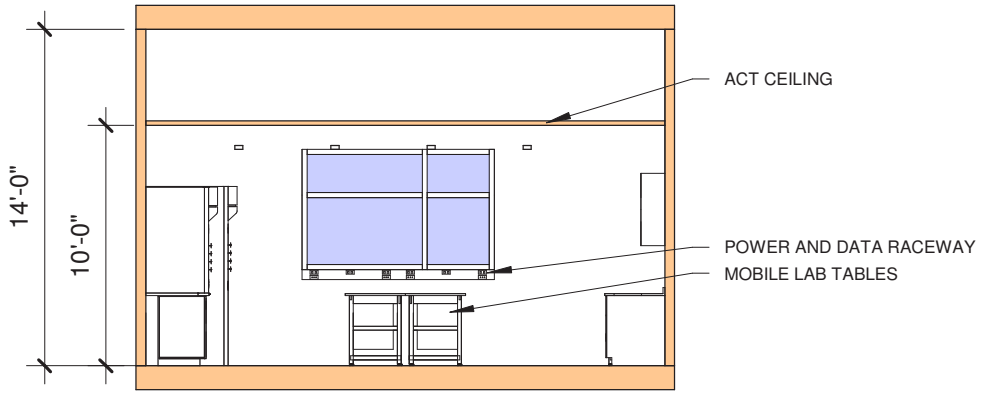
HIGH TEMPERATURE SYNTHESIS LAB

Synthesis of novel inorganic materials often requires high temperature reactions spanning from solid state reactions to melt-driven crystal growth. The development of frontier materials spanning from complex oxides to functional intermetallics requires the reaction of a variety of chemical precursors in controlled gas environments, and this is accomplished inside an array of tailored furnaces. These furnaces are driven via resistive heating elements which draw a high power load, and chemical volatility during the reaction requires substantial exhaust infrastructure. As a result, an expansive exhaust infrastructure and high power density is required for this laboratory.



HIGH TEMPERATURE SYNTHESIS LAB - (2) BAYS - 660 ASF



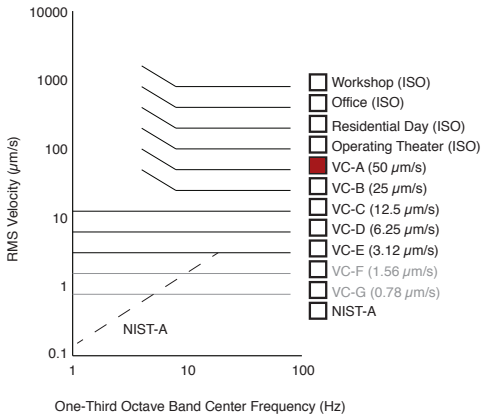


HIGH TEMPERATURE SYNTHESIS LAB - SECTIONS

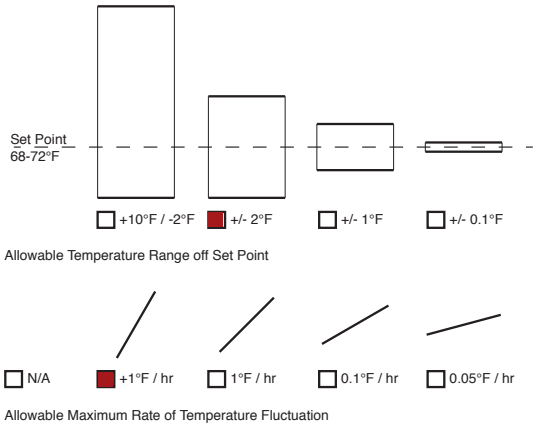
Laboratory Performance Criteria

Laboratory Type: High Temperature Synthesis Lab
Laboratory Function: Soft Materials, Inorganic Materials, Biomolecular & Macromolecular
Description of Activities: High-Temperature Solid State Synthesis

Vibration Control



Temperature Control



Acoustic Control

- ☐ NC-15 TEM / Recording
- ☐ NC-20 SEM
- ☐ NC-25 Dil Fridge
- ☐ NC-30 High Perf Lab
- ☐ NC-35 Conference
- ☐ NC-40 Private Office
- ☐ NC-45 Open Office
- ■ NC-50 Laboratory
- ☐ No Requirement

Air Quality

- ☐ ISO 3 1
- ☐ ISO 4 10
- ☐ ISO 5 100
- ☐ ISO 6 1,000
- ☐ ISO 7 10,000
- ☐ ISO 8 100,000
- ■ No Classification
- ☐ Laminar Flow
- ☐ Moveable T-stat

Humidity Control

- ■ 30%-50% RH
- ☐ 30%-50% RH Settable
- ☐ No Humidification

- ☐ Return Air Allowed
- ☐ Local FCU (Remote)
- ☐ Positive Pressure
- ■ Negative Pressure
- ☐ +/- 2% RH

Power Density

- ☐ 5 W/sf (2W/sf demand)
- ☐ 10 W/sf (5W/sf demand)
- ☐ 20 W/sf (10W/sf demand)
- ■ 30 W/sf (15W/sf demand)
- ☐ 50 W/sf (25W/sf demand)
- ☐ 80 W/sf (40 W/sf demand)
- ☐ 100 W/sf (50W/sf demand) *300W/sf furnaces
- ■ Pump Power
- ■ Instrument Power
- ☐ Clean Ground
- ■ Emergency Power

Electromagnetic Interference (EMI) Control

- ■ 100 nT RMS (300 nTp-p): General High Performance Lab
- ☐ 35 nT RMS (100 nTp-p): Dilution Refrigerator Lab
- ☐ 18 nT RMS (50 nTp-p): E Beam / FIB
- ☐ 11 nT RMS (30 nTp-p): SEM / TEM
- ☐ 4 nT RMS (10nTp-p): FEI Titan / JEOL 2100F

Architectural

- ☐ ESD Flooring
- ☐ Seamless Flooring
- ☐ Cryo Safe Flooring
- ■ Chemical Resistant Flooring
- ☐ Wall Mounts
- ☐ Ceiling Mounts
- ■ Double Door
- ■ Windows Allowed

Infrastructure

- ■ Clean Dry Air
- ■ House Vacuum
- ■ House Nitrogen (gas)
- ☐ House Helium (gas)
- ■ Cylinder Gas Manifolds Qty 6
- ☐ Helium Recovery (Vertical)
- ☐ Other _____
- ☐ 480V 3p Required

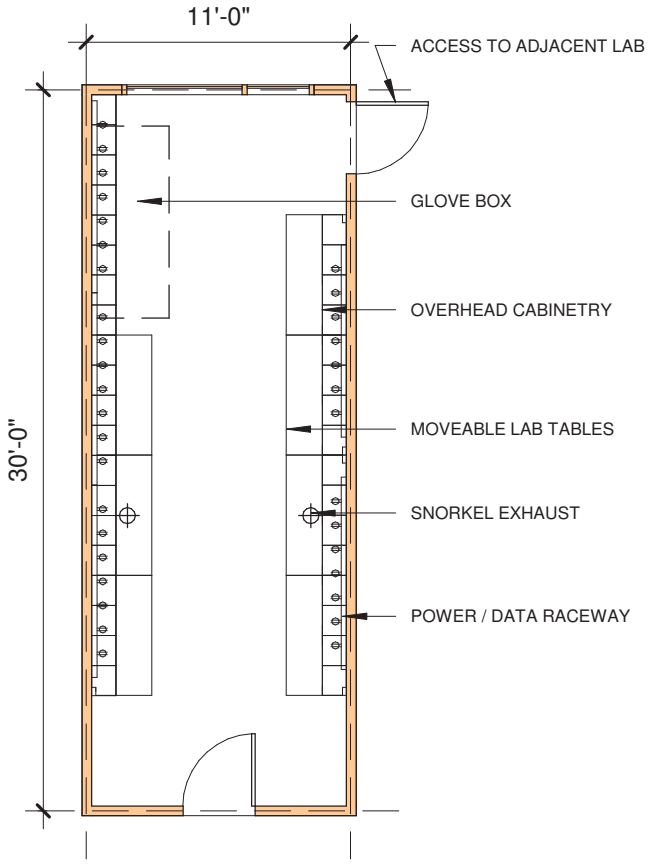
- ■ Hot Water
- ■ Cold Water
- ■ RODI
- ■ Eyewash (Tempered Water)
- ■ Safety Shower (Tempered Water)
- ☐ Other _____
- ☐ Data (Fiber)
- ■ Data (Copper)

*floor drain

- ■ Fume Hood*(4) 8ft hoods + (1) walk-in
- ■ Snorkel Exhaust
- ☐ Biological Safety Cabinet
- ☐ HEPA Filter
- ☐ ULPA Filter
- ☐ Process Chilled Water
  ____Percent of Power Demand
- ☐ 12V DC LED Lighting
- ■ Standard LED Lighting

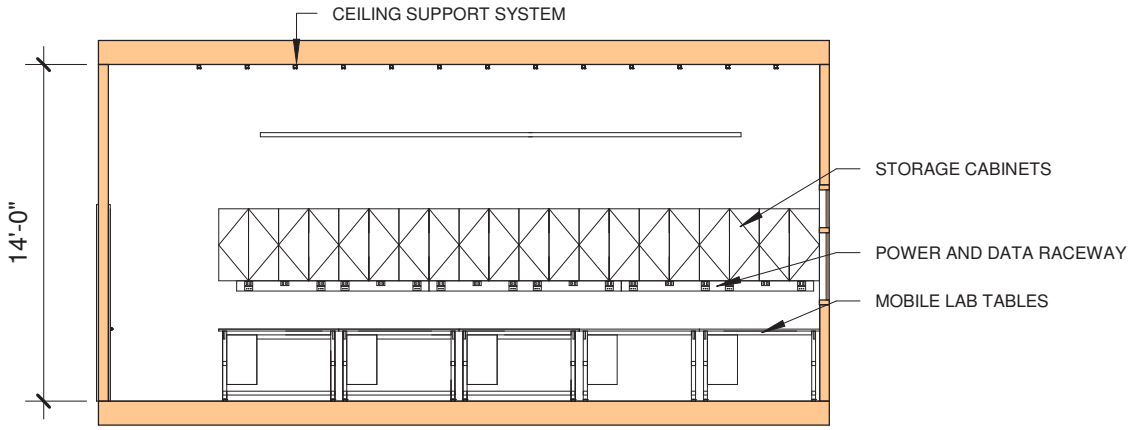
CHARACTERIZATION LAB

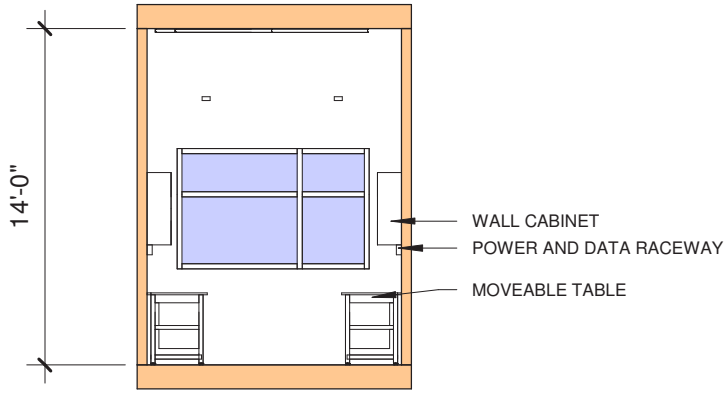
The detailed characterization of materials mandates a broad complement of techniques probing both their structural and electronic properties. Measurements spanning from detailed electrical transport, electrochemical properties, optical and infrared spectroscopy, and various thermodynamics properties require a versatile lab capable of supporting high precision instrumentation. As a result, this lab requires modest exhaust relative to the synthesis laboratories to support glovebox-based device preparation as well as the infrastructure required to power optical spectrometers and associated light sources, atomic force microscopes, He-gas closed cycle refrigerators, and high precision current and voltage sources.



CHARACTERIZATION LAB - ONE BAY - 330 ASF

CHARACTERIZATION LAB - (1) BAY - 330 ASF



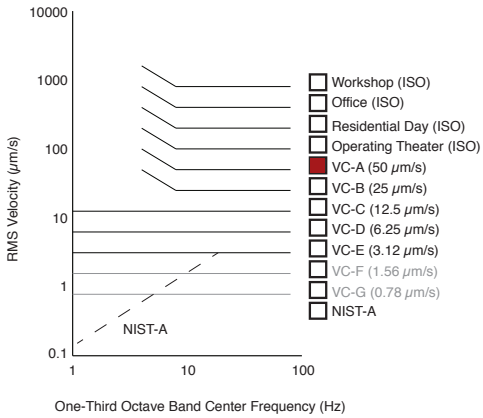


CHARACTERIZATION LAB - SECTIONS

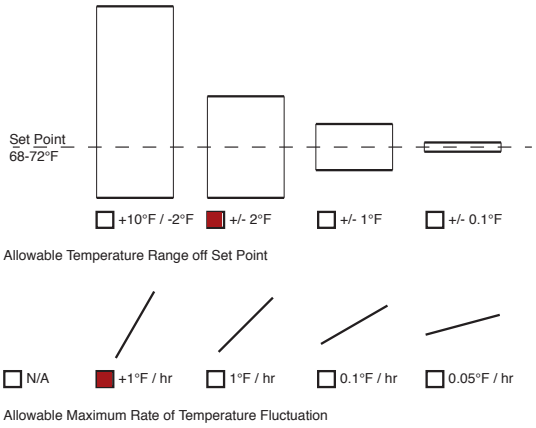
Laboratory Performance Criteria

Laboratory Type: Characterization Lab
Laboratory Function: Soft Materials, Inorganic Materials, Biomolecular & Macromolecular
Description of Activities: Low Temperature Characterization, Optical Spectrometry, Thermographic Analysis

Vibration Control



Temperature Control



Acoustic Control

- ☐ NC-15 TEM / Recording
- ☐ NC-20 SEM
- ☐ NC-25 Dil Fridge
- ☐ NC-30 High Perf Lab
- ■ NC-35 Conference
- ☐ NC-40 Private Office
- ☐ NC-45 Open Office
- ☐ NC-50 Laboratory
- ☐ No Requirement

Air Quality

- ☐ ISO 3 1
- ☐ ISO 4 10
- ☐ ISO 5 100
- ☐ ISO 6 1,000
- ☐ ISO 7 10,000
- ☐ ISO 8 100,000
- ■ No Classification
- ☐ Laminar Flow
- ☐ Moveable T-stat

Humidity Control

- ■ 30%-50% RH
- ☐ 30%-50% RH Settable
- ☐ No Humidification

- ☐ Return Air Allowed
- ☐ Local FCU (Remote)
- ■ Positive Pressure
- ☐ Negative Pressure
- ☐ +/- 2% RH

Power Density

- ☐ 5 W/sf (2W/sf demand)
- ☐ 10 W/sf (5W/sf demand)
- ☐ 20 W/sf (10W/sf demand)
- ☐ 30 W/sf (15W/sf demand)
- ■ 50 W/sf (25W/sf demand)
- ☐ 80 W/sf (40 W/sf demand)
- ☐ 100 W/sf (50W/sf demand)
- ■ Pump Power
- ■ Instrument Power
- ☐ Clean Ground
- ☐ Emergency Power

Electromagnetic Interference (EMI) Control

- ■ 100 nT RMS (300 nTp-p): General High Performance Lab
- ☐ 35 nT RMS (100 nTp-p): Dilution Refrigerator Lab
- ☐ 18 nT RMS (50 nTp-p): E Beam / FIB
- ☐ 11 nT RMS (30 nTp-p): SEM / TEM
- ☐ 4 nT RMS (10nTp-p): FEI Titan / JEOL 2100F

Architectural

- ■ ESD Flooring
- ☐ Seamless Flooring
- ☐ Cryo Safe Flooring
- ☐ Chemical Resistant Flooring
- ☐ Wall Mounts
- ■ Ceiling Mounts
- ☐ Double Door
- ■ Windows Allowed

Infrastructure

- ■ Clean Dry Air
- ■ House Vacuum
- ■ House Nitrogen (gas)
- ☐ House Helium (gas)
- ■ Cylinder Gas Manifolds Qty___
- ☐ Helium Recovery (Vertical)
- ☐ Other _____
- ☐ 480V 3p Required

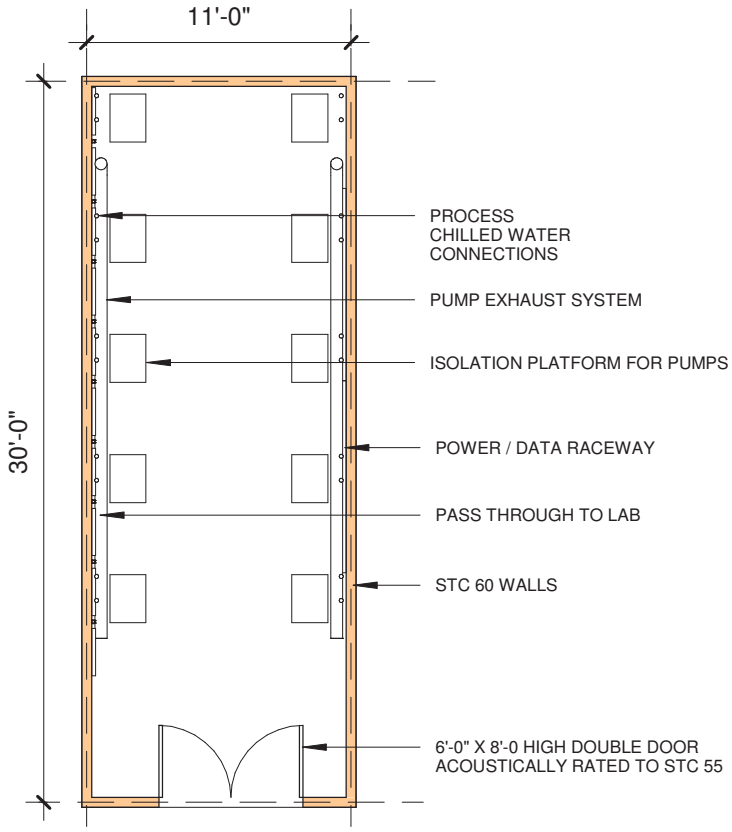
*water line, milliQ, cup sink

- ☐ Hot Water
- ■ Cold Water
- ■ RODI
- ☐ Eyewash (Tempered Water)
- ☐ Safety Shower (Tempered Water)
- ☐ Other _____
- ☐ Data (Fiber)
- ■ Data (Copper)

