Introduction

The OSU Design & Construction Standards support OSU’s policies related to the design and maintenance of facilities on campus and to the OSU Campus Master Plan. They identify specific requisites that should be utilized in the construction of buildings and outdoor spaces on campus. They also note requirements for project drawings and address universal design, sustainability, and environmental best practices and requirements.

The documents are separated by divisions according to Construction Specification Institute (CSI) MasterFormat 2014. The table of contents provides easy identification of the sections covered within each division. Division 1 documents provide general information pertinent to most projects, while other divisions are more specific to a particular trade or subject.

These standards are to be used by all Design Professionals, and other design and construction professionals under contract to do work at and for OSU. It is also a resource for staff and faculty.

These OSU Construction Standards have been researched and selected by a cross section of staff and professional consultants. They are standards, but are not absolutes. If a more appropriate product, material or practice provides additional value to OSU, it should be considered. Items different from those identified in the Design & Construction Standards will be reviewed by OSU for life cycle cost, environmental impact and future flexibility. Proposed changes should be submitted as early as possible during the design process. Designs must comply with the Design & Construction Standards, unless written verification of deviation is provided by OSU.

Technical Bulletins and supplemental, updated information are considered appendices to the Design & Construction Standards and must be adhered to as well.

Please note that OSU’s University Housing and Dining Services department has a similar document that directs work within their facilities. Contact the OSU Project Manager for more information.

Additionally, OSU’s Network Services department has a set of design standards that are applicable to network infrastructure, internet connectivity and phone services, and these are now part of OSU Design & Construction Standards. BICSI RCDD Certification is required for anyone performing infrastructure design, specifications, and/or drawings. Specified materials and design of communication rooms must comply with the Design & Construction Standards. All documents, if applicable to the project(s), must be adhered to by design and construction professionals under contract to provide services at OSU. Contact the OSU Project Manager for more information.

Please direct any general questions or comments about the OSU Construction Standards to Julie Drolet, Project Manager, Capital Planning and Development by email at Julie.Drolet@oregonstate.edu
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Section 01 10 00: Design Requirements for OSU

1. REGULATORY REQUIREMENTS

   A. The Design Professional shall design the project in compliance with all applicable Federal, State and Local codes, ordinances, laws and other regulations, which have jurisdiction over the nature of the construction. If any of these requirements are different from the material in this manual, the most demanding requirements shall be observed.

   B. In addition to the above mentioned codes, for University owned buildings, the University uses the most current editions of the following codes and standards as design criteria:

      i. Applicable codes of the Oregon Structural Specialty Code (OSSC) and other Specialty Codes

      ii. 2010 ADA Standards for Accessible Design (See OSU Construction Standard 01 10 02)

      iii. ASME Codes and Standards

      iv. National Fire Protection Association (NFPA)

   C. Unless specifically indicated otherwise, the Design Professional is responsible for completing all applications and forms and producing all documents required for compliance. The University will approve and sign all forms as applicant prior to submission to regulatory agencies.

2. UNIVERSAL DESIGN

   A. It is the intention of Oregon State University to develop a built environment which is universally designed to incorporate access for persons with disabilities as an integral element in anything built or purchased. The Design Professional will take the initiative to meet this value, which are not separate or special, but rather are universal in utility.

   B. Refer to Section 01 10 02 Accessibility Best Practices for OSU for more information.

3. SUSTAINABILITY

   A. New construction and major renovations at Oregon State University shall reach compliance under an OSU-approved external or internal green building rating system. Approved external rating systems include the current versions of 1) the LEED green building rating system, 2) Green Globes, or 3) Living Building Challenge. When external certification is determined by OSU to be unnecessary or impractical, OSU’s internal certification, known as OSU Requirements for Sustainable Development (RSD), shall be used. OSU RSD is a points-based system similar to other green building rating systems, where more sustainability related features result in more points awarded to the project. The RSD also requires all projects meet a minimum 50% point threshold, achieving at least half of the point applicable to that project. Projects are encouraged to reach 60% or higher, when possible, and emphasize measures that reduce energy consumption and long term costs.

   i. For all green building rating systems, OSU reserves the right to request documentation of design and construction practices that demonstrate compliance. Acceptable minimum certification levels are as follows.

      a. RSD: Acceptable (50% of available points)

      b. LEED (all tracks): Gold target, Silver minimum
c. Green Globes: 3 Globes target, 2 Globes minimum

d. Living Building Challenge: Certified Living.

B. Certain sections of the OSU Design & Construction Standards have been modified to guide accomplishment of this goal. It is the responsibility of the A/E to review these and other applicable criteria for appropriate inclusion.

4. SITE PLANNING

A. All site planning, design and development for new and existing construction (e.g., renovations and remodels, additions) for any building, structure, or facility located within the OSU campus boundary shall conform to all OSU plans and policies including, but not limited to, the OSU Corvallis Campus Vision, OSU Transportation Plan, OSU Campus Master Plan and all applicable land use regulations.

i. For the Corvallis campus, applicable Corvallis Land Development Code chapters include, but are not limited to, the following: Chapters 2.9, 3.36, 4.0, 4.1, 4.2, 4.7, 4.12, and 4.13.

ii. A copy of the Corvallis Campus Vision, OSU Transportation Plan, and OSU Campus Master Plan can be obtained from the Capital Planning and Development website.

iii. The Corvallis Land Development Code can be obtained from the City of Corvallis Planning Department. Refer to http://www.ci.corvallis.or.us/

B. The siting of new construction or the long-term use of land within the OSU Campus Master Plan boundary, as well as the schematic design of new and renovated facilities, is subject to review and recommendation by the Campus Planning Committee (CPC).

i. On major Capital Projects, preparation of CPC submittal materials is part of the Design Professional’s scope.

ii. Written narrative and drawings, such as site plans and elevations, shall be submitted to the Project Manager and University Land Use Planning (ULUP) staff forty-five (45) days prior to the CPC meeting.