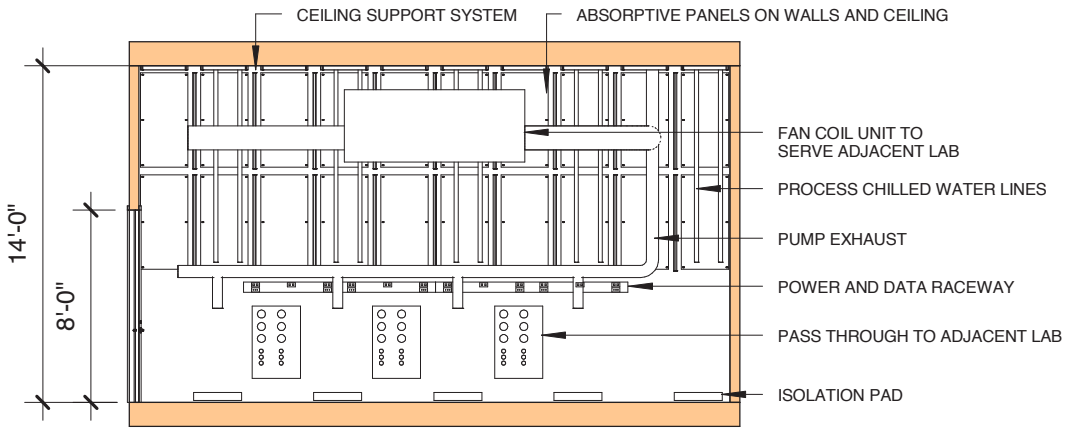
- ☐ Fume Hood
- ■ Snorkel Exhaust
- ☐ Biological Safety Cabinet
- ☐ HEPA Filter
- ☐ ULPA Filter
- ☐ Process Chilled Water
  ____Percent of Power Demand
- ☐ 12V DC LED Lighting
- ■ Standard LED Lighting

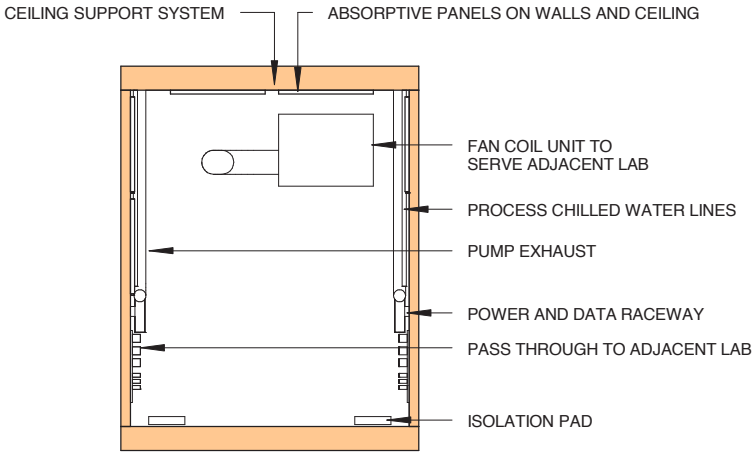
PUMP CLOSET

The pump closet supports many types of labs by providing segregated space for placement of noisy peripheral equipment.



PUMP CLOSET - (1) BAY - 330 ASF



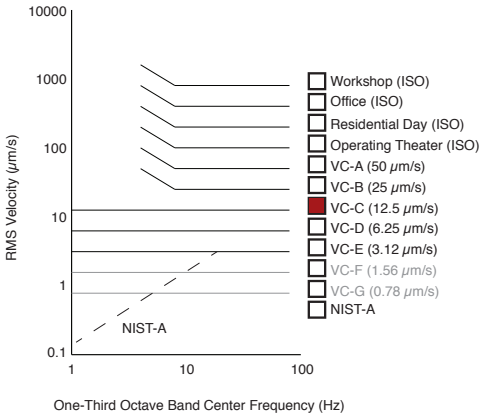


PUMP CLOSET - SECTIONS

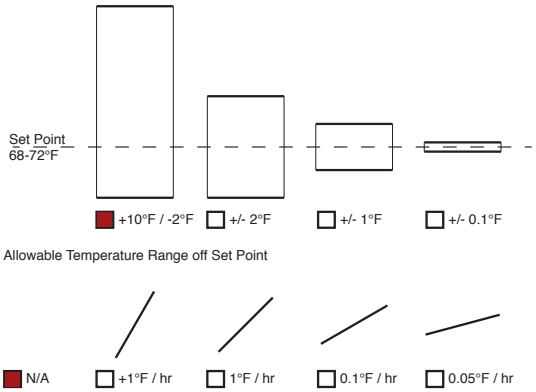
Laboratory Performance Criteria

Laboratory Type: Pump Closet
Laboratory Function: Support Room
Description of Activities: Vibration and acoustically isolated room for pumps and chillers and local FCU

Vibration Control



Temperature Control



Acoustic Control

- ☐ NC-15 TEM / Recording
- ☐ NC-20 SEM
- ☐ NC-25 Dil Fridge
- ☐ NC-30 High Perf Lab
- ☐ NC-35 Conference
- ☐ NC-40 Private Office
- ☐ NC-45 Open Office
- ■ NC-50 Laboratory
- ☐ No Requirement

Air Quality

- ☐ ISO 3 1
- ☐ ISO 4 10
- ☐ ISO 5 100
- ☐ ISO 6 1,000
- ☐ ISO 7 10,000
- ☐ ISO 8 100,000
- ■ No Classification
- ☐ Laminar Flow
- ☐ Moveable T-stat
- ■ Pump Exhaust

Humidity Control

- ☐ 30%-50% RH
- ☐ 30%-50% RH Settable
- ■ No Humidification

- ■ Return Air Allowed
- ■ Local FCU (Remote)
- ☐ Positive Pressure
- ■ Negative Pressure
- ☐ +/- 2% RH

Power Density

- ☐ 5 W/sf (2W/sf demand)
- ☐ 10 W/sf (5W/sf demand)
- ☐ 20 W/sf (10W/sf demand)
- ☐ 30 W/sf (15W/sf demand)
- ☐ 50 W/sf (25W/sf demand)
- ☐ 80 W/sf (40 W/sf demand)
- ■ 100 W/sf (50W/sf demand)
- ■ Pump Power
- ☐ Instrument Power
- ☐ Clean Ground
- ■ Emergency Power

Electromagnetic Interference (EMI) Control

- ■ 100 nT RMS (300 nTp-p): General High Performance Lab
- ☐ 35 nT RMS (100 nTp-p): Dilution Refrigerator Lab
- ☐ 18 nT RMS (50 nTp-p): E Beam / FIB
- ☐ 11 nT RMS (30 nTp-p): SEM / TEM
- ☐ 4 nT RMS (10nTp-p): FEI Titan / JEOL 2100F

Architectural

- ☐ ESD Flooring
- ☐ Seamless Flooring
- ☐ Cryo Safe Flooring
- ☐ Chemical Resistant Flooring
- ■ Wall Mounts
- ■ Ceiling Mounts
- ■ Double Door
- ■ Windows Allowed

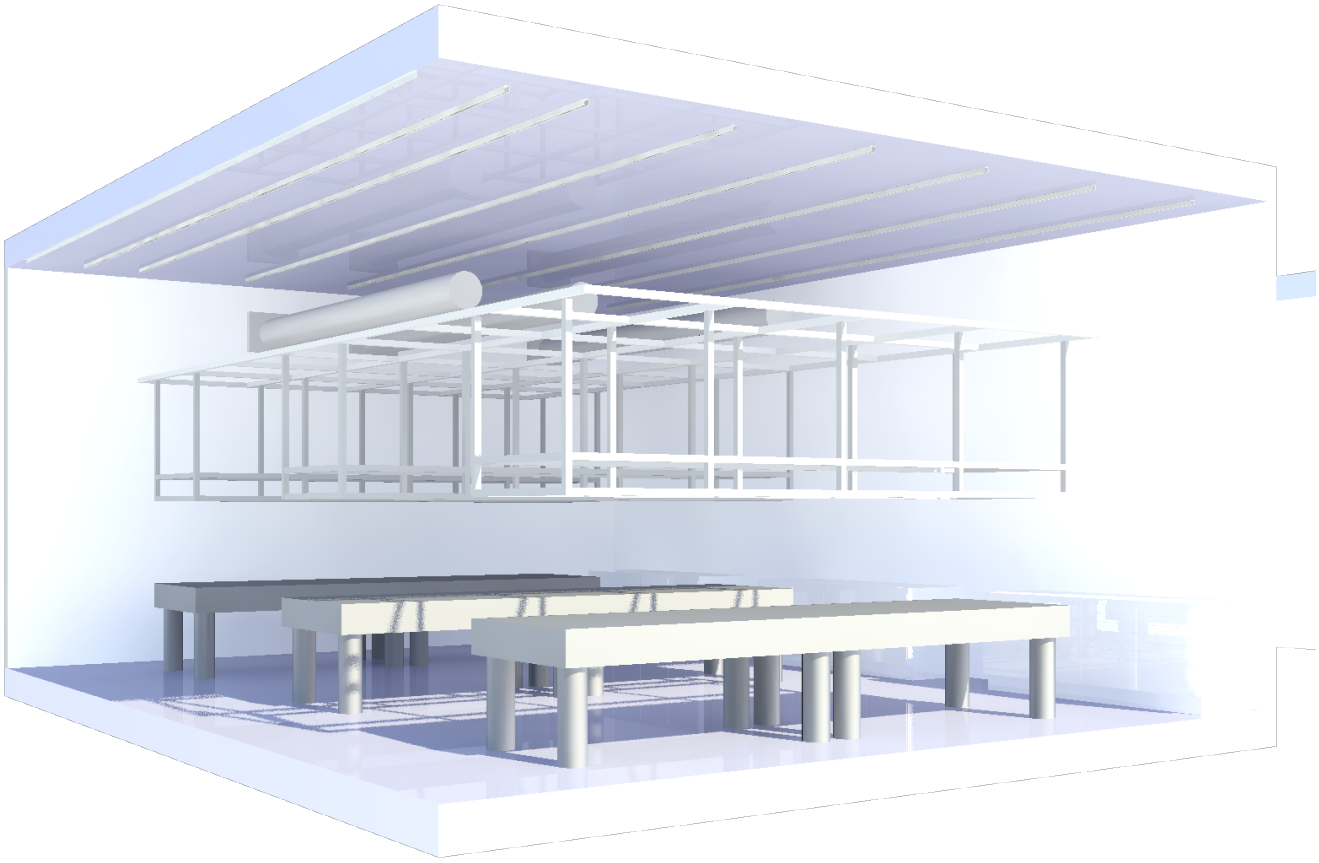
Infrastructure

- ■ Clean Dry Air
- ☐ House Vacuum
- ■ House Nitrogen (gas)
- ☐ House Helium (gas)
- ■ Cylinder Gas Manifolds Qty 2
- ■ Helium Recovery (Vertical)
- ■ Other Pump Exhaust
- ■ 480V 3p Required

- ☐ Hot Water
- ☐ Cold Water
- ☐ RODI
- ☐ Eyewash (Tempered Water)
- ☐ Safety Shower (Tempered Water)
- ☐ Other _____
- ■ Data (Fiber)
- ■ Data (Copper)

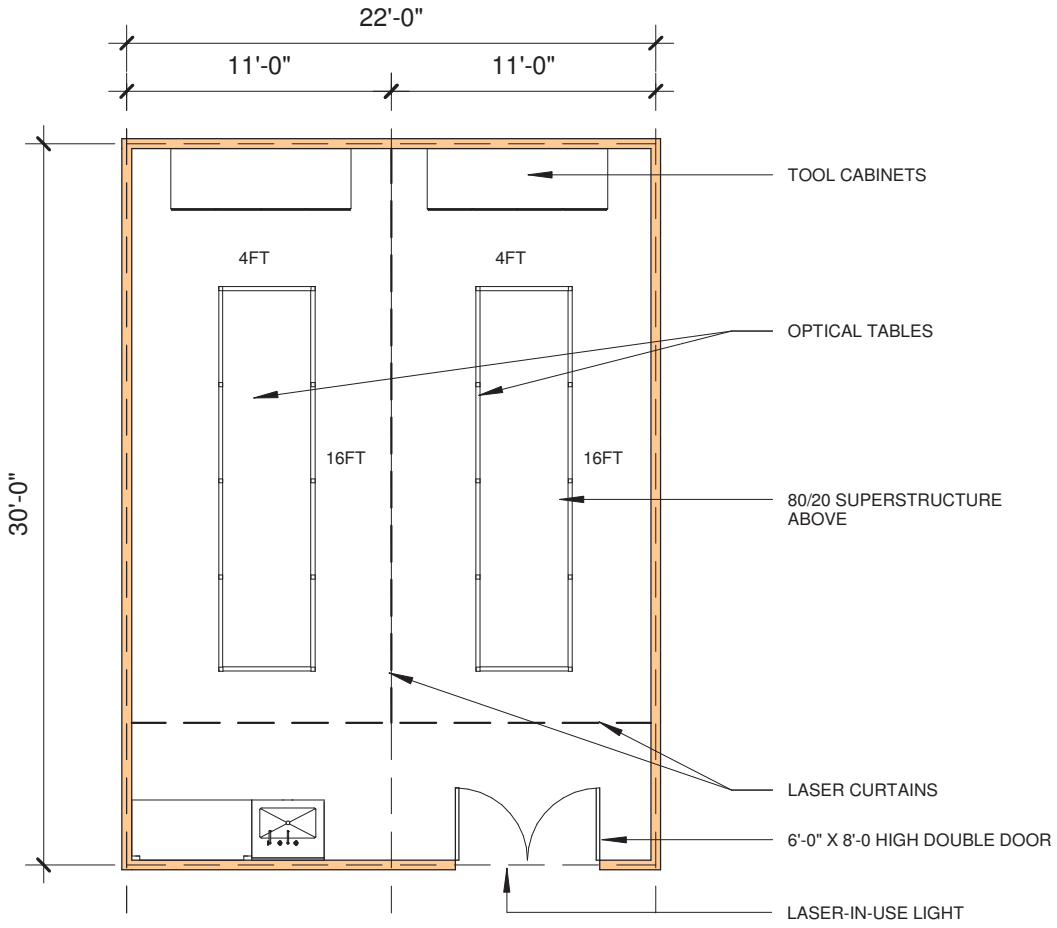
- ☐ Fume Hood
- ☐ Snorkel Exhaust
- ☐ Biological Safety Cabinet
- ☐ HEPA Filter
- ☐ ULPA Filter
- ■ Process Chilled Water
  75% Percent of Power Demand
- ■ 12V DC LED Lighting
- ☐ Standard LED Lighting

vi. ELECTRONICS & PHOTONICS (ECE)

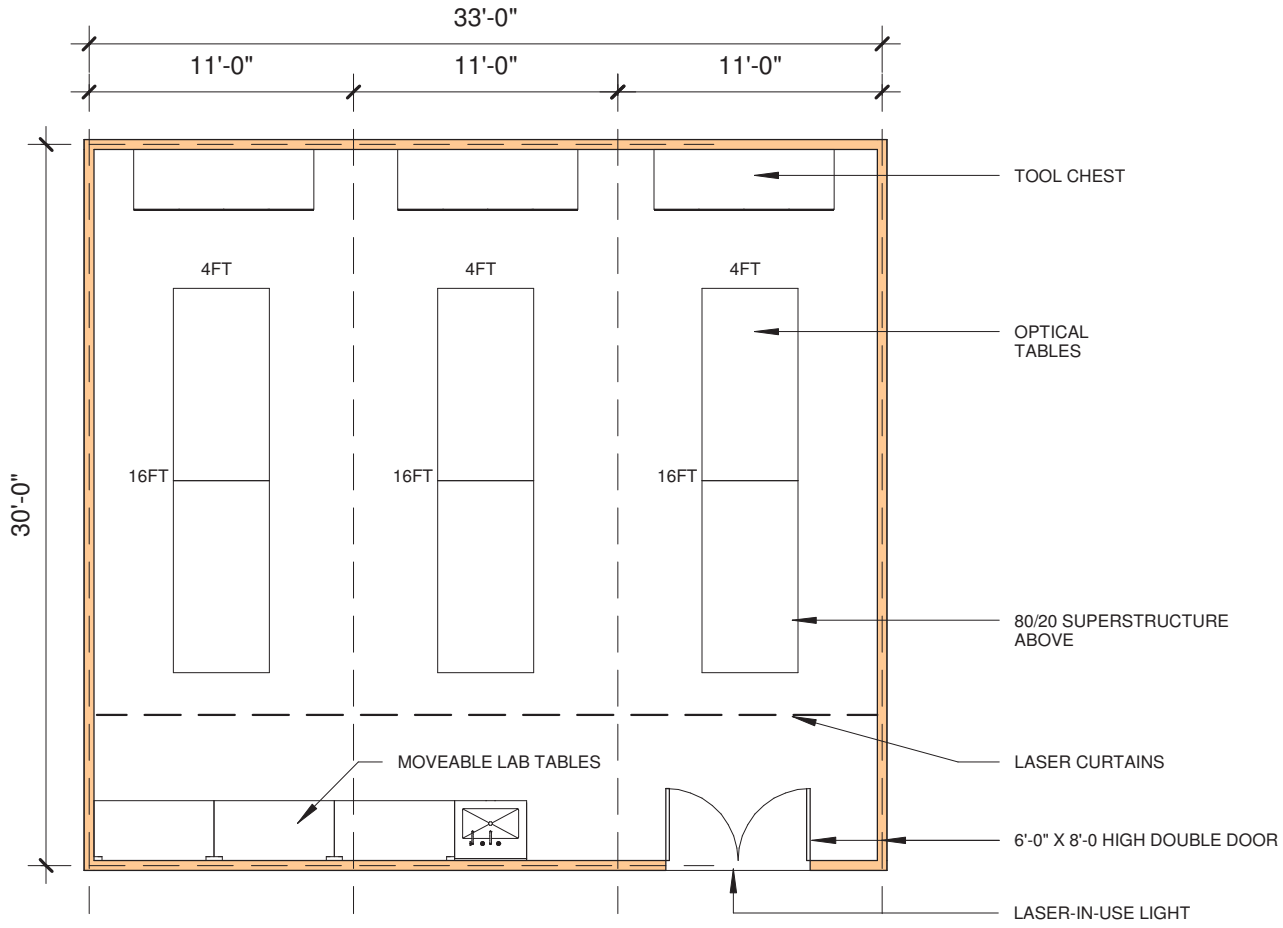


LASER LAB (ECE)

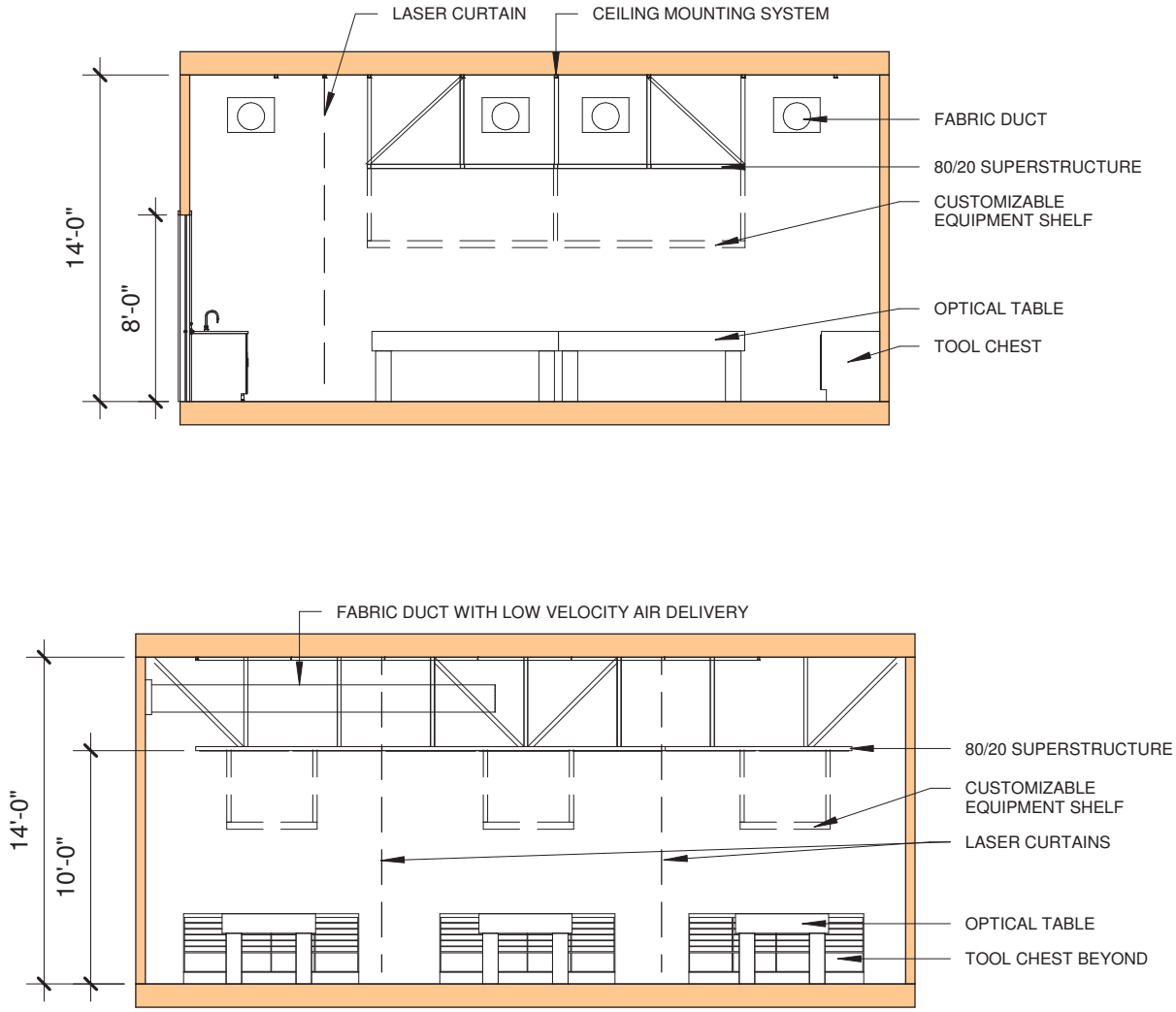
The ECE Laser Lab supports multi-disciplinary research activities in a broad range of Electronics and Photonics, Nanophotonics, Integrated Circuits and Infrared Spectroscopy. The Laser Lab is intended to support electronic and photonic device assembly and characterization, electronic and photonic integrated circuit test and measurement, and electronic and photonic packaging facilities. A typical laboratory would utilize floating optical tables and work benches, along with overhead shelving to house probe stations, fiber optic components, and high-speed test equipment for performing measurements and could be repartitioned to support dark room measurements.



LASER LAB (ECE) - (2) BAYS - 660 ASF



LASER LAB (ECE) - (3) BAYS - 990 ASF

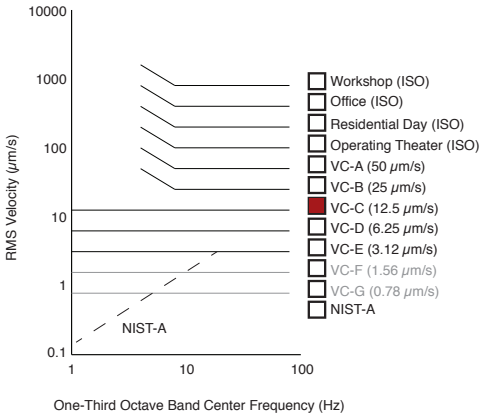


LASER LAB (ECE) - SECTIONS

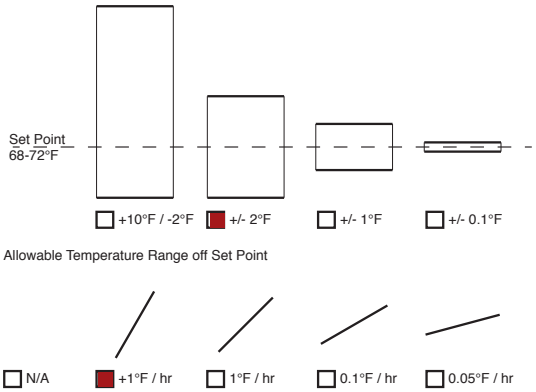
Laboratory Performance Criteria

Laboratory Type: Laser Lab (ECE)
Laboratory Function: Advanced Laser Optics
Description of Activities: Electronics & Photonics, Nanophotonics, Integrated Circuits, IR Spectrosopy

Vibration Control



Temperature Control



Acoustic Control

- ☐ NC-15 TEM / Recording
- ☐ NC-20 SEM
- ☐ NC-25 Dil Fridge
- ■ NC-30 High Perf Lab
- ☐ NC-35 Conference
- ☐ NC-40 Private Office
- ☐ NC-45 Open Office
- ☐ NC-50 Laboratory
- ☐ No Requirement

Air Quality

- ☐ ISO 3 1
- ☐ ISO 4 10
- ☐ ISO 5 100
- ☐ ISO 6 1,000
- ☐ ISO 7 10,000
- ☐ ISO 8 100,000
- ■ No Classification
- ☐ Laminar Flow
- ■ Moveable T-stat

*Low Velocity, Fabric Duct

Humidity Control

- ■ 30%-50% RH
- ☐ 30%-50% RH Settable
- ☐ No Humidification

- ■ Return Air Allowed
- ■ Local FCU (Remote)
- ■ Positive Pressure
- ☐ Negative Pressure
- ☐ +/- 2% RH

Power Density

- ☐ 5 W/sf (2W/sf demand)
- ☐ 10 W/sf (5W/sf demand)
- ☐ 20 W/sf (10W/sf demand)
- ☐ 30 W/sf (15W/sf demand)
- ☐ 50 W/sf (25W/sf demand)
- ■ 80 W/sf (40 W/sf demand)
- ☐ 100 W/sf (50W/sf demand)
- ■ Pump Power
- ■ Instrument Power
- ■ Clean Ground
- ■ Emergency Power *UPS

Electromagnetic Interference (EMI) Control

- ☐ 100 nT RMS (300 nTp-p): General High Performance Lab
- ☐ 35 nT RMS (100 nTp-p): Dilution Refrigerator Lab
- ■ 18 nT RMS (50 nTp-p): E Beam / FIB
- ☐ 11 nT RMS (30 nTp-p): SEM / TEM
- ☐ 4 nT RMS (10nTp-p): FEI Titan / JEOL 2100F

Architectural

- ☐ ESD Flooring *Concrete Flooring
- ☐ Seamless Flooring
- ☐ Cryo Safe Flooring
- ☐ Chemical Resistant Flooring
- ■ Wall Mounts
- ■ Ceiling Mounts
- ■ Double Door
- ■ Windows Allowed *Blackout Shades

Infrastructure

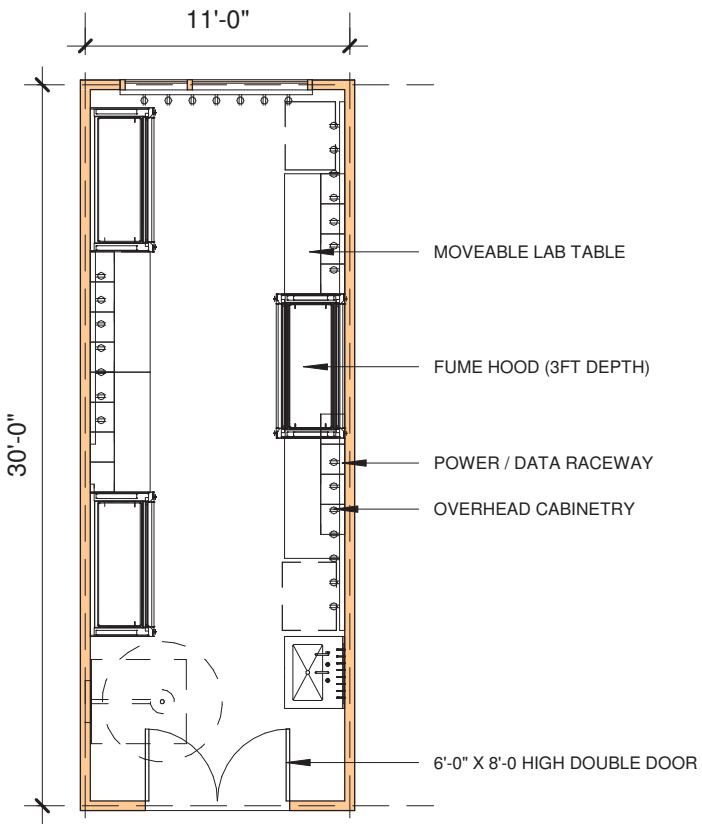
- ■ Clean Dry Air
- ■ House Vacuum
- ■ House Nitrogen (gas)
- ☐ House Helium (gas)
- ■ Cylinder Gas Manifolds Qty 2
- ☐ Helium Recovery (Vertical)
- ☐ Other _____
- ☐ 480V 3p Required

- ■ Hot Water
- ■ Cold Water
- ☐ RODI
- ■ Eyewash (Tempered Water)
- ■ Safety Shower (Tempered Water)
- ■ Other Laser in use light
- ■ Data (Fiber)
- ■ Data (Copper)

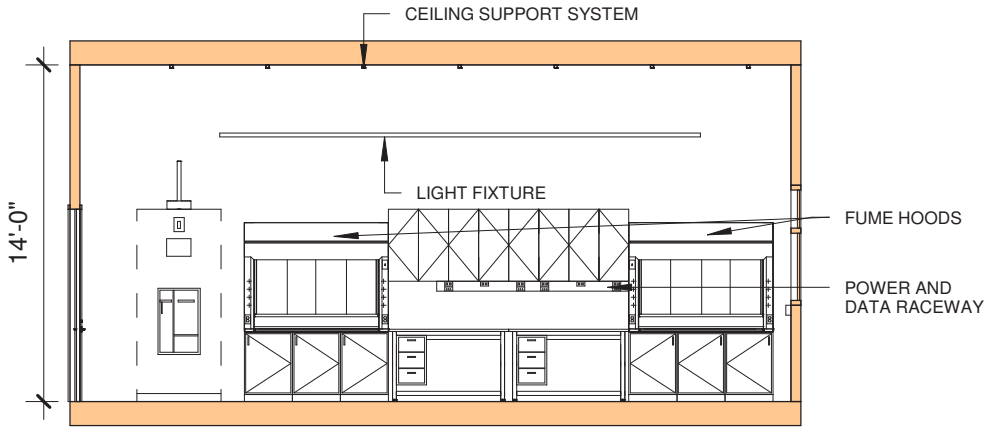
- ☐ Fume Hood
- ■ Snorkel Exhaust
- ☐ Biological Safety Cabinet
- ■ HEPA Filter
- ■ ULPA Filter
- ■ Process Chilled Water
  25% Percent of Power Demand
- ☐ 12V DC LED Lighting
- ■ Standard LED Lighting

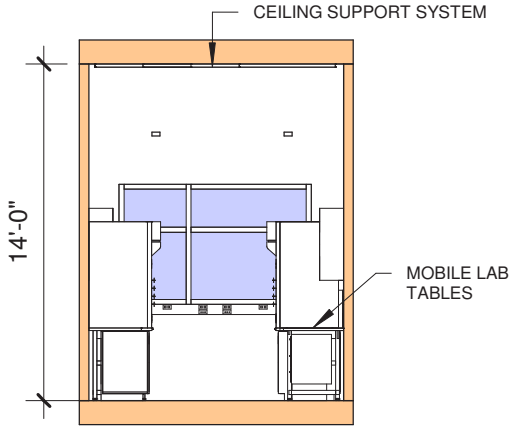
GENERAL LAB (ECE)

The ECE General Lab is shared by multiple research groups for sample preparation, polishing, parts cleaning and other functions. Dedicated chemical fume hoods are provided for each group, with 3 foot depth to accommodate polishing equipment.