iii. Submittal information to be confirmed with the OSU PM and ULUP staff and will be not limited to the following:

a. Project name

b. Project overview: provide a brief description of the project including the location, project description, proposed use(s), if the project involves any unique uses/features or relationships to adjacent buildings, and note any structural, landscape or infrastructure on the site that will be removed and/or demolished as part of the projects (as well as information on replacement if applicable).

c. Preferred location; including at least two preferred locations and describe the reason for these locations.

d. Adjacent building and/or structure name(s) and location(s)

e. Sector

f. Existing use of site

g. Proposed uses
h. Estimated building size; including estimated footprint, number of floors, and total square feet
i. Anticipated occupancy; including staff, student, other users if applicable
j. Parking Displacement: yes or no
k. Utility extension will be required: yes or no
l. Additional information pertinent to site request.
m. Graphic Materials (Exhibits) as PDF’s (standard 8 1/2 x 11 or 11 x 17)
   1) Site Location(s)
   2) Conceptual site (area) plan showing multiple buildings or structures (if applicable)
   3) Photo exhibits or mockup drawings (if available)

C. The siting and design of buildings and facilities shall conform to applicable design guidelines set forth in the
   Corvallis Campus Vision and OSU Campus Master Plan.

D. Site work drawing shall include at a minimum.
   i. Any drawings necessary to meet minimum submission requirements for the City of Corvallis.
      a. Include critical dimensions as required by code.
   ii. Proposed footprint of new building, structure, and/or facility.
   iii. The Development Area boundary as defined in Chapter 3.36: OSU Zone of the Corvallis Land
        Development Code
   iv. Adjacent streets; sidewalks, walkways, bike facilities.
   v. Lighting
   vi. Landscape features
   vii. Site furnishings
   viii. Transit stops (if applicable)
   ix. Parking areas for vehicles and bicycles
   x. Where applicable, the location of any Neighborhood Transition Areas as identified in Chapter 3.36: OSU
       Zone of the Corvallis Land Development Code.

5. SPACE ALLOCATION

   A. Space Standards and policies can be obtained from the Office of Capital Planning and Development, Space
      Management.

   B. All space at OSU is owned or leased by the university and is a shared and finite resource. Managing space
      efficiently reduces resource expenditures for operations and maintenance and reduces the need for capital
      construction. Allocating space judiciously ensures that existing space is managed efficiently, and new and
      renovated construction is planned realistically and conservatively. It is the intent of OSU to provide
      academic and administrative departments with a quality workplace environment that supports program
operations, preserves the value of space, promotes environmental sustainability and reduces operation and maintenance costs. OSU work space should support and improve the productivity of its employees/faculty and programs. Standards and practices for space planning will be used to achieve this goal.

i. Link to Office Space Standards: https://ufio.oregonstate.edu/space/office-space-standards

6. SPACE USE CATEGORIES
   A. See Appendix “Space Use Categories”

7. CATEGORIES OF BUILDING MEASUREMENT

8. OSU HISTORIC DISTRICT
   A. Development in the OSU National Historic District is subject to the requirements of the City of Corvallis Land Development Code, Chapter 2.9 – Historic Preservation Provisions and the OSU Historic Preservation Plan.

   i. The City of Corvallis has established procedures and standards for the review of all development in the OSU National Historic District. OSU’s University Land Use Planning (ULUP) staff prepares and submits Historic Preservation Permit (HPP) exemption requests and applications. Preparation of HRC-level application materials and presentation at the Historic Resources Commission hearing may be part of the Design Professional’s scope; in these instances, ULUP serves as a resource and liaison to the Design Professional and OSU Project Manager. Historic preservation permit applications shall be submitted by the ULUP staff to the City for review and approval.

   ii. For projects within the OSU National Historic District, the Design Professional is responsible to prepare HRC-level application materials and shall consult with the Project Manager and ULUP on requirements of submittal documents and process timelines. Application to the City is by ULUP.

   B. Refer to the OSU National Historic District map found at: https://fa.oregonstate.edu/university-land-use-planning/resources-forms/osu-national-historic-district-map

9. BUILDING EXTERIORS
   A. All exterior building features must meet or exceed Oregon Energy Code, Chapter 13, of the current Oregon Structural Specialty Code, and the current Oregon Occupational Health & Safety Code requirements.

   B. Select materials for compatibility with adjacent structures per the OSU Corvallis Campus Vision, OSU Campus Master Plan design guidelines, and OSU Historic Preservation Plan requirements.

   C. Exterior brick for the envelope must be of the highest quality selected for harmonious color, texture, appearance, the Pacific Northwest climate, and environmental impacts.

   D. Metal coping is required on all brick or masonry parapets.

   E. Asbestos containing materials are not allowed.

   F. Provide exterior architectural louvers with factory finish that does not require field painting. The Design Professional shall specify louvers.
10. RISK MANAGEMENT AND PROPERTY LOSS CONTROL

A. A project’s design may involve a Design Development and/or Construction Document plan review focused on building loss prevention, which involves submitting drawings and incorporating recommendations from OSU’s Risk Management and Property Loss Control engineering consultants. Coordinate submittal with OSU’s Project Manager.

B. Document Review during Construction
   i. Sprinkler Drawings and Calculations (See Section 07 10 00)
   ii. Roof Submittals (See Section 21 10 00)

11. ROOM NUMBERING

A. OSU has a specific system of numbering rooms within a building. Room numbering standards allow floor and room numbering and way-finding procedures to be applied consistently to all university buildings. They are provided for the use of Design Professionals for projects involving new construction. Existing university buildings will also be evaluated for these standards for remodel/renovation projects. Because room numbers affect emergency responders, as well as multiple campus databases, room numbers should not be changed without a formal review process by OSU Space Management.

B. Room numbering review by OSU Space Allocation Manager shall be at Schematic Design phase and before the Design Development documents submittal. Review will be coordinated through OSU Project Manager.

C. OSU Space Allocation Manager will validate the building number and address, any new room numbers, and identify rooms needing inactivation for interior room signage. The timing for these tasks is critical for entering information into the OSU space inventory database.

D. Any changes during construction that affect room numbering needs to be reviewed by OSU Space Allocation Manager for coordination with the OSU numbering system. Review will be coordinated with OSU Project Manager.

12. OWNER FURNISHED ITEMS

A. The Design Professional is to work with the OSU PM on confirming and determining Owner Furnished items during the design phases of the project. This discussion to include whether the Owner Furnished item is Owner Furnished, Owner Installed (OFOI) or Owner Furnished, Contractor Installed (OFCI).

B. The Design Professional is to include a list of OFOI and OFCI items in a log on the General (G-Sheet) Drawing(s) of the Construction Documents.

13. DESIGN & CONSTRUCTION STANDARD DEVIATION REQUEST PROCESS REQUIREMENTS

A. The Design & Construction Standard Deviation Request Process is for Design Professionals, including their consultants to request a deviation of items, products, strategies, etc. from the current version of the OSU Design & Construction Standards. Deviation requests to be submitted prior to end of Design Development (unless there is an approved exception by Project Manager for an unforeseen situation).

B. Deviations must meet all applicable codes.

C. A formal Design & Construction Standard Deviation Request and Project Management approval is required prior to any deviation from the Design & Construction Standards. Only upon prior approval can they be
included in SD, DD, or CD documents for review or implementation. It is the design professionals’ responsibility to meet the OSU Design & Construction Standards.

D. Submit requests using the provided Design & Construction Standard Deviation Request form.
   
i. Submit the completed request and required supporting documentation for consideration to the Project Manager who will coordinate with the appropriate OSU stakeholder(s) for additional signatures & comments from those impacted by the request.

E. The Design Professional is to include a log of approved Deviation Requests on their General (G-Sheet) drawing(s) in the Design Development Documents and Construction Documents.
OSU DESIGN & CONSTRUCTION STANDARDS DEVIATION REQUEST FORM

TO: _______________________________________________ (Project Manager)

PROJECT: ____________________________________________

STANDARD ITEM: _______________________________________

STANDARD SECTION NUMBER: ___________________________

PROPOSED STANDARD DEVIATION:
Attached data includes design or product description, specifications, drawings, photographs, performance and test data, product information, etc. adequate for evaluation of requested Standard deviation. Attached data also includes description of changes to related and/or impacted building system(s) or component(s) that will result from the requested Standard deviation.

Proposing party certifies that the following items are correct unless noted & described in attachments:
1. Proposed Standard deviation does not affect OSU maintainability/serviceability.
2. Deviations must meet all applicable codes.
3. Proposing party pays for changes to the building design and/or redesign caused by the Standard deviation.
4. Proposing party will supply appropriate detailing, specification, etc. for construction of the Standard deviation.
5. Proposed Standard deviation notes and describes all adverse effects on other trades, design schedule, drawing coordination, construction schedule, warranty requirements, project budget, etc.
6. Maintenance and service parts are available locally or readily obtainable for the proposed Standard deviation.

Proposing party further certifies function, appearance, and quality of proposed Standard deviation are equivalent or superior to the Standard.

Submitted by: _________________________________________

Firm Name: __________________________________________

For use by OSU Project Manager

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Comments:
Section 01 10 01: Administrative/Document Requirements for OSU

1. DRAWING REQUIREMENTS (DEPENDING UPON TYPE OF PROJECT)
   A. For projects that do not include an A&E design firm or are self-performed by OSU, marked-up record drawings are required, indicating the following.
      i. Modifications
      ii. Dimensions
      iii. Equipment lists
      iv. Other information necessary for ongoing operations and maintenance.
   B. For projects that include an A&E design firm, OSU requires the following.
      i. The Construction Drawings will be plotted on sheets not exceeding 30” x 42”.
      ii. All documents and drawings shall include the OSU Project Number on the Title Block.
      iii. The current OSU Design & Construction Standards Version/Date shall be referenced on the General Information/Drawing Index sheet.
      iv. The design professional will also provide OSU with a complete set of 'Record' drawings, and a full-size scanned image of each sheet in PDF format at a minimum resolution of 400dpi. All PDF files shall be correctly oriented (right-reading).
      v. If the work is performed through the OSU Shops, the appropriate vendor, contractor or internal construction group is responsible for providing these drawing updates at the completion of the project.

2. SCHEDULE OF REQUIRED DRAWINGS
   A. OSU requires the receipt of a complete set of the construction documents and Book Plan files (See Item 4: Book Plans) in digital form at the following stages.
      i. 100% Construction Documents or Bid Documents.
      ii. Record (as-constructed) drawings.

3. DIGITAL DRAWINGS
   A. Shall be AutoCAD Version- confirm version with OSU.
   B. Shall include all and fully resolved ‘External References (xref)’ (including nested xrefs). They shall be bound to the parent file using the ‘insert’ option of the ‘Bind xref’ dialog (in AutoCAD).
   C. Shall be accompanied by any associated plotter configuration file(s), font (shx), shape (shp), AutoDesk ‘object enabler’, and/or proprietary files necessary for reproduction.

4. BOOK PLANS
   A. OSU requires a 2 dimensional CAD drawing (internally referred to as “bookplan drawing) in a simplified format for each floor (and roof) of each project. The drawing format is easiest to create from Revit by using a pre-established procedure coordinating with the Space Management Office (SMO). The procedure includes steps to export a drawing with the correct layers and level of detail needed for this type of drawing. The
bookplan drawings to be developed from the final Construction Document drawings and modified by SMO if required after construction with review of the Record Drawings and a walkthrough of the space by SMO. If the source drawings for the project have been created using AutoCAD or another drafting software, coordinate with SMO (via the Project Manager) for instructions on how to best format drawing to maintain consistency with the OSU CAD drawing library.

5. BUILDING MAP
   A. Provide an “11x17” building map for each floor that clearly identifies the location of the building exits, elevators, fire extinguishers, ADA restrooms, men’s restroom, women’s, restrooms, unisex restrooms, fire alarm pull stations, and closest exit.

6. PUBLIC UTILITIES, PIPC only, MODIFICATIONS
   A. When a project involves the modification of public utilities (PIPC), OSU requires two (2) sets of digital and hard copy ‘Record Drawings’ within thirty (30) days following the local jurisdiction’s approval of that portion of the construction. The Design Professional shall provide one set to local jurisdiction’s Public Works Department, and one set to OSU.