GENERAL LAB (ECE) - (1) BAY - 330 ASF



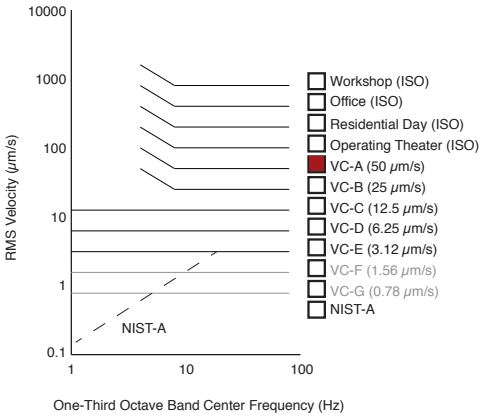


GENERAL LAB (ECE) - SECTIONS

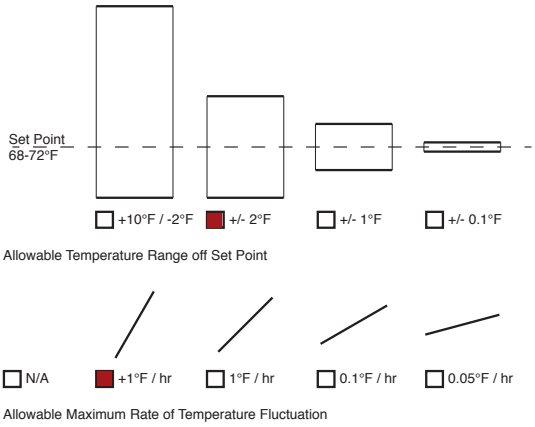
Laboratory Performance Criteria

Laboratory Type: General Lab (ECE)
Laboratory Function: Support Lab
Description of Activities: Sample Prep, Polishing, Parts Cleaning

Vibration Control



Temperature Control



Acoustic Control

- ☐ NC-15 TEM / Recording
- ☐ NC-20 SEM
- ☐ NC-25 Dil Fridge
- ☐ NC-30 High Perf Lab
- ☐ NC-35 Conference
- ☐ NC-40 Private Office
- ☐ NC-45 Open Office
- ■ NC-50 Laboratory
- ☐ No Requirement

Air Quality

- ☐ ISO 3 1
- ☐ ISO 4 10
- ☐ ISO 5 100
- ☐ ISO 6 1,000
- ☐ ISO 7 10,000
- ☐ ISO 8 100,000
- ■ No Classification
- ☐ Laminar Flow
- ☐ Moveable T-stat

Humidity Control

- ☐ 30%-50% RH
- ☐ 30%-50% RH Settable
- ■ No Humidification

- ☐ Return Air Allowed
- ☐ Local FCU (Remote)
- ☐ Positive Pressure
- ■ Negative Pressure
- ☐ +/- 2% RH

Power Density

- ☐ 5 W/sf (2W/sf demand)
- ☐ 10 W/sf (5W/sf demand)
- ■ 20 W/sf (10W/sf demand)
- ☐ 30 W/sf (15W/sf demand)
- ☐ 50 W/sf (25W/sf demand)
- ☐ 80 W/sf (40 W/sf demand)
- ☐ 100 W/sf (50W/sf demand)
- ☐ Pump Power
- ☐ Instrument Power
- ☐ Clean Ground
- ☐ Emergency Power

Electromagnetic Interference (EMI) Control

- ☐ 100 nT RMS (300 nTp-p): General High Performance Lab
- ☐ 35 nT RMS (100 nTp-p): Dilution Refrigerator Lab
- ☐ 18 nT RMS (50 nTp-p): E Beam / FIB
- ☐ 11 nT RMS (30 nTp-p): SEM / TEM
- ☐ 4 nT RMS (10nTp-p): FEI Titan / JEOL 2100F

Architectural

- ☐ ESD Flooring
- ☐ Seamless Flooring
- ☐ Cryo Safe Flooring
- ■ Chemical Resistant Flooring
- ☐ Wall Mounts
- ☐ Ceiling Mounts
- ■ Double Door
- ■ Windows Allowed

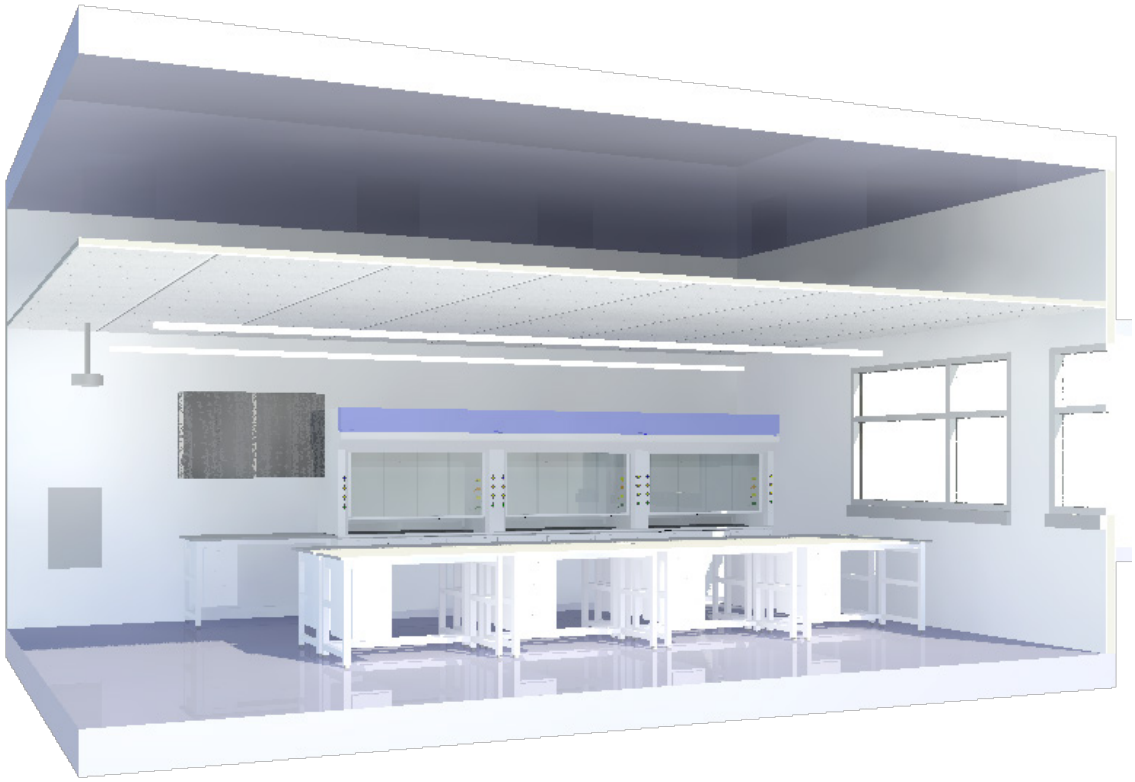
Infrastructure

- ■ Clean Dry Air
- ■ House Vacuum
- ■ House Nitrogen (gas)
- ☐ House Helium (gas)
- ☐ Cylinder Gas Manifolds Qty 2
- ☐ Helium Recovery (Vertical)
- ☐ Other _____
- ☐ 480V 3p Required

- ■ Hot Water
- ■ Cold Water
- ■ RODI
- ■ Eyewash (Tempered Water)
- ■ Safety Shower (Tempered Water)
- ☐ Other _____
- ■ Data (Fiber)
- ■ Data (Copper)

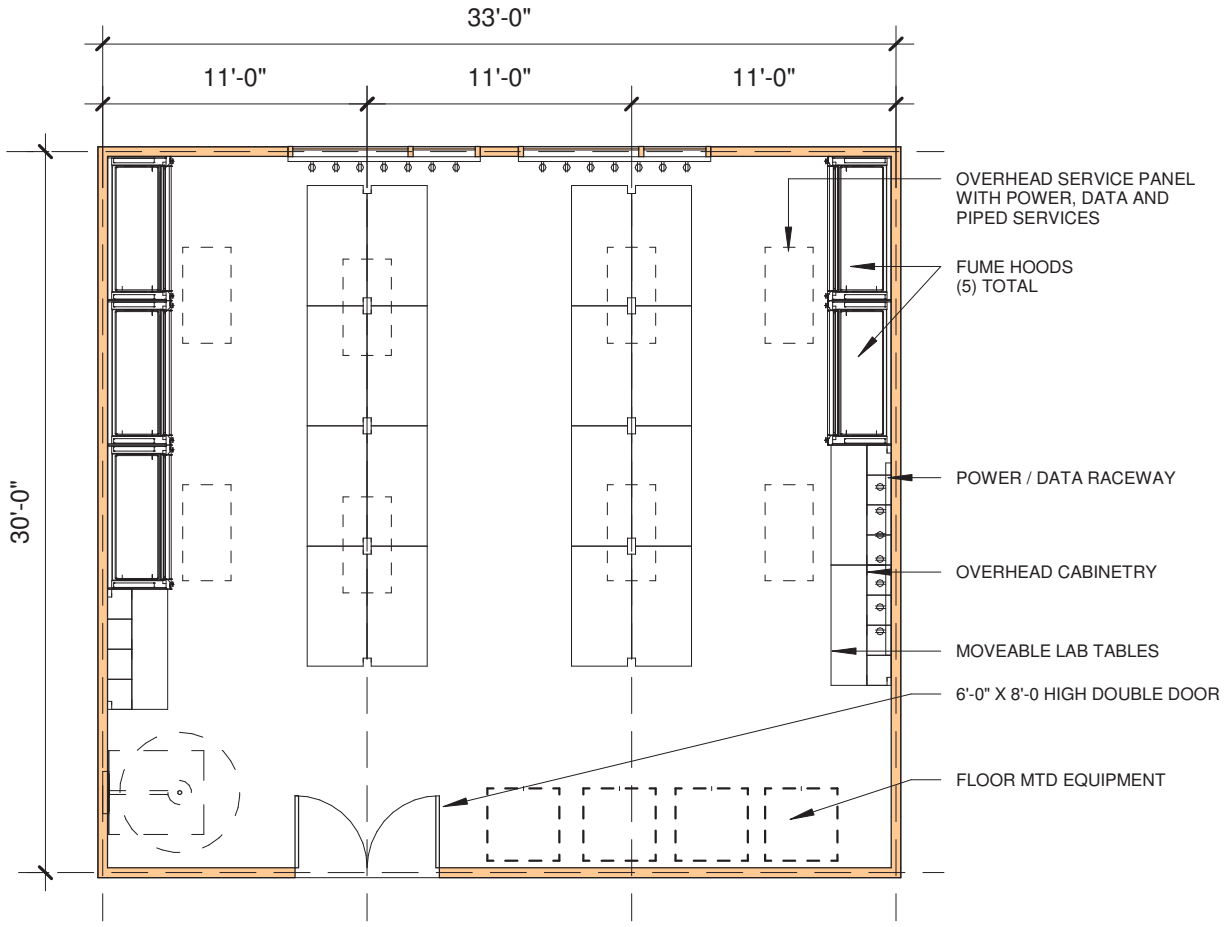
- ■ Fume Hood (3) 6ft Hoods - 3ft Depth
- ☐ Snorkel Exhaust
- ☐ Biological Safety Cabinet
- ☐ HEPA Filter
- ☐ ULPA Filter
- ☐ Process Chilled Water
  ____Percent of Power Demand
- ☐ 12V DC LED Lighting
- ■ Standard LED Lighting

vii. MATERIALS & INTERFACES (ChE)

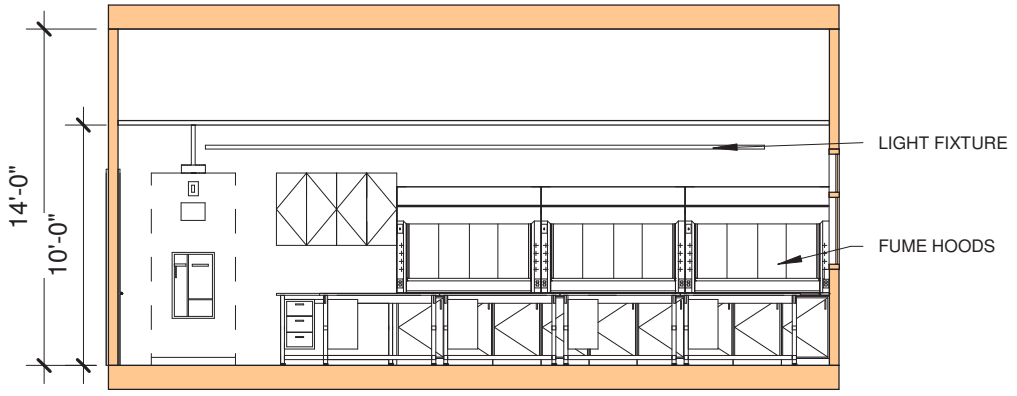


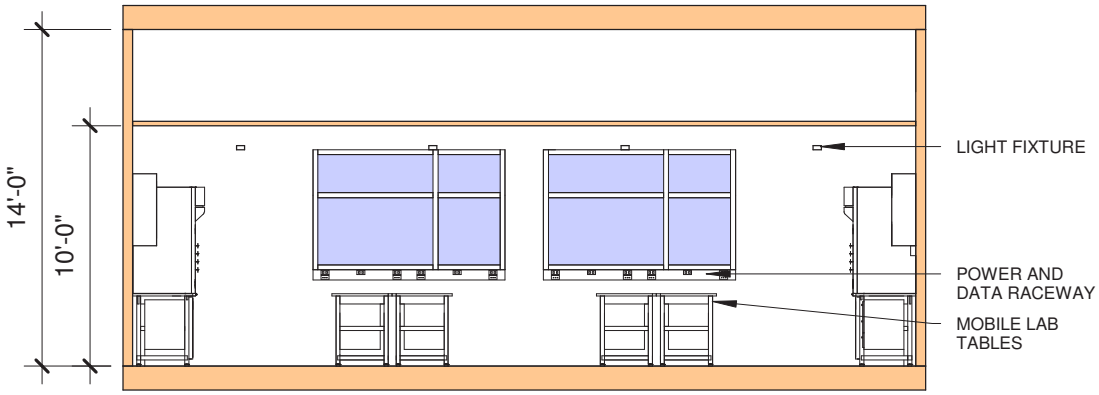
WET LAB

Complex materials and chemical interfaces serve as the basis for nearly all modern technologies. The Chemical Engineering faculty and research groups study how the synthesis, processing and properties of these systems can be used to engineer products and devices with well-controlled or novel performance for a variety of applications. A fundamental goal is usually to understand the interplay between molecular chemistry and multi-scale structure to design materials and interfaces, and the processes used to prepare them.



WET LAB - (3) BAYS - 990 ASF



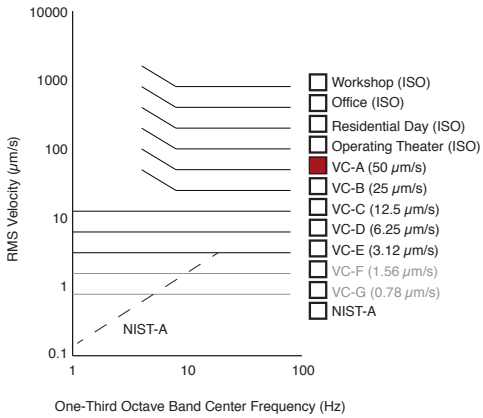


WET LAB - SECTIONS

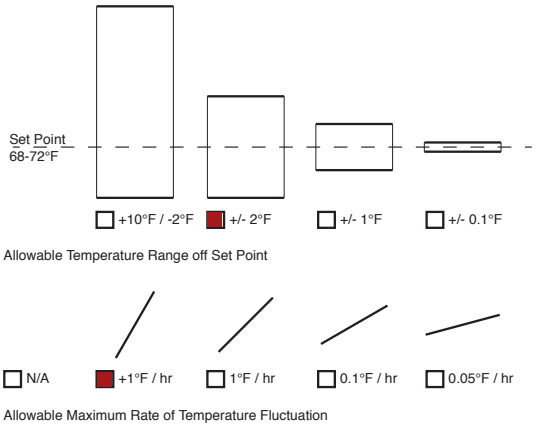
Laboratory Performance Criteria

Laboratory Type: Wet Lab (ChE)
Laboratory Function: Materials & Interfaces
Description of Activities:

Vibration Control



Temperature Control



Acoustic Control

- ☐ NC-15 TEM / Recording
- ☐ NC-20 SEM
- ☐ NC-25 Dil Fridge
- ☐ NC-30 High Perf Lab
- ☐ NC-35 Conference
- ☐ NC-40 Private Office
- ☐ NC-45 Open Office
- ■ NC-50 Laboratory
- ☐ No Requirement

Air Quality

- ☐ ISO 3 1
- ☐ ISO 4 10
- ☐ ISO 5 100
- ☐ ISO 6 1,000
- ☐ ISO 7 10,000
- ☐ ISO 8 100,000
- ■ No Classification
- ☐ Laminar Flow
- ☐ Moveable T-stat

Humidity Control

- ■ 30%-50% RH
- ☐ 30%-50% RH Settable
- ☐ No Humidification

- ☐ Return Air Allowed
- ☐ Local FCU (Remote)
- ☐ Positive Pressure
- ■ Negative Pressure
- ☐ +/- 2% RH

Power Density

- ☐ 5 W/sf (2W/sf demand)
- ☐ 10 W/sf (5W/sf demand)
- ☐ 20 W/sf (10W/sf demand)
- ■ 30 W/sf (15W/sf demand)
- ☐ 50 W/sf (25W/sf demand)
- ☐ 80 W/sf (40 W/sf demand)
- ☐ 100 W/sf (50W/sf demand)
- ■ Pump Power
- ■ Instrument Power
- ☐ Clean Ground
- ■ Emergency Power

Electromagnetic Interference (EMI) Control

- ☐ 100 nT RMS (300 nTp-p): General High Performance Lab
- ☐ 35 nT RMS (100 nTp-p): Dilution Refrigerator Lab
- ☐ 18 nT RMS (50 nTp-p): E Beam / FIB
- ☐ 11 nT RMS (30 nTp-p): SEM / TEM
- ☐ 4 nT RMS (10nTp-p): FEI Titan / JEOL 2100F

Architectural

- ☐ ESD Flooring
- ☐ Seamless Flooring
- ☐ Cryo Safe Flooring
- ■ Chemical Resistant Flooring
- ☐ Wall Mounts
- ☐ Ceiling Mounts
- ■ Double Door
- ■ Windows Allowed

Infrastructure

- ■ Clean Dry Air
- ■ House Vacuum
- ■ House Nitrogen (gas)
- ☐ House Helium (gas)
- ■ Cylinder Gas Manifolds Qty 2
- ☐ Helium Recovery (Vertical)
- ☐ Other _____
- ☐ 480V 3p Required

- ■ Hot Water
- ■ Cold Water
- ■ RODI
- ■ Eyewash (Tempered Water)
- ■ Safety Shower (Tempered Water)
- ☐ Other _____
- ☐ Data (Fiber)
- ■ Data (Copper)

*floor drain

- ■ Fume Hood *(5) total per lab
- ■ Snorkel Exhaust
- ☐ Biological Safety Cabinet
- ☐ HEPA Filter
- ☐ ULPA Filter
- ☐ Process Chilled Water
  ____Percent of Power Demand
- ☐ 12V DC LED Lighting
- ■ Standard LED Lighting