7. LIFE SAFETY DRAWINGS
   A. Architectural drawings (may be on General/G-sheets) will include life safety drawings, which should include the following.
      i. Zoning requirements
      ii. Required side yards
      iii. Fire resistivity of exterior walls
      iv. Fire classification of the building’s construction type
      v. The sheet(s) will include floor plan drawing(s) indicating, but not limited to:
         a. Required fire classification of walls, doors, windows, and duct work.
         b. Area separation
         c. Flame spread characteristics
         d. Rated ceilings
         e. Allowable areas and proposed area.
         f. Allowable building height and proposed building height.
         g. Occupancy types and occupancy loads
         h. Number of stories, basements, and attics
         i. Other elements important to a zoning/life safety code check, as required by the AHJ, and Oregon Structural Specialty Code (OSSC).
         j. Identify means of egress including the path of the exit discharge to the public way.
         k. Location of fire extinguishers.
I. Location of exit signs.
   m. Location of knob box.

8. All Drawings to include a Graphic Scale - in all phases and on all sketches

9. MECHANICAL AND PLUMBING DRAWINGS

   A. Provide complete drawings suitable for competitive bidding. Drawing packages must include, but not
      limited to, the following as appropriate.
      i. Legend Sheet that includes all symbols used on the drawings with a description of what that symbol
         indicates. The symbols used shall comply with industry standards.

   B. Schedule Sheets
      i. Schedules for new and existing mechanical equipment shall include all performance data including
         capacity, air/water pressure drops, rpm, entering and leaving conditions, motor horsepower, KW, or
         amps, voltage/phase, basis of design manufacturer, location of equipment, identification numbers,
         unit physical dimensions, weight, and type of material
      ii. In the upper right hand corner, on the first sheet of the plumbing drawing, or on the title sheet of
          projects without separate plumbing drawings, include a O1."PLUMBING Fixture SCHEDULE." This
          information will be used in determining the fixture count for the City of Corvallis review.
      iii. List all abandoned, demolished or deleted fixtures as well as the new fixtures.
      iv. Plumbing fixture schedules shall include fixture identification, connection sizes for water, waste and
          vent, and gases.

   C. Riser Diagrams
      i. Modification to existing systems shall include the riser diagram for the existing systems and piping back
         to the nearest main branch.
      ii. Include diagrams for all mechanical systems including heating water, chilled water, condenser water,
          and refrigerant piping.
      iii. Include diagrams for all waste and vent systems, hot and cold water, and storm water systems.
      iv. Fire protection one line riser diagrams.

   D. Underground and Foundation Plans
      i. Indicate all buried piping, starting invert elevations, and invert elevations at point five feet outside
         building. Provide invert elevations on underground sanitary waste, storm, water, and other underground
         piping on plans.

   E. Mechanical Floor Plans
      i. Show all ductwork, piping, and equipment on floor plans at a scale to match the architectural plans.
      ii. Provide Enlarged or Partial Plans to adequately show the work in complex or confined installations.
      iii. Show locations of steam system anchors, slides, guides, and expansion joints.
F. Sections and Details for mechanical drawings
   
   i. Provide building sections to show locations of mechanical system components in relation to building elements. Mechanical components shall be coordinated with work of other trades.

   ii. Provide details for mounting or connection of equipment.

   iii. Provide pipe support and anchoring details for steam piping 4 inches and above.

   iv. Mechanical rooms shall be detailed at no less than \( \frac{1}{4} \)" per foot with piping and ductwork shown double line. Drops and offsets shall take into consideration the actual space it takes to make connections and turns.

10. SPECIFICATIONS

   A. Submit, as part of the design development package and at each construction document review stage, a list of equipment and the manufacturers to be used on the project in the CSI Master Format 2014.

11. REFLECTED CEILING PLANS

   A. The reflected ceiling plans shall locate, and not limited to, lighting fixtures, sprinkler heads, supply air diffusers, return air registers and all equipment mounted to or suspended from the ceiling.

   i. Lighting located to serve work stations may determine the direction of a ceiling grid pattern, location of fire sprinkler heads, and location of supply and return air inlets and outlets.

   ii. Orientation of the lighting fixtures may dictate that the ceiling grid be broken to accommodate some lighting fixtures.

   B. Ceiling Heights

   C. Ceiling Materials

12. WARRANTY REQUIREMENTS

   A. Minimum warranty for all material and workmanship for a minimum of 1-year after date of substantial completion OR for the extended period of time determined by manufacturer’s guarantee.

   B. Extended warranties may be required for specific items as noted in the Construction Standards.

   C. Correct immediately any failure caused by poor material or workmanship during warranty period; within 72 hours of notice.

   D. If the Project Manager or Facilities Services personnel are required to proceed with repairs, the responsible party of the warranty will be billed for costs and damages when failing to comply.
Section 01 10 02: Accessibility Best Practices for OSU

PART 1: PURPOSE

In the pursuit of becoming a fully accessible campus, Oregon State University expects all Design Professionals, consultants and service providers to design to 2010 ADA Standards for Accessible Design, the latest adopted edition of the Oregon Structural Specialty Code (OSSC), and to exhibit a commitment to employing Universal Design Principles in their service and product delivery. Consultants will engage with project representatives on how Universal Design Principles will enhance campus accessibility that will meet a variety of needs and create a campus that is accessible to everyone. The Design Professionals will ensure that the principles of Universal Design are considered to the project representative’s satisfaction.

PART 2: DESIGN PROCESS AND REVIEW REQUIREMENTS

1. ACCESSIBILITY CONSIDERATIONS AND REVIEW IN PROJECT DESIGN

A. University Facilities, Infrastructure, and Operations (UFIO) and Equal Opportunity and Access (EOA) are charged with developing and overseeing the implementation of a comprehensive plan for improving the accessibility of OSU’s built environment. UFIO and EOA shall be consulted if any of the following conditions exist:

i. Accessibility Best Practices for OSU cannot be strictly adhered to because of conditions beyond the control of the Design Professional.

ii. An element of the project requires further interpretation of the Accessibility Best Practices for OSU or further discussion to determine the most appropriate solution.

iii. Adhering to the Accessibility Best Practices for OSU is in conflict with the requirements of the Corvallis Historic Resources Commission, if applicable.

iv. The Design Professional believes an alternative solution meets or exceeds the functionality of the Accessibility Best Practices for OSU.

v. An element of the project will impact accessibility and the Accessibility Best Practices for OSU do not address the issue.