IV. ROOM LIST

DETAILED ROOM LIST - NON-LAB SPACE - MATERIALS

MATERIALS Non-Lab Space				
	No.	**Unit Area**	**Total Area**	**Comment**
Faculty Office	22	140	3,080	
Post Doc Office	42	70	2,940	9 Computational
Graduate Student Office	137	50	6,850	10 per open office max, 36 Computation
Technical Staff	9	120	1,080	8 current, 2 vacancy; 4 current SSLEC
Administrative Staff	13	120	1,560	11 current--revised in conversation with Dawn; 3 SSLEC
Large Conference (40p)	1	800	800	
Medium Conference (15-20)	1	400	400	
Small Conference	1	200	200	
Board Room	1	400	400	
Visitor Office	-	140	-	
			-	
Secure Bike Storage	1		-	Outdoors
Receiving Room	1	120	120	Office Support Service
Storage	1	500	500	Files, finance, furniture
Mail Room / Copy Area	2	200	400	
Scholarly Activity	6	200	1,200	May be able to reduce if 4-5 story building
			-	
Classroom	-		-	
Seminar (100p)	-	2,000	-	
Seminar (50p)	1	1,000	1,000	
Seminar (40p)	1	800	800	
Poster Session Break Out	1	-	-	Outdoor patio
			-	
			-	
Total			**21,330**	

Revised: 2/24/17; 3/30/17

DETAILED ROOM LIST - NON-LAB SPACE - ELECTRONICS & COMPUTER ENGINEERING

ECE Non-Lab Space				
	No.	**Unit Area**	**Total Area**	**Comment**
Faculty Office	12	140	1,680	11 current + 1 growth
Post Doc Office	22	70	1,540	22 current, per floor plan
Graduate Student Office	111	50	5,550	104 current, growth=x10%-3
Technical Staff	3	120	360	4 current,per floor plan - Stacia accounted for in MAT
Administrative Staff	5	120	600	4 current
Medium Conference (10-12)	1	300	300	1 current @ 173 asf
Copy/Supply	1	120	120	
Total			**10,150**	

DETAILED ROOM LIST - NON-LAB SPACE - CHEMICAL ENGINEERING

ChE Non-Lab Space				
	No.	Unit Area	Total Area	Comment
Faculty Office	-	140	-	
Post Doc Office	1	70	70	
Graduate Student Office	10	50	500	
Technical Staff	-	120	-	
Administrative Staff	-	120	-	
Total			**570**	

DETAILED ROOM LIST - LAB SPACE - STRUCTURAL MATERIALS

Dept.	Area	Description	General Lab	Wet Lab	Synthesis Lab	Laser Lab	Structural Lab	Characterization Lab	Control Room	Pump Closet	Microscopy Lab	MOCVD Lab	MBE Lab	Total
			Bays	Bays	Bays	Bays	Bays	Bays	Bays	Bays	Bays	Bays	Bays	Bays
MAT	Crystal Growth Casting	Ground Floor					3			0.50				3.50
MAT	Processing SPS Pressing	Ground Floor					3			0.50				3.50
MAT	Mech.Behav. Testing	GF if poss.					3			0.50				3.50
MAT	Blast laser					4				0.5				4.5
MAT	General Laser Optics	Pollock				3				0.5				3.5
MAT	General Laser	Gianola	1			2								3
MAT	Spec Prep, Wet Proc. Ceramic Process, Material Characterization		6							0.5				6.5
MAT	Future Hire in Structural		0											0
MAT	EDM 1bay, 3D Printing, 3D Powder		3											3
MAT	Thin Film, Proc. Furnaces	Non First Floor Non-High Bay					3			0.5				3.5
MAT	**Total Structural**		**10**			**9**	**12**			**3.50**				**34.50**
														0
MAT	**Microscopy Expansion**	Titan only							0.5	0.5	1.5			**2.5**
MAT	**Structural Materials**	**Total**	**10**			**9**	**12**		**0.5**	**4.00**	**1.5**			**37**

DETAILED ROOM LIST - LAB SPACE - ELECTRONICS & PHOTONICS (MATERIALS)

Dept.	Area	Description	General Lab	Wet Lab	Synthesis Lab	Laser Lab	Structural Lab	Characterization Lab	Control Room	Pump Closet	Microscopy Lab	MOCVD Lab	MBE Lab	Total
			Bays	Bays	Bays	Bays	Bays	Bays	Bays	Bays	Bays	Bays	Bays	Bays
MAT	MBE (10 systems-8 today)									4			10	14
MAT	MBE-Electrical Shop		0.5											0.5
MAT	MBE-Maintenance Shop		0.5											0.5
MAT	MBE-Storage													0
MAT	MBE-Gowning		0.5											0.5
MAT	MBE-Total		1.5							4			10	**15.5**
MAT	MBE-Large (Palmstrom's set-up)													0
MAT	MBE-Large-Storage													0
MAT	MBE-Large-Clean Assembly													0
MAT	MBE Large Total													0
MAT	MBE Total		1.5							4			10	**15.5**
MAT	MOCVD Facility													
MAT	6 MOCVD Machines (6 current)									3		10.2		**13.2**
MAT	Clean Prep, Parts Clean,		3.5											**3.5**
MAT	MOCVD Corridor	part of gross sf										0		**0**
MAT	MOCVD Total		**3.5**							**3**		**10.2**		**16.7**
MAT	Electronics & Photonics	Total	**5**	**0**	**0**	**0**	**0**	**0**	**0**	**7**	**0**	**10.2**	**10**	**32.2**

DETAILED ROOM LIST - LAB SPACE - INORGANIC, SOFT, MACRO MATERIALS

Dept.	Area	Description	General Lab	Wet Lab	Synthesis Lab	Laser Lab	Structural Lab	Characterization Lab	Control Room	Pump Closet	Microscopy Lab	MOCVD Lab	MBE Lab	Total
			Bays	Bays	Bays	Bays	Bays	Bays	Bays	Bays	Bays	Bays	Bays	Total
MAT	Bates				2			1		0				3
MAT	Chabinyc				2			1		0				3
MAT	Wilson				2			1		0				3
MAT	Seshadri				0			0		0				0
MAT	BioMacro-New Hire 2017				2			1		0				3
MAT	Inorganic-New Hire 2017				2			1		0				3
MAT	Inorganic-New Hire 2018	to HH			0			0		0				0
MAT	Senior Faculty				6			0		0				6
MAT	Senior Faculty	eliminate			0			0		0				0
MAT	Shared				0			0		1				1
MAT	Note: eliminated New Segalman = 4 syn + 2 char + 2 pump													
MAT	Inorganic Materials	Total	0	0	16	0	0	5	0	1	0	0	0	22

DETAILED ROOM LIST - LAB SPACE - ELECTRONICS & PHOTONICS (ECE)

Dept.	Area	Last Name	General Lab	Wet Lab	Synthesis Lab	Laser Lab	Structural Lab	Characterization Lab	Control Room	Pump Closet	Microscopy Lab	MOCVD Lab	MBE Lab	Totals
			Bays	Bays	Bays	Bays	Bays	Bays	Bays	Bays	Bays	Bays	Bays	Bays
ECE	12 Faculty Labs	Current = 11; growth+1 fac	2			31								33
	3 bays/7 faculty; 2 bays/5 faculty; share 2 Syn labs w/fume hoods													
ECE	**Electronics & Photonics**	**Total**	**2**	**0**	**0**	**31**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**33**

DETAILED ROOM LIST - LAB SPACE - MATERIALS & INTERFACES (ChE)

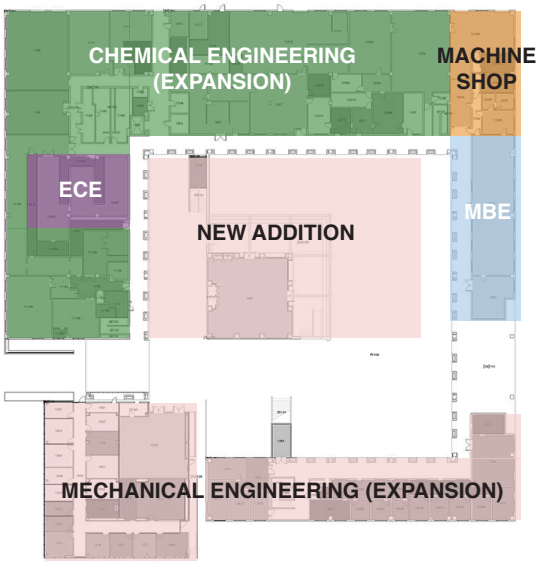
Dept.	Area	Description	General Lab	Wet Lab	Synthesis Lab	Laser Lab	Structural Lab	Characterization Lab	Control Room	Pump Closet	Microscopy Lab	MOCVD Lab	MBE Lab	TOTALS
			Bays	Bays	Bays	Bays	Bays	Bays	Bays	Bays	Bays	Bays	Bays	Bays
ChE	ChemE Space for Engr II Swap	Segalman		6										6
ChE	Materials and Interfaces	Total	0	6	0	0	0	0	0	0	0	0	0	6

V. APPENDIX

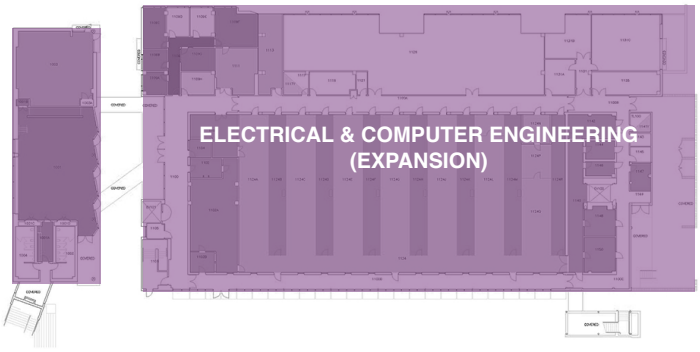
RELEASED SPACE

As a result of the additional assignable square footage proposed in the new building, space within the three existing buildings will be released for renovation. The goal of the released space renovation work is to consolidate the departments within the College of Engineering, which are currently spread out over several campus spaces. A conceptual summary of the proposed release space renovation work is outlined in the diagram below. This diagram represents a general consolidation of the departments in concept only. This is not meant to allocate specific spaces within each buidling. Further review of the released space program will be required during subsequent phases of design.

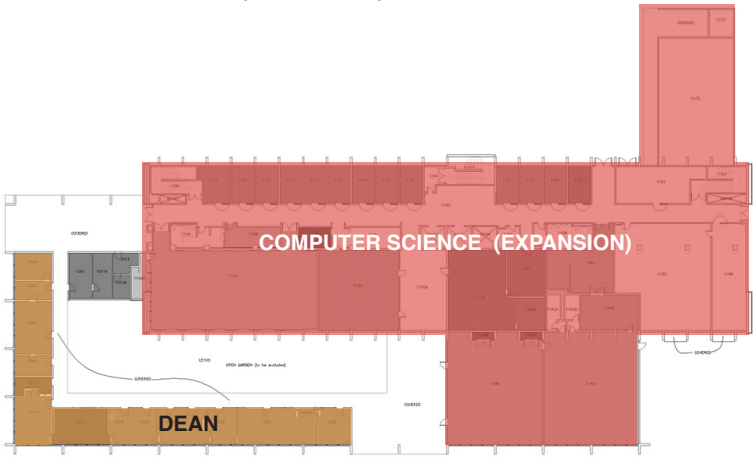
ENGINEERING II (RENOVATED)



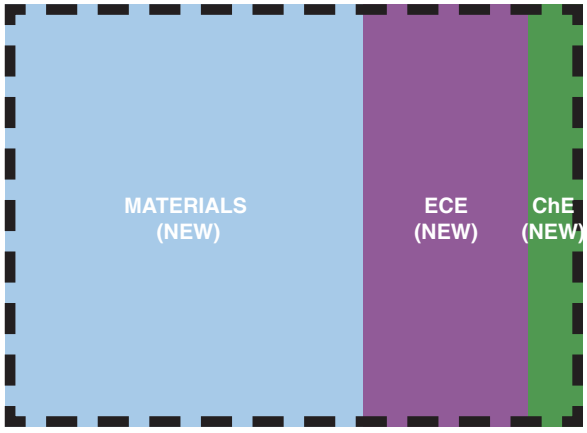
ENGINEERING SCIENCE BUILDING (RENOVATED)



HAROLD FRANK HALL (RENOVATED)



ENGINEERING III (NEW CONSTRUCTION)



RELEASED SPACE

ENGINEERING II (RENOVATED)

Engineering II will be the home of Chemical Engineering, Mechanical Engineering and the COE Machine Shop. Two existing facilities, ECE's Teaching Cleanroom and Materials' Large MBE will remain in their current locations in EII. As a home to ChemE and ME, EII renovations will include an upgrade to the existing infrastructure to better serve the needs of research in these areas, including, but not limited to an HVAC upgrade that includes better controls of humidity and temperature. The courtyard Addition will more efficiently utilize the building footprint and given the very large unmet space need, even after Engineering III is constructed, will allow COE to accommodate leaving the Large MBE and Teaching Cleanroom in the building and anticipated growth of both ChemE, ME and other departments. Further thought and planning will need to proceed, at the appropriate time, for this space.

ENGINEERING SCIENCE BUILDING (RENOVATED)

ESB will be home to Electrical and Computer Engineering. Faculty offices, research labs and the department's administrative offices will relocate from Harold Frank Hall to the newly vacated ESB space. The anticipated renovations may include minor rework of existing office space to accommodate the administrative staff and also some minimal changes to the research lab space. ESB will continue to be the home of the College's Nanofabrication Facility on the first floor.

HAROLD FRANK HALL (RENOVATED)

HFH will be the home for Computer Science and include space for the Electrical and Computer Engineering teaching labs and the Dean's Office. As the home for Computer Science, the renovation will need to bring this 50-plus year old building into the modern era, with a renovation where aesthetics is as important as infrastructure. Computer Science continues to increase their reputation nationally and internationally, as such the building needs to reflect this stature. CS seeks a collaborative space, with opportunities for interaction on each floor, modular labs, conference rooms and appropriate space for faculty, staff and students. The following page includes a list of visioning objectives that the Department is very interested in achieving. These should be viewed as a starting point for the renovation discussion that will follow the Engineering III Building project. Finally, since HFH is a 50-plus year old building, an infrastructure upgrade, especially HVAC, will need to be included in this renovation.

RELEASED SPACE

COMPUTER SCIENCE - Visioning Objectives for Harold Frank Hall

This list is based on meetings with Ambuj Singh and Giovanni Vigna, who have consulted with their colleagues. This is a starting point for discussion on what Harold Frank Hall may look like in the future, to serve Computer Science's needs.

1. Rework the building's main entrance to the east side. Create a true presence with this entrance. Create an atrium that spans multiple floors.

2. Create conference room space on the roof, as outlined in the 2013 Concept Study by M+M Creative Studio.

3. Flip office and lab locations within the building. Offices on the south to capture the ocean views and labs on the north.

4. Meeting spaces on all floors. Mix of large and smaller conference rooms alternating floors. For example, 1 large on second, 2 small on third and so forth.

5. Outside deck on top of first floor Dean's wing.

6. Add office space on top of north mechanical rooms, per Concept Study.

7. Consolidate ECE Teaching space to the first floor.

8. Consolidate Administrative Office spaces. Some at entrance on first floor and some on second floor. Be cognizant of student traffic and investigate best location for these staff.

9. Lower windows on the south side of the building.

10. Proper restrooms on each floor. Include a shower (both men's and women's) in one of the restroom locations.

11. Modular labs. Some labs connected for faculty to work together or ability to have singular labs. Lab module is in the 400-500 ASF range.

12. Higher ceilings in the building to add some character.

13. Interaction space on each floor with sink and coffee bar.

14. Graduate Student Lounge meeting space.

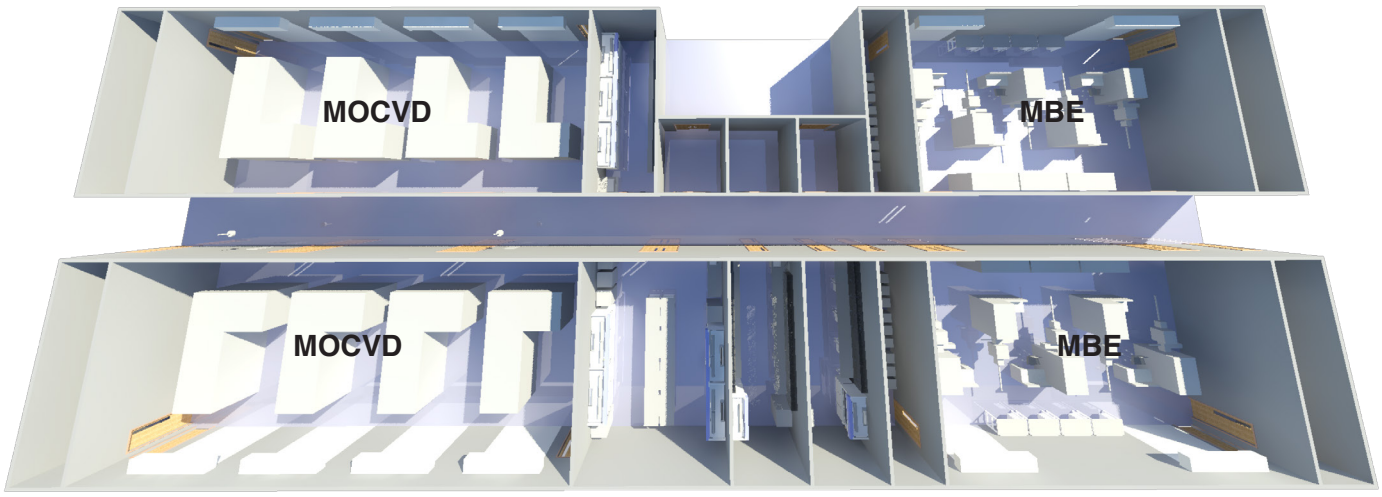
15. Undergraduate Student meeting space for Capstone projects.

MOCVD & MBE ADJACENCY STUDY

Looking ahead to subsequent stages of design, the following study explored the potential adjacencies between the MOCVD group and the MBE group on the ground floor of the new Engineering III building. The MOCVD group shares many of the same prep lab types, pump closets, gas storage and distribution needs, and envinromental criteria with the MBE group. Both labs require ground floor space with direct access to the exterior. Both labs will require specific gowning protocols before entering the shared corridor. The shared corridor may require HPM designations and fire protection criteria common to both lab groups.

This study also helps to demonstrate program efficiencies by acheiving additional assignable square footage within the same bay count as the standalone lab diagrams would indicate. By removing walls, more tools can fit within the same program area. By reducing the overall width of the pump closets from 11ft to 7ft, space can be allocated back to functional tool areas. Sharing process hoods among a greater quantity of tools allows for more functional tool areas and a greater number of future tools.

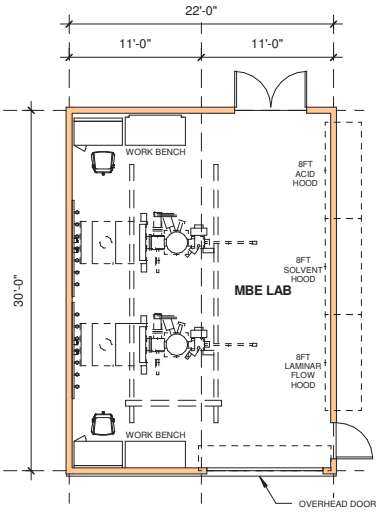
This is a preliminary concept only, and further review will be required during subsequent stages of design.



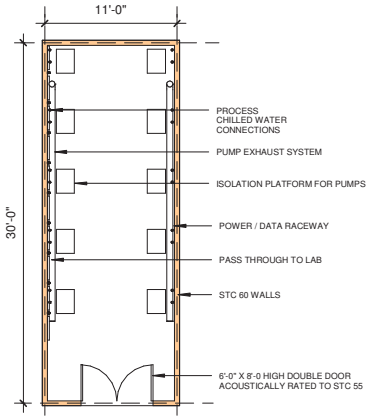
MBE

MEETING 3 TOTALS

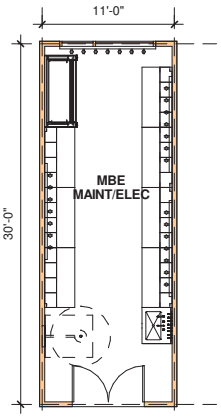
MBE LAB	10.0 BAYS (10 TOOLS)
PUMP	4.0 BAYS
MAINT/ELEC	1.0 BAY
MBE GOWN	0.5 BAYS
TOTAL	**15.5 BAYS**
AREA	5,115 ASF



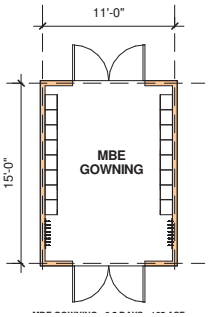
MBE LAB (5x)



PUMP (4x)



MAINT/ELEC

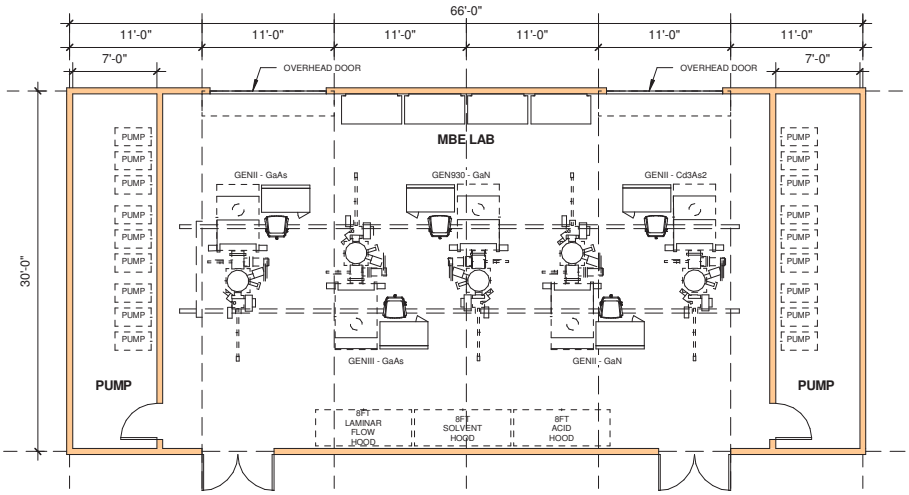


GOWNING

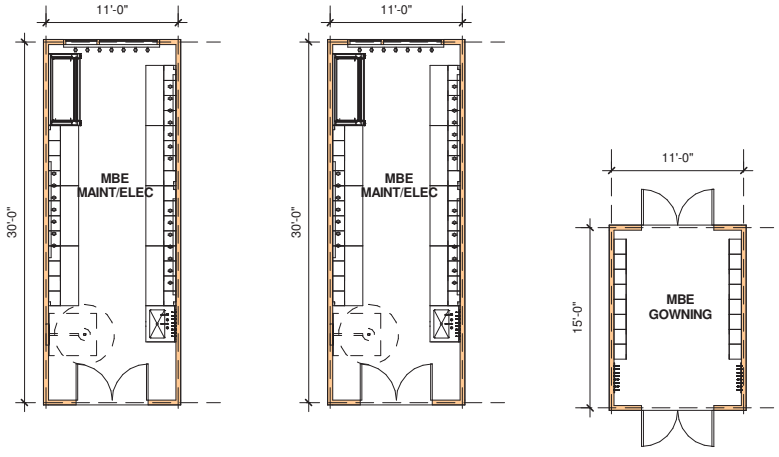
MBE

PROPOSED

MBE LAB	12.0 BAYS (10 TOOLS)
PUMP	INCLUDED IN LAB
MAINT/ELEC	2.0 BAYS
MBE GOWN	0.4 BAYS
STORAGE	0.2 BAYS
TOTAL	**14.6 BAYS**
AREA	4,818 ASF



MBE LAB (2x)

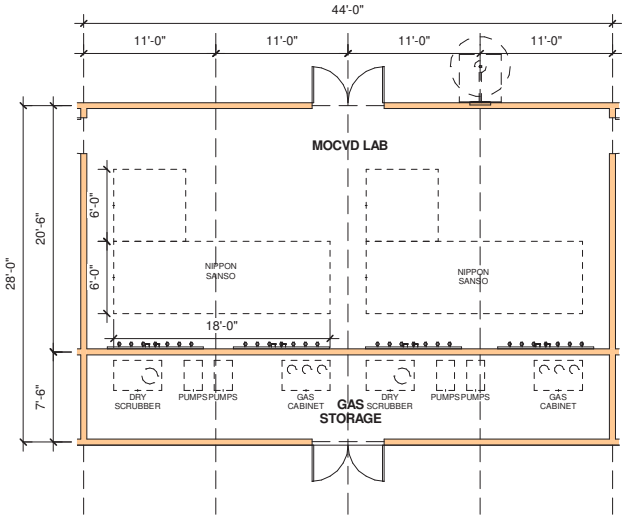


MAINTENANCE **ELECTRICAL** **GOWNING**

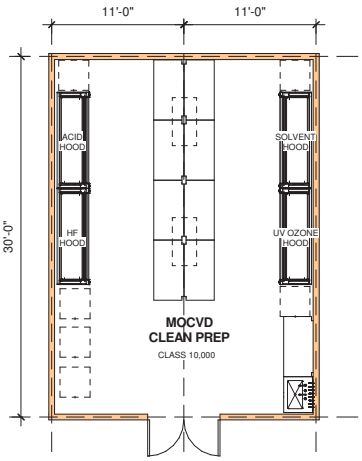
MOCVD

MEETING 3 TOTALS

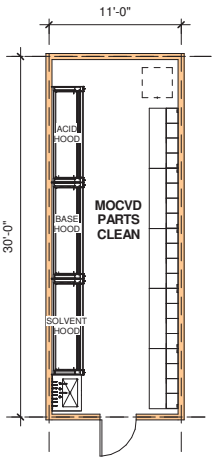
MOCVD LAB	14.2 BAYS (7 TOOLS) *two bays added back during post-meeting
PUMP	2.0 BAYS
CLEAN PREP	2.0 BAYS
PARTS CLEAN	1.0 BAYS
MOCVD GOWN	0.5 BAYS
TOTAL	**16.7 BAYS**
AREA	5,511 ASF



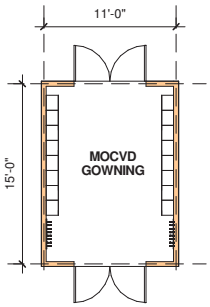
MOCVD LAB (3x)



CLEAN PREP



PARTS CLEAN

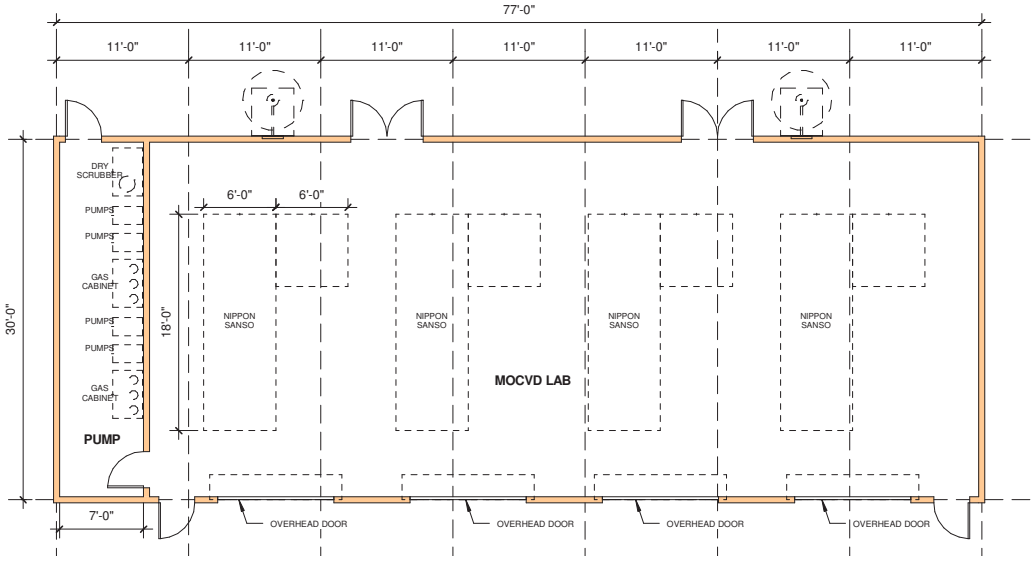


GOWNING

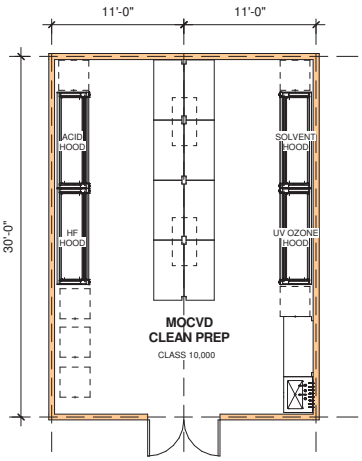
MOCVD

PROPOSED

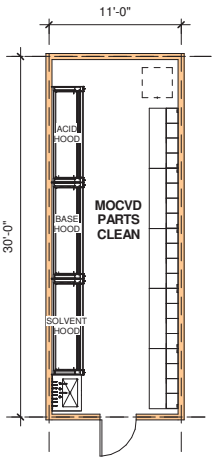
MOCVD LAB	14.0 BAYS (8 TOOLS)
PUMP	*INCLUDED IN LAB*
CLEAN PREP	2.0 BAYS
PARTS CLEAN	1.0 BAYS
MOCVD GOWN	0.4 BAYS
STORAGE	0.2 BAYS
TOTAL	**17.6 BAYS**
AREA	5,808 ASF



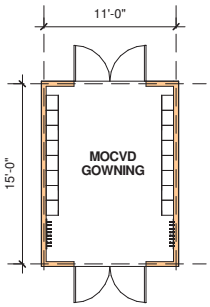
MOCVD LAB (2x)



CLEAN PREP



PARTS CLEAN



GOWNING

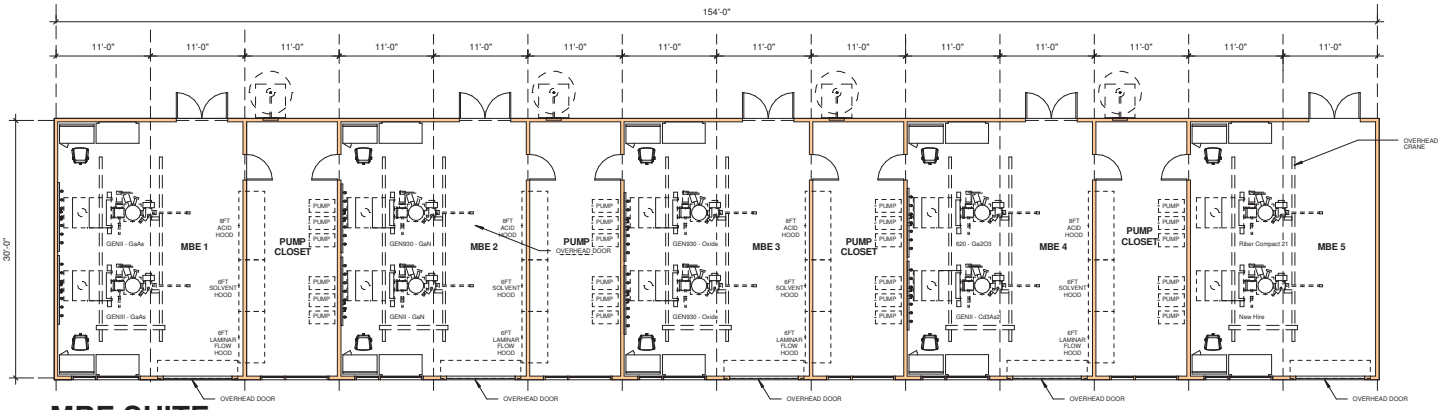
MBE + MOCVD ADJACENCY

MEETING 3 TOTALS

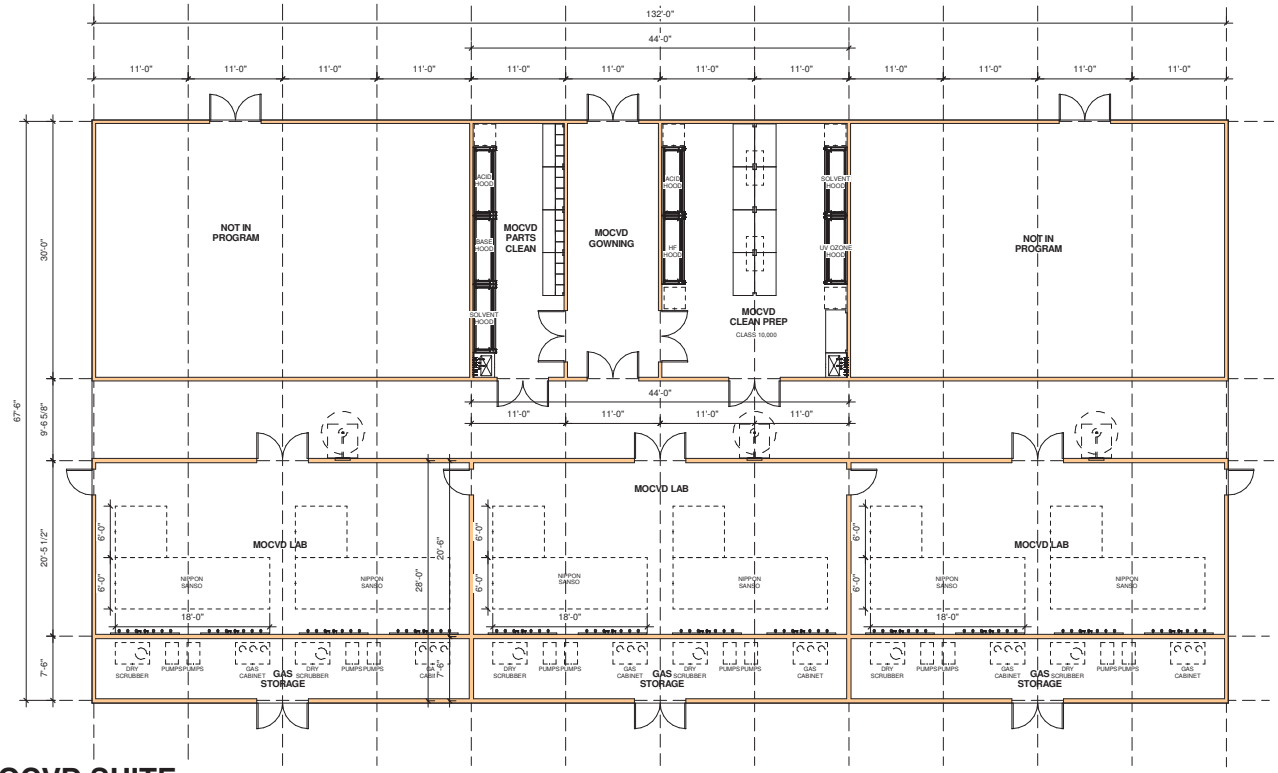
MBE LAB	10.0 BAYS (10 TOOLS)
PUMP	4.0 BAYS
MAINT/ELEC	1.0 BAY
MBE GOWN	0.5 BAYS
TOTAL (MBE)	**15.5 BAYS**
AREA	5,115 ASF