B. Design Review and Recommendations by UFIO and EOA. For all New Construction and Major Renovation projects, the Design Professional(s) (including architect/engineer and consultants), Capital Planning and Development Project Manager and Construction Manager assigned to the project, and project “client/partner” will engage in an initial accessibility design meeting with the ADA Coordinator in EOA and other relevant parties, as early as possible, to identify issues related to the specific project and to explore innovative approaches to accessibility. The following should be discussed:

i. Specific accessibility issues related to the projects; including known barriers within the facility and how the project will connect to the OSU Accessible Travel Grid.

ii. Opportunities for innovative solutions to provide a fully accessible and universally designed facility.

iii. How accessibility issues will be addressed and how the innovative solutions discussed above can be integrated into the design.

iv. Incorporation of the requirements of the Accessibility Best Practices for OSU.
C. Third-Party Review
   i. A third-party accessibility review shall be conducted on all new building construction and major renovation projects. A consultant, hired by OSU, may be contracted to provide the following services:
      a. Review drawings and specifications for accessibility at the schematic design phase.
      b. Review drawings and specifications at the construction document phase for accessibility.
      c. After each of the two phases of review, the consultant will provide OSU and the design team with input related to elements depicted on the documents that appear to be out of compliance and provide suggestions on how to improve accessibility.
      d. As a project approaches substantial completion, the consultant shall perform an on-site accessibility evaluation of the project to verify that all accessibility-related elements have been constructed as per the drawings and specifications. Any elements that are non-compliant shall be added to the punch list of items to be corrected.

PART 3: DESIGN ELEMENTS

1. APPLICABLE CODE, GUIDELINES AND STANDARDS
   A. All design work shall comply with all applicable sections of the following (or latest updates, as applicable):
      i. 2010 ADA Standards for Accessible Design
      iii. ICC/ANSI A117.1 – 2017 Accessible and Usable Buildings and Facilities (Referenced by OSCC)
      vi. ASME A17.1 – 2016 Safety Code for Elevators and Escalators
      vii. BHMA A156.10-2017 American National Standard for Power Operated Pedestrian Doors
      x. ORS 447.233 - Oregon Transportation Commission Standards for Accessible Parking Spaces (August 2018)
      xi. ORS 447.220 - It is the purpose of (state law) to make affected buildings, including but not limited to, commercial facilities, public accommodations, private entities, private membership clubs and churches in the state accessible to and usable by persons with disabilities, as provided in the Americans with Disabilities Act, and to make covered multifamily dwellings in the state accessible to and usable by all persons with disabilities, as provided in the Fair Housing Act.

2. REFERENCES
   A. The Principles of Universal Design – The Center for Accessible Design (NC State University – 1997)
   B. Access for Everyone – Dr. Arvid E Osterberg (Iowa State University - 2010)
C. Signs and the ABA/ADA – Sharon Toji (2010)


E. OSU Campus Pedestrian Facilities: ADA Assessment and Survey (includes recommended performance standards (pg.29-30) – SZS Consulting Group

F. Accessibility assessments for individual buildings (2012-2020)

3. ALTERATIONS TO EXISTING BUILDINGS

A. Alterations include, but are not limited to, additions, remodeling, renovation, rehabilitation, reconstruction, historic preservation, changes or arrangement in structural parts or elements, and changes or rearrangement in the plan configuration of walls and full height partitions.

B. All of the accessibility construction standards, contained herein, shall apply to existing buildings undergoing alterations unless technically infeasible.

C. The technical infeasibility of alterations shall be jointly determined by OSU’s Project Manager and the Design Professional in consultation with the EOA. EOA has final authority in determining “technical infeasibility.”

D. At a minimum, the alterations must include an accessible route connecting all functional areas in the building to nearby accessible parking and pedestrian routes. OSU maintains an Accessible Travel Grid; whereas, all projects must connect to this grid even if barriers needing to be remedied, within reason as determined by the Project Manager and EOA, are outside of the traditional scope of the project.

E. At least 25% of the alteration cost must be spent on accessibility improvements per the 2019 Statewide Code Interpretation (ADA requires 20%, but OSSC requires 25%)

   i. Exceptions (as per OSSC)

      a. Alterations limited solely to windows, hardware, operation controls, electrical outlets, signs, roofs, siding, and general maintenance upgrades.

      b. Alterations limited solely to mechanical systems, electrical systems, fire protections systems or hazardous material abatement

      c. Alterations undertaken solely by the purpose of increasing accessibility.

F. The accessibility improvements shall be prioritized as follows:

   i. Parking

   ii. Accessible entrance

   iii. Accessible route to the altered area

   iv. At least one accessible restroom for each sex or a single unisex restroom

   v. Accessible telephones

   vi. Accessible drinking fountains

   vii. Additional accessible elements
4. **BUILDINGS WITHIN THE OSU/CORVALLIS HISTORIC DISTRICT**

   A. All of the accessibility construction standards shall apply to any buildings located within the Oregon State University Historic District undergoing alterations unless technically infeasible. This is in addition to the requirements listed above in the section Alterations to Existing Buildings.

   B. Where compliance would threaten or destroy the historic significance of a building as determined by the City of Corvallis Historic Resources Commission, alternative solutions must be implemented to ensure accessibility.

   C. At least one accessible entrance from an accessible route shall be provided. The preference is to make at least the main entrance accessible, when all public entrances cannot be made accessible. Any decision to make less than 60% of the entrances accessible during major renovation must be approved by the City of Corvallis Historic Resources Commission and discussed with EOA.

   D. Alternative solutions shall be provided to OSU’s satisfaction. Decisions on alternative solutions must include and be approved by EOA.

   E. Where the alteration to existing restrooms would adversely affect the historic significance of a building, at least one fully accessible family or assisted-use toilet room shall be provided.

5. **DESIGN SPECIFICATIONS**

   A. The following design specifications should be incorporated into all new construction. In alteration work, these specifications should be utilized to the greatest extent feasible.

      i. **Building Blocks**

         a. **Floor and Ground Surfaces**

            1) Use hard or resilient flooring in high traffic, general university areas such as lobbies, corridors, restrooms, and other common areas along all accessible routes.

            2) Carpet should only be used within general use circulation areas where it is not a part of an accessible route or in areas where acoustics are a concern, such as in residence hallway.

            3) Where carpet is used, use only short-pile carpet tiles.

            4) At entrances to buildings, provide recessed walk-off mats that are flush with the adjoining floor surface.

            5) Pavers or stamped concrete should not be used on accessible paths of travel. Pavers may be used in other areas, but must be set in mortar on a concrete slab and have flush joints. Stamped concrete, if used, should not have joints larger than 1/8” wide.

      ii. **Turning Space**

         a. Provide elongated circle minimum turning space (67-inches x 78-inches). (ADA allows a 67-inch radius or a T-shaped turning area in new buildings or 60-inch radius or T-shaped turning area in existing buildings)

         b. Only use 60-inch radius and T-shaped turning space in alterations where space for the elongated circle is not available.
iii. Floor and Ground Clear Areas
   a. Provide clear floor areas with minimum dimensions of 36-inches x 54-inches. (ICC A117.1 allows 30-inches x 52-inches in new buildings)

iv. Knee Space
   a. Provide 30-inch minimum knee space under tables and counters, wherever possible. It is acknowledged that this amount of knee space is not available with lavatories due to lavatory bowls and plumbing. (ADA allows 27-inch minimum.)

v. Reach Ranges
   a. Provide all controls for building occupants between 18-inches and 43-inches above the floor. (ADA allows 15-inch to 48-inch or up to 44-inches over counters up to 25-inch deep.)
   b. Controls and objects shall be placed at least 18-inch away from inside corners of walls to allow for wheelchair access.
   c. Locate outlets and other objects that are normally closer to the floor at a consistent height of 18-inches above the floor measured to the centerline of the outlet or object. (ADA allows outlets to be located as low as 15-inches.)

vi. Operable Parts
   a. Operable parts intended for public use, such as automatic door operators, emergency call boxes, switches, or controls, shall be designed with a minimum 36” x 54” clear floor or ground space having a maximum slope of 1.5% (1:66.7) in any direction.

B. Exterior Accessible Routes
   i. Paths of Travel
      a. All projects must connect to the OSU Accessible Travel Grid, an integrated pathway connecting every building with at least one accessible route. OSU Project Managers can provide this map.
      b. All projects must consider connections from the project site to accessible parking as well as to accessible routes of travel that connect the building to the rest of campus to ensure that we are creating an integrated campus.
      c. When an accessible route of travel needs to be closed for construction purposes, the Design Professional shall direct the contractor to either provide an alternate accessible route or provide signage that directs people to the nearest accessible route.
      d. Where an accessible route intersects with multiple routes where one or more routes are not accessible, provide signage directing people to the accessible route.
      e. Minimum walkway width: 60-inches (ICC A117.1 minimum is 48-inches). See Street Standards in Section 34 00 00 Transportation of OSU Design & Construction Standards on required widths of walks.
      f. Design accessible exterior routes without ramps whenever possible.
g. Whenever possible, locate items such as cleanouts, vault covers, grates, and similar items outside of the path of travel. When these items are located within the path of travel, they shall be flush with the surrounding walk.

h. For exterior routes, choose alternatives to ramps (such as sidewalks and proper grading) to achieve gentler slopes.

i. Maximum running slope: 1:25 (4%). The ADA allows up to 1:20 or just over 5%.

j. Note: 1:25 (4%) slopes cannot always be met due to existing conditions and grades. Grades up to 1:20 (5%) are allowable where existing conditions prevent lesser grades.

k. Where design slopes on walks approach 1:20 (5%) due to existing conditions, consider the incorporation of a ramp or ramps to provide reduced slopes along the majority of the route. Ramps may be preferred over long stretches of walks at maximum allowable grade.

l. On accessible routes with slope greater than 4%, landings shall be provided at least every 50 feet. Consider the placement of benches or other seating elements at the landings.

m. Maximum cross slope: 1.5% (1:66.7) ADA allows 1:48 or just over 2%. This is to ensure that, with construction tolerances, the resulting slope will be less than 2% (1:48).

n. The specifications or drawing notes should clearly state that any pathways or sidewalks that are constructed with slopes exceeding 2% (1:48) cross slope or 1:20 (5%) running slope shall be replaced at the contractor’s expense. Determinations of non-compliant slopes will be at the discretion of OSU EOA representative via the OSU Project Manager/Construction Manager, measured using a two (2)-foot digital level.

o. Along open walkways, provide minimum of 12-inch of landscaping along edges of walks that are flush with walk or provide edge protection such as a curb. This does not apply to the street side of curbside sidewalks.

p. Bicycle parking should not be located within paths of travel. See OSU Construction Standards Section 34 00 00.

ii. Exterior Ramps

a. When a ramp is necessary, design the ramp slope between 1:20 (5%) and 1:16 (6.25%). Strive for the least amount of slope that is feasible. (ADA allows 1:12 (8.33%) maximum slope for ramps.)

b. Individual sections of ramps shall not be longer than 25-feet without a level landing.

c. Install handrails with centerline of handrail at 36-inches above ramp surface. (ADA allows 34-inches to 38-inches) Also, include handrail at 26-inches in locations used primarily or frequently by children.

d. Avoid curved ramps.

e. Where possible, provide a minimum 60-inches x 72-inches area at top, bottom, and intermediate landings.

f. The cross slope of ramps and landings shall be 1.5% (1:66.7) maximum. ADA allows up to 2% (1:48). This is to ensure that, with construction tolerances, the resulting slope will be less than 2% (1:48).
g. The specifications or drawing notes should clearly state that any ramp sections that are constructed with slopes exceeding 2% (1:48) cross slope or 8.33% (1:12) running slope shall be replaced at the contractor's expense. Determinations of non-compliant slopes will be at the discretion of OSU EOA representative via the OSU Project Manager/Construction Manager, measured using a 2-foot digital level.