MOCVD LAB	14.2 BAYS (7 TOOLS)
PUMP	2.0 BAYS
CLEAN PREP	2.0 BAYS
PARTS CLEAN	1.0 BAYS
MOCVD GOWN	0.5 BAYS
TOTAL (MOCVD)	**16.7 BAYS**
AREA	5,511 ASF

TOTAL (COMBINED)	**32.2 BAYS**
AREA	10,626 ASF



MBE SUITE



MOCVD SUITE

MBE + MOCVD ADJACENCY

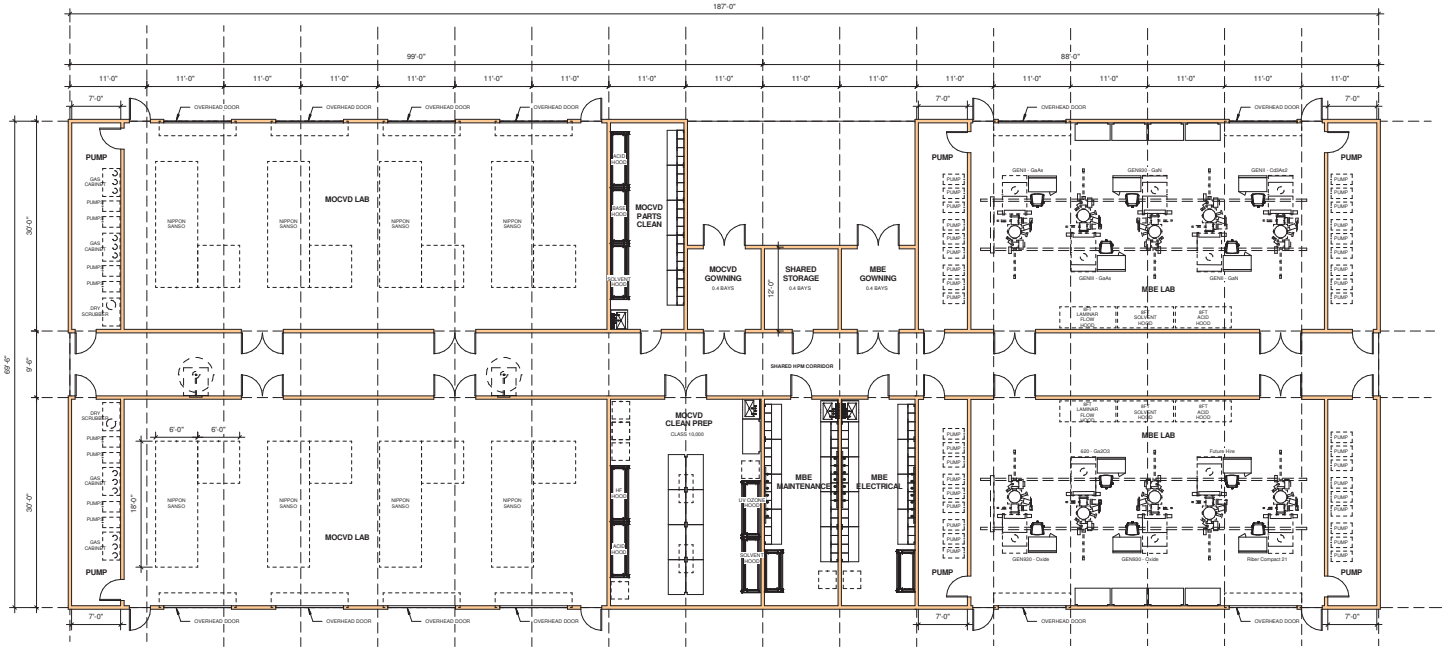
PROPOSED

MBE LAB	12.0 BAYS (10 TOOLS)
PUMP	INCLUDED IN LAB
MAINT/ELEC	2.0 BAYS
MBE GOWN	0.4 BAYS
STORAGE	0.2 BAYS
TOTAL	**14.6 BAYS**
AREA	4,818 ASF

PROPOSED

MOCVD LAB	14.0 BAYS (8 TOOLS)
PUMP	*INCLUDED IN LAB*
CLEAN PREP	2.0 BAYS
PARTS CLEAN	1.0 BAYS
MOCVD GOWN	0.4 BAYS
STORAGE	0.2 BAYS
TOTAL	**17.6 BAYS**
AREA	5,808 ASF

TOTAL (COMBINED) **32.2 BAYS**
AREA 10,626 ASF

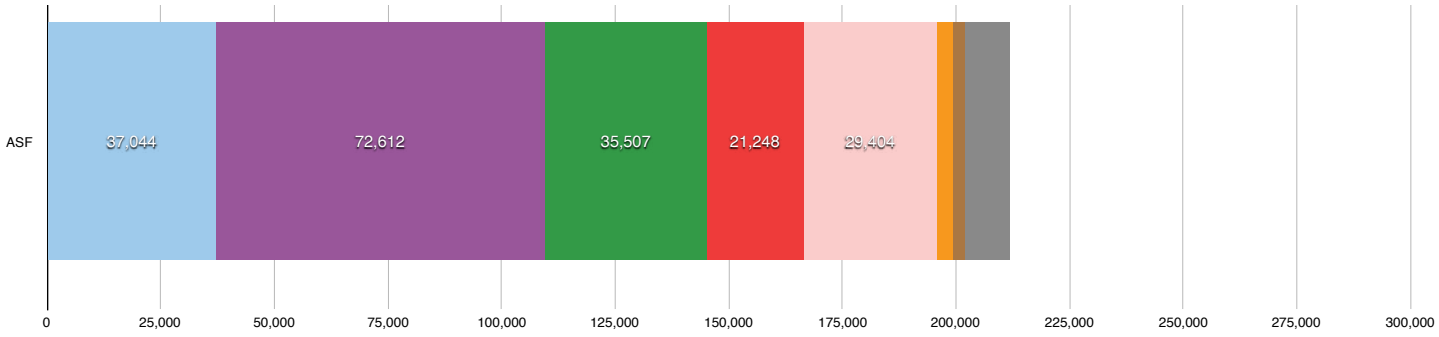


MBE + MOCVD GROUND FLOOR OPTION?

1. REMOVE WALLS (MORE EFFICIENT / MORE TOOLS PER ROOM)
2. REDUCE WIDTH OF PUMP CLOSETS TO 7FT CLEAR (SINGLE SIDED)
3. REDUCE QTY OF PROCESS HOODS (MBE)
4. ADD BACK MBE ELEC PREP & MBE MAINTENANCE (2 BAYS TOTAL)
5. 10 MBE TOOLS + 8 MOCVD TOOLS
6. SAME TOTAL BAYS, SAME TOTAL ASF
7. COULD GAS STORAGE BE MOVED TO GROSS? BUILDING SUPPORT? GAS YARD?
8. COMMON HPM CORRIDOR

EXISTING SPACE - COLLEGE OF ENGINEERING

COLLEGE OF ENGINEERING	TOTALS			
	RM COUNT	ASF	AVG	%
MATERIALS (MAT)	123	37,044	301	17%
ELECTRICAL & COMPUTER ENGINEERING (ECE)	210	72,612	346	34%
CHEMICAL ENGINEERING (ChE)	97	35,507	366	17%
COMPUTER SCIENCE (CS)	75	21,248	283	10%
MECHANICAL ENGINEERING (ME)	96	29,404	306	14%
DEAN'S OFFICE	20	3,575	179	2%
COMPUTING INFRASTRUCTURE	18	2,644	147	1%
I&R GENERAL	24	9,859	411	5%
TOTALS	**663**	**211,893**		

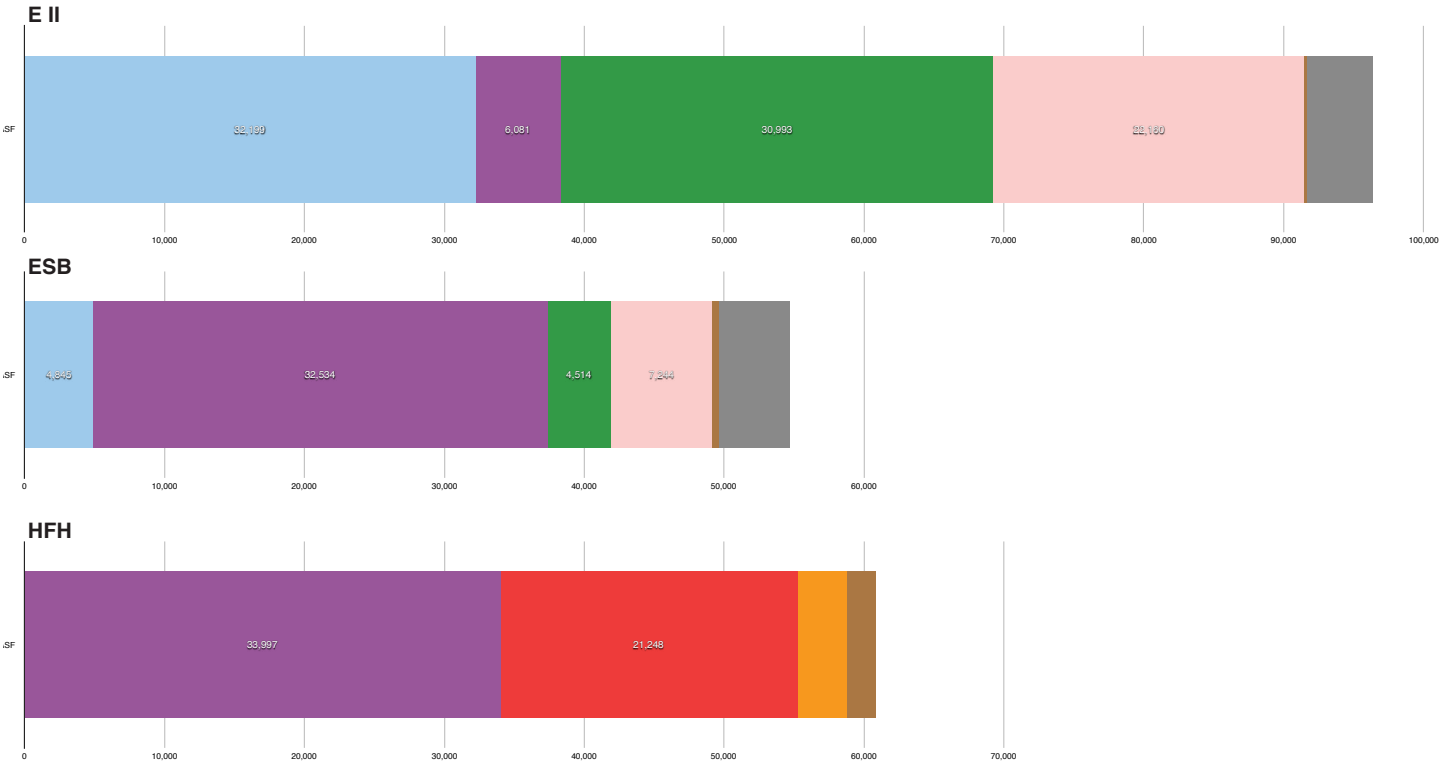


NOTE: The College of Engineering also occupies 77,347 ASF in other permanent and temporary buildings and trailers elsewhere on campus.

Department
- Materials
- Electrical & Computer Engineering
- Chemical Engineering
- Computer Science
- Mechanical Engineering
- Dean College of Engineering
- Engineering Computing Infrastructure
- Engineering-I&R General

EXISTING SPACE COMPARISON BY BLDG

TOTALS	E II		ESB		HFH	
	RM CT	ASF	RM CT	ASF	RM CT	ASF
MATERIALS (MAT)	105	32,199	18	4,845	0	0
ELECTRICAL & COMPUTER ENGINEERING (ECE)	14	6,081	100	32,534	96	33,997
CHEMICAL ENGINEERING (ChE)	86	30,993	11	4,514	0	0
COMPUTER SCIENCE (CS)	0	0	0	0	75	21,248
MECHANICAL ENGINEERING (ME)	67	22,160	29	7,244	0	0
DEAN'S OFFICE	0	0	0	0	20	3,575
COMPUTING INFRASTRUCTURE	1	206	7	436	10	2,002
I&R GENERAL	16	4,726	8	5,133	0	0
TOTALS	**289**	**96,365**	**173**	**54,706**	**201**	**60,822**



Department

- Materials
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- Engineering Computing Infrastructure
- Engineering-I&R General

EXISTING SPACE BY DEPARTMENT

ENGINEERING II - LEVEL 1

ENGINEERING II (EII)	LEVEL 1	
	RM CT	ASF
MATERIALS (MAT)	59	18,692
ELECTRICAL & COMPUTER ENGINEERING (ECE)	14	6,081
CHEMICAL ENGINEERING (ChE)	7	4,599
COMPUTER SCIENCE (CS)		
MECHANICAL ENGINEERING (ME)		
DEAN'S OFFICE		
COMPUTING INFRASTRUCTURE	1	206
I&R GENERAL	16	4,726
TOTALS	**97**	**34,304**

Department

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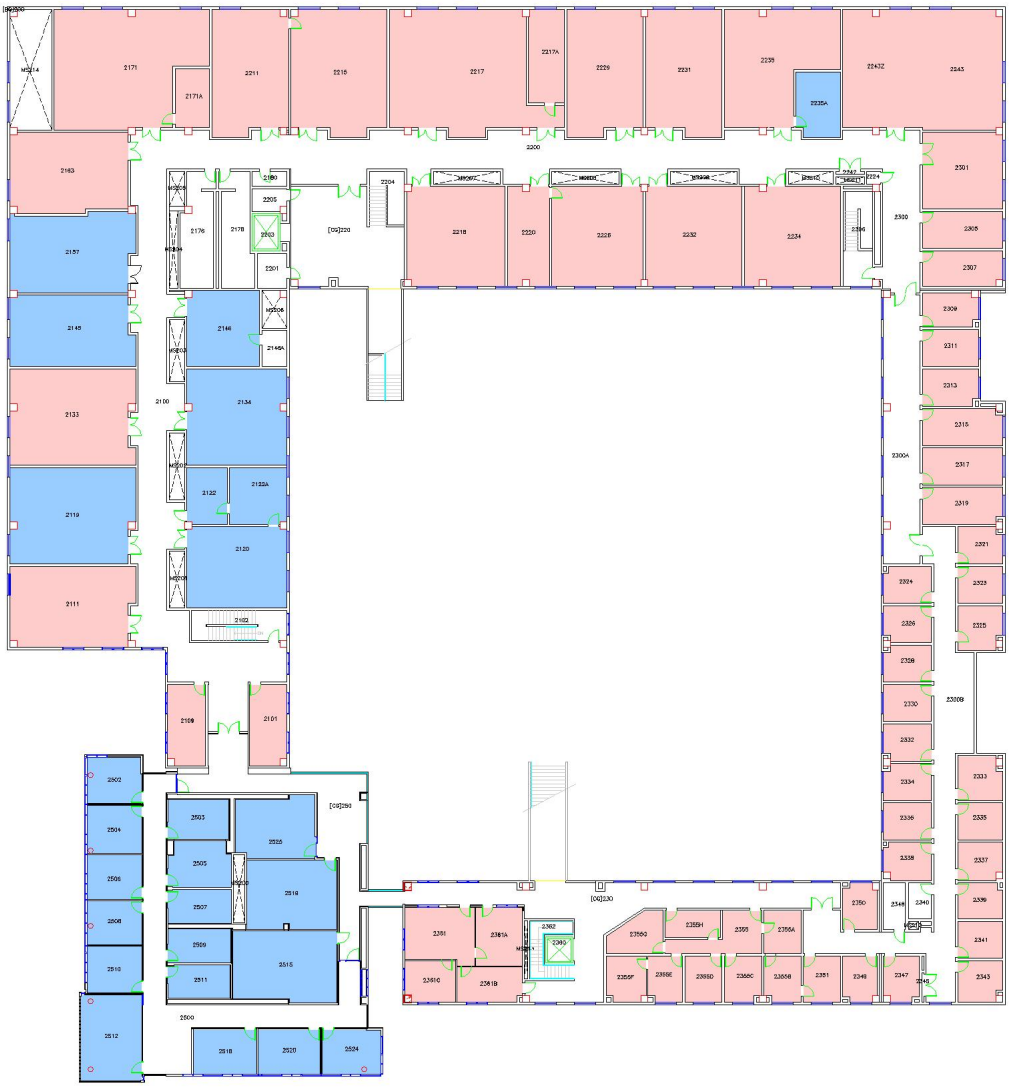
- Engineering-I&R General

EXISTING SPACE BY DEPARTMENT



ENGINEERING II - LEVEL 2

ENGINEERING II (EII)	LEVEL 2	
	RM CT	ASF
MATERIALS (MAT)	26	9,135
ELECTRICAL & COMPUTER ENGINEERING (ECE)		
CHEMICAL ENGINEERING (ChE)		
COMPUTER SCIENCE (CS)		
MECHANICAL ENGINEERING (ME)	64	21,560
DEAN'S OFFICE		
COMPUTING INFRASTRUCTURE		
I&R GENERAL		
TOTALS	90	30,695