h. Provide continuous handrails around the perimeter of intermediate landings.

i. The minimum widths required for all ramps and landings are to be the dimensions between handrails.

j. When using steel pipe or tubing, provide minimum wall thickness of .140".

k. Round handrails are preferred.

iii. Exterior Stairs

a. Do not design a step with a single riser, design a sloped walkway instead.

b. Ensure that the leading edge of treads contrasts with the rest of the treads to increase visibility and safety where appropriate. Provide a contrasting strip on the leading edge of the tread that extends a total of 2-inches back from the leading edge of each tread. Integral, colored, cast-in-place stair nosings are preferred. Federal yellow or white.

c. Slope treads of exterior stairs 1.5% (1:66.7) slope toward the leading edge of the treads. This is to ensure that, with construction tolerances, the resulting slope will be less than 2% (1:48).

d. Install handrails with centerline of handrail at 36" above nosings. (ADA allows 34-inches to 38-inches.) Also, include handrail at 26-inches in locations used primarily or frequently by children.

e. OSSC requires that there be handrails within 30-inches of any portion of a stair that is determined to be an egress route. On exterior stairs that are not part of an egress route, provide intermediate handrail(s) evenly spaced in increments not exceeding 8-feet.

f. Provide continuous handrails around the perimeter of intermediate landings.

g. When using steel pipe or tubing, provide minimum wall thickness of .140".

h. Round handrails are preferred.

C. General Site Elements

i. Accessible Parking

a. See Oregon Transportation Commission’s (OTC) Standards for Accessible Parking Places. The following shall be supplemental to the OTC standards. Where conflicts exist, the following standards shall prevail.

b. Parking stalls shall be designed to be a minimum 9-feet wide by 18'-6" deep. (ADA allows 8-feet wide stalls.)

c. Standard access aisles shall be a minimum of 6-feet wide (ADA allows minimum of 5-feet)
d. Access aisles adjacent to van accessible or wheelchair accessible spaces shall be a minimum of 8-feet wide (ADA allows 8-feet access aisle with 8-feet wide parking space or 5-feet access aisle with 11-feet wide parking space; OSSC requires minimum of 17-feet overall.)

e. Both parking spaces and access aisles should be designed with a maximum slope of 1.5% (1:66.7) in any direction. This is to ensure that, with construction tolerances, the resulting spaces and access aisles will be less than 2% (1:48) and still provide enough slope for drainage.

f. The specifications or drawing notes should clearly state that any accessible parking spaces or access aisle slopes that exceed 2% (1:48) shall be replaced at the contractor's expense. Determinations of non-compliant slopes will be at the discretion of OSU, measured using a 2-foot digital level.

g. All accessible parking spaces and access aisles shall be constructed with concrete to allow for better control of slopes during construction.

h. Where adjoining walks are less than 8-feet wide, wheel stops should be used to ensure maneuvering clearance is maintained.

i. Curb ramps serving accessible parking spaces shall not receive detectable warning.

j. Accessible routes from parking access aisles should not cross behind vehicles or go into vehicular traffic.

k. Accessible parking signage should not be located within a pedestrian way unless location elsewhere would place the sign too far from the accessible parking space. When it becomes necessary to install an accessible parking sign in a pedestrian way, the bottom of the sign should be at a minimum height of 84-inches.

l. Ensure that all access striping includes a “No Parking” pavement marking. In areas that are high traffic, where the access aisle is hard to see, or where snow or sand may cover the access aisle striping, install signs that read “Access Aisle No Parking” at the head of the access aisle. (New 2018 OTC standard).

m. Parking Meters: Coin slots and credit card swipes for accessible parking spaces or pay stations that serve accessible parking spaces shall be located at a height between 24-inches and 43-inches. The height of any visual display shall be no greater than 38-inches.

n. Electric Vehicle Charging Stations: An accessible electric vehicle charging station should have all controls at a height between 24-inches and 43-inches. The height of any visual display shall be no greater than 38-inches. At least one, but no less than one in each five electric vehicle-charging stations in a grouping, shall be accessible.

ii. Accessible Parallel Parking Spaces (Passenger Loading Zones, similar)

a. Accessible parallel parking spaces are not the preferred type of accessible parking space, but may be the only option for providing accessible parking near a facility.

b. When provided, provide 8-feet wide by 24-feet long parking space with a 67-inches wide access aisle, 8-feet wide access aisle if possible for van access.

c. Provide accessible parking signage adjacent to the parking space from 4-feet behind the front of the parking space, angled toward the street.
iii. Curb Ramps
   a. Provide curb ramps where accessible routes cross curbs and where blended transitions are not provided.
   b. Unless limited by existing conditions, provide maximum slope of 1:14 (7.14%) on ramp and flared surfaces.
   c. Provide minimum 48” x 60” (in direction of travel) landing at sidewalk at top of curb ramp. Maximum slope on landings to be 1.5% (1:66.7).
   d. Do not install diagonal curb ramps.
   e. Maximum gutter counter slope shall be designed at 4.5% (1:22.2). This is to ensure that, with construction tolerances, the resulting gutter counter slope does not exceed 5% (1:20).
   f. Minimize the slope at the landing at bottom of the curb ramp to the greatest extent possible. Consider going to a blended transition at intersections where the crown of the existing street creates excessive slope at the gutter line.
   g. Do not paint curb ramp surfaces.
   h. Provide safety yellow detectable warning on all curb ramps that lead to a vehicular crossing. In general, driveways are excluded unless it is determined that the anticipated volume of traffic entering or exiting a driveway warrants detectable warning.
   i. When new curb ramps are installed as part of a project, existing, non-compliant curb ramps shall be replaced on the opposite side of the street, as applicable.