Department

- Materials
- Electrical & Computer Engineering
- Chemical Engineering
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- Mechanical Engineering
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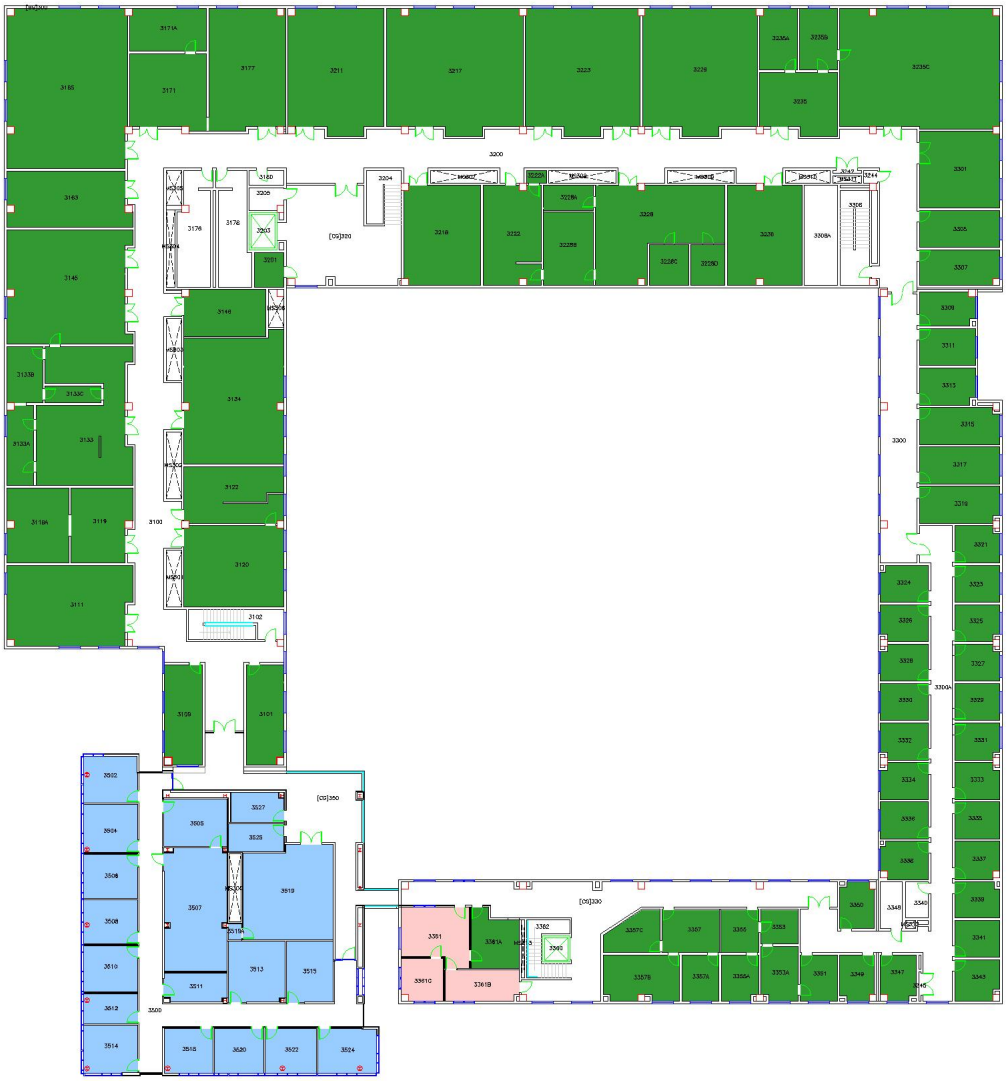
- Engineering Computing Infrastructure
- Engineering-I&R General

EXISTING SPACE BY DEPARTMENT



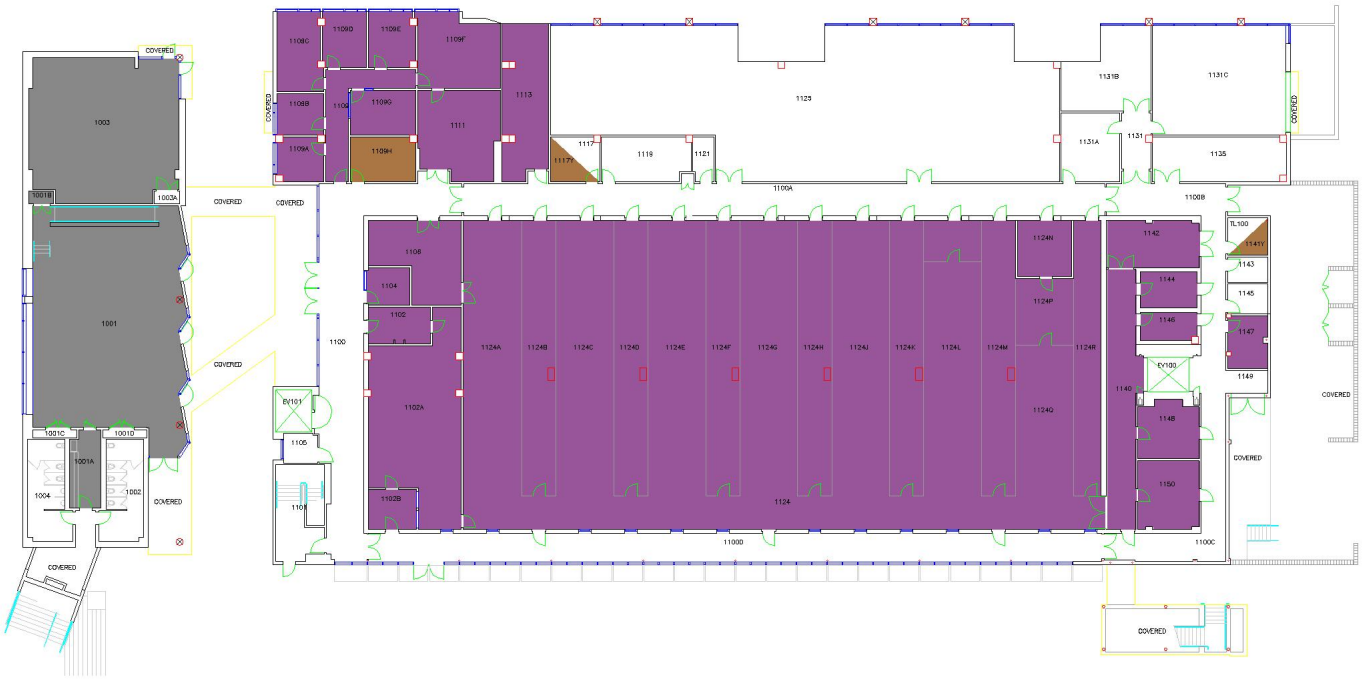
ENGINEERING II - LEVEL 3

ENGINEERING II (EII)	LEVEL 3	
	RM CT	ASF
MATERIALS (MAT)	20	4,372
ELECTRICAL & COMPUTER ENGINEERING (ECE)		
CHEMICAL ENGINEERING (ChE)	79	26,394
COMPUTER SCIENCE (CS)		
MECHANICAL ENGINEERING (ME)	3	600
DEAN'S OFFICE		
COMPUTING INFRASTRUCTURE		
I&R GENERAL		
TOTALS	102	31,366

Department

- Materials
- Electrical & Computer Engineering
- Chemical Engineering
- Computer Science
- Mechanical Engineering
- Dean College of Engineering
- Engineering Computing Infrastructure
- Engineering-I&R General

EXISTING SPACE BY DEPARTMENT



ENGINEERING SCIENCE BUILDING - LEVEL 1

ENGINEERING SCIENCE (ESB)	LEVEL 1	
	RM CT	ASF
MATERIALS (MAT)		
ELECTRICAL & COMPUTER ENGINEERING (ECE)	39	16,569
CHEMICAL ENGINEERING (ChE)		
COMPUTER SCIENCE (CS)		
MECHANICAL ENGINEERING (ME)		
DEAN'S OFFICE		
COMPUTING INFRASTRUCTURE	3	273
I&R GENERAL	4	3,313
TOTALS	46	20,155

Department

- Materials
- Electrical & Computer Engineering
- Chemical Engineering
- Computer Science
- Mechanical Engineering
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- Engineering Computing Infrastructure
- Engineering-I&R General

EXISTING SPACE BY DEPARTMENT

ENGINEERING SCIENCE BUILDING - LEVEL 2

ENGINEERING SCIENCE (ESB)	LEVEL 2	
	RM CT	ASF
MATERIALS (MAT)		
ELECTRICAL & COMPUTER ENGINEERING (ECE)	41	11,003
CHEMICAL ENGINEERING (ChE)		
COMPUTER SCIENCE (CS)		
MECHANICAL ENGINEERING (ME)	20	5,236
DEAN'S OFFICE		
COMPUTING INFRASTRUCTURE	2	79
I&R GENERAL	3	1,759
TOTALS	66	18,077

Department

- Materials
- Electrical & Computer Engineering
- Chemical Engineering
- Computer Science
- Mechanical Engineering
- Dean College of Engineering
- Engineering Computing Infrastructure
- Engineering-I&R General

EXISTING SPACE BY DEPARTMENT

ENGINEERING SCIENCE BUILDING - LEVEL 3

ENGINEERING SCIENCE (ESB)	LEVEL 3	
	RM CT	ASF
MATERIALS (MAT)	18	4,845
ELECTRICAL & COMPUTER ENGINEERING (ECE)	20	4,962
CHEMICAL ENGINEERING (ChE)	11	4,514
COMPUTER SCIENCE (CS)		
MECHANICAL ENGINEERING (ME)	9	2,008
DEAN'S OFFICE		
COMPUTING INFRASTRUCTURE	2	84
I&R GENERAL	1	61
TOTALS	**61**	**16,474**

Department

- Materials
- Electrical & Computer Engineering
- Chemical Engineering
- Computer Science
- Mechanical Engineering
- Dean College of Engineering
- Engineering Computing Infrastructure
- Engineering-I&R General

EXISTING SPACE BY DEPARTMENT

HAROLD FRANK HALL - LEVEL 1

HAROLD FRANK HALL (HFH)	LEVEL 1	
	RM CT	ASF
MATERIALS (MAT)		
ELECTRICAL & COMPUTER ENGINEERING (ECE)	5	4,040
CHEMICAL ENGINEERING (ChE)		
COMPUTER SCIENCE (CS)	19	5,160
MECHANICAL ENGINEERING (ME)		
DEAN'S OFFICE	20	3,575
COMPUTING INFRASTRUCTURE		
I&R GENERAL		
TOTALS	44	12,775

Department

- Materials
- Electrical & Computer Engineering
- Chemical Engineering
- Computer Science
- Mechanical Engineering
- Dean College of Engineering
- Engineering Computing Infrastructure
- Engineering-I&R General

EXISTING SPACE BY DEPARTMENT

HAROLD FRANK HALL - LEVEL 2

HAROLD FRANK HALL (HFH)	LEVEL 2	
	RM CT	ASF
MATERIALS (MAT)		
ELECTRICAL & COMPUTER ENGINEERING (ECE)	4	2,498
CHEMICAL ENGINEERING (ChE)		
COMPUTER SCIENCE (CS)	36	9,451
MECHANICAL ENGINEERING (ME)		
DEAN'S OFFICE		
COMPUTING INFRASTRUCTURE		
I&R GENERAL		
TOTALS	40	11,949

Department

- Materials
- Electrical & Computer Engineering
- Chemical Engineering
- Computer Science
- Mechanical Engineering
- Dean College of Engineering
- Engineering Computing Infrastructure
- Engineering-I&R General

EXISTING SPACE BY DEPARTMENT

HAROLD FRANK HALL - LEVEL 3

HAROLD FRANK HALL (HFH)	LEVEL 3	
	RM CT	ASF
MATERIALS (MAT)		
ELECTRICAL & COMPUTER ENGINEERING (ECE)	31	8,501
CHEMICAL ENGINEERING (ChE)		
COMPUTER SCIENCE (CS)	6	1,670
MECHANICAL ENGINEERING (ME)		
DEAN'S OFFICE		
COMPUTING INFRASTRUCTURE	9	1,809
I&R GENERAL		
TOTALS	**46**	**11,980**

Department

- Materials
- Electrical & Computer Engineering
- Chemical Engineering
- Computer Science
- Mechanical Engineering
- Dean College of Engineering
- Engineering Computing Infrastructure
- Engineering-I&R General

EXISTING SPACE BY DEPARTMENT

HAROLD FRANK HALL - LEVEL 4

HAROLD FRANK HALL (HFH)	LEVEL 4	
	RM CT	ASF
MATERIALS (MAT)		
ELECTRICAL & COMPUTER ENGINEERING (ECE)	33	11,945
CHEMICAL ENGINEERING (ChE)		
COMPUTER SCIENCE (CS)		
MECHANICAL ENGINEERING (ME)		
DEAN'S OFFICE		
COMPUTING INFRASTRUCTURE		
I&R GENERAL		
TOTALS	33	11,945

Department

- Materials
- Electrical & Computer Engineering
- Chemical Engineering
- Computer Science
- Mechanical Engineering
- Dean College of Engineering
- Engineering Computing Infrastructure
- Engineering-I&R General

EXISTING SPACE BY DEPARTMENT

HAROLD FRANK HALL - LEVEL 5

HAROLD FRANK HALL (HFH)	LEVEL 5	
	RM CT	ASF
MATERIALS (MAT)		
ELECTRICAL & COMPUTER ENGINEERING (ECE)	23	7,013
CHEMICAL ENGINEERING (ChE)		
COMPUTER SCIENCE (CS)	14	4,967
MECHANICAL ENGINEERING (ME)		
DEAN'S OFFICE		
COMPUTING INFRASTRUCTURE	1	193
I&R GENERAL		
TOTALS	**38**	**12,173**

Department

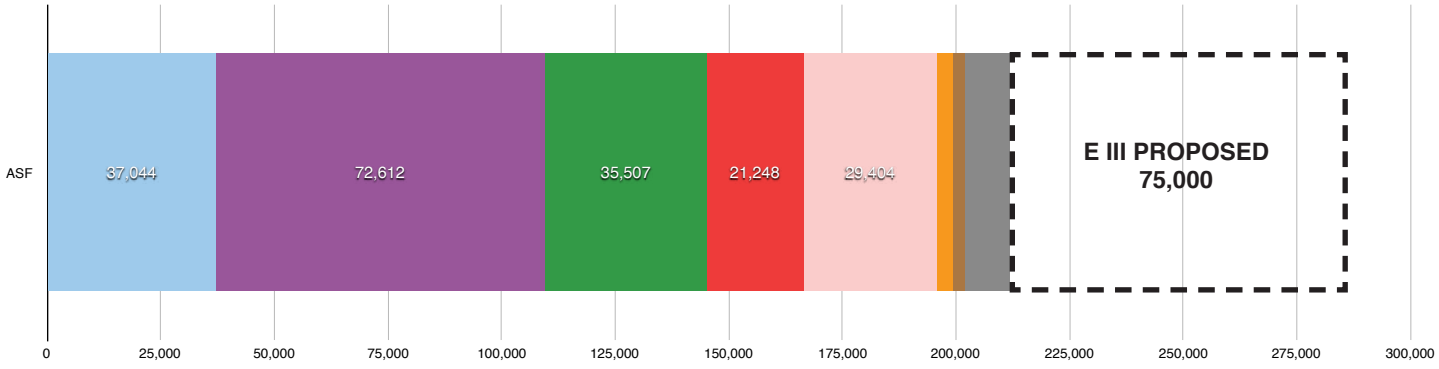
- Materials
- Electrical & Computer Engineering
- Chemical Engineering
- Computer Science
- Mechanical Engineering
- Dean College of Engineering
- Engineering Computing Infrastructure
- Engineering-I&R General

PROPOSED SPACE - ENGINEERING III BUILDING

COLLEGE OF ENGINEERING	TOTALS			
	RM COUNT	ASF	AVG	%
MATERIALS (MAT)	123	37,044	301	17%
ELECTRICAL & COMPUTER ENGINEERING (ECE)	210	72,612	346	34%
CHEMICAL ENGINEERING (ChE)	97	35,507	366	17%
COMPUTER SCIENCE (CS)	75	21,248	283	10%
MECHANICAL ENGINEERING (ME)	96	29,404	306	14%
DEAN'S OFFICE	20	3,575	179	2%
COMPUTING INFRASTRUCTURE	18	2,644	147	1%
I&R GENERAL	24	9,859	411	5%
TOTALS	**663**	**211,893**		

E III (PROPOSED)

BAYS	ASF
91.2	51,426
33	21,040
6	2,550
130.2	**75,016**



Department

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SPACE COMPARISON BY BLDG

TOTALS

	RM CT	ASF
MATERIALS (MAT)	105	32,199
ELECTRICAL & COMPUTER ENGINEERING (ECE)	14	6,081
CHEMICAL ENGINEERING (ChE)	86	30,993
COMPUTER SCIENCE (CS)	0	0
MECHANICAL ENGINEERING (ME)	67	22,160
DEAN'S OFFICE	0	0
COMPUTING INFRASTRUCTURE	1	206
I&R GENERAL	16	4,726
TOTALS	**289**	**96,365**

E II

RM CT	ASF
105	32,199
14	6,081
86	30,993
0	0
67	22,160
0	0
1	206
16	4,726
289	**96,365**

ESB

RM CT	ASF
18	4,845
100	32,534
11	4,514
0	0
29	7,244
0	0
7	436
8	5,133
173	**54,706**

HFH

RM CT	ASF
0	0
96	33,997
0	0
75	21,248
0	0
20	3,575
10	2,002
0	0
201	**60,822**

E III (PROPOSED)

BAYS	ASF
91.2	51,426
33	21,040
6	2,550
130.2	**75,016**