iv. Driveways
   a. Driveways that cross sidewalks shall be designed such that:
      1) The sidewalk at the top of the sloped driveway has a maximum cross slope of 1.5% (1:66.7) providing a continuous clear pedestrian access route.
      2) An option for a narrow curbside sidewalk, although less desirable, would be to provide sloped 1:14 (7.14%) ramps along the sidewalk on either side of the driveway (so the sidewalk is closer to street grade) and slope the driveway up beyond the sidewalk. The sidewalk portion should have a maximum 1.5” (1:66.7) cross slope. (See Diagram 01 10 02A at the end of the Section)
   b. In general, driveways shall not receive detectable warning. At driveways that have high traffic volumes and driveways to large parking lots, detectable warning may be warranted. EOA and Inclusion shall be consulted to make the determination as to whether or not a driveway is considered high volume.

v. Site Furnishings
   a. Where benches are provided, provide at least one fully accessible bench in each grouping of benches. Where multiple benches are provided, provide at least one accessible bench for each five benches in a grouping or portion thereof.
   b. Provide companion seating adjacent to a minimum of 50% of all benches.
c. Where picnic tables are provided, provide at least one accessible picnic table in each grouping of picnic tables. Where multiple picnic tables are provided, provide at least one accessible picnic table for each five picnic tables in a grouping or portion thereof.

vi. Loading Docks and Service Yards

a. Whenever feasible, do not design loading docks and service yards where vehicles will encroach onto a sidewalk or pathway. This, though temporary, will cause someone with a disability to backtrack and may block the only or most accessible route through a site.

b. Where it is not feasible to avoid encroachment onto a sidewalk or pathway, ensure that another pathway in close proximity exists to get around the vehicle, and ensure that it is easily findable.

D. Interior Accessible Routes

i. Accessible Routes

a. Minimum width: 60-inches (ICC A117.1 minimum is 48-inches)

b. Design accessible routes without ramps whenever possible.

c. Elevators are preferred over ramps wherever level changes greater than three vertical feet are necessary.

d. Avoid the use of vertical platform lifts in new construction. In existing buildings, vertical platform lifts may be an option for making an area accessible, but should always be the last resort.

e. Ensure that the lighting levels on ramps and stairs are at least equivalent to the lighting levels in adjacent areas.

ii. Interior Ramps

a. When a ramp is necessary, design the ramp slope between 1:20 (4%) and 1:16 (6.25%). Strive for the least amount of slope that is feasible and meets code and ADA. (ADA allows 1:12 (8.33%) maximum slope for ramps.)

b. Install handrails with a centerline of handrail at 36-inches above ramp surface. (ADA allows 34” to 38”). Also, include handrail at 26-inches in locations used primarily or frequently by children.

c. Avoid curved ramps.

d. Where possible, provide a minimum 60” x 72” area at top, bottom, and intermediate landings.

e. Provide continuous handrails around the perimeter of landings.

f. When using steel pipe or tubing, provide minimum wall thickness of .140”.

g. Round handrails are preferred.

iii. Interior Stairs

a. Do not design a step with a single riser.

b. Ensure that the leading edge of treads contrasts with the rest of the treads to increase visibility and safety where appropriate. Provide a contrasting strip on the leading edge of the tread that extends a total of 1” to 2” back from the leading edge of each tread
c. Install handrails with centerline of handrail at 36-inches above stair nosings. (ADA allows 34" to 38"). Also, include handrail at 26-inches in locations used primarily or frequently by children.

d. OSSC requires that there be handrails within 30-inches of any portion of a stair that is determined to be an egress route. On stairs that are not part of an egress route, provide intermediate handrail(s) evenly spaced in increments not exceeding 8-feet.

e. Provide continuous handrails around the perimeter of landings.

f. When using steel pipe or tubing, provide minimum wall thickness of .140”.

g. Round handrails are preferred.

h. Lighting levels for stairwells is allowed to be 1 f.c. as long as there are occupancy sensors that increase light levels to at least 10 f.c. when the sensors detect a person in the proximity of the stairwell.

iv. Elevators

a. Provide hall call buttons that fully illuminate and are bright and are easy to recognize when activated.

b. Use flat-surfaced, raised buttons because they are easier to activate than convex buttons.

c. Hall call buttons shall be located with the down button centered at a height of 35-inches above the floor. The up button shall not be located more than 43” above the floor (ADA allows a range of 15-inches to 48-inches; State Elevator Code allows a range of 35-inches to 48-inches).

d. All car controls and emergency buttons (inside elevator) shall be located so that the lowest button is centered at a height of 35-inches and the highest buttons is centered at a height of 48-inches or less. (The State Elevator Code requires all buttons to be located between the height of 35-inches and 48-inches).

e. In public elevators serving high-use buildings, install two sets of buttons, one with the highest buttons located at 48-inches and the second set with the lowest buttons located at 33-inches. The lower set of buttons shall be mounted with the longest dimension horizontal.

1) The Design Professional, OSU Project Manager, and EOA, during the project review process described in Part 2 above, shall determine whether or not a building would be considered “high-use”, on a case-by-case basis.

2) Provide a handrail on every wall of elevator cabs except those walls that have either doors or elevator controls. The handrails should be located at a height of 32-inches.

f. In new construction, provide at least one elevator cab that can accommodate an ambulance stretcher (84-inches long minimum). In buildings that have an emergency generator, this elevator should be tied into the emergency system. See the current Oregon Elevator Specialty Code

g. See Section 14 20 00 in the OSU Construction Standards for additional elevator requirements.

E. General Building Elements

i. General Design
a. When designing rooms and spaces, include furnishings, trash receptacles, and other moveable objects in the design drawings to make sure these items will not encroach on accessible routes, turning spaces and required clear floor spaces. The design should incorporate space for these items.

ii. Building Ingress and Egress

a. Where technically feasible, all public access points to a new building or major remodel/renovation should be made accessible.

1) This includes changing out door knobs to lever handles or other acceptable accessible door hardware satisfying accessibility and fire & building code exiting/egress requirements.

b. In those cases where at least 60 percent of all public entrances cannot be made accessible due to technical infeasibility, the EOA will be contacted and will review the design. EOA has final authority in determining “technical infeasibility.”

c. Provide clear means of egress from all areas of a building.

iii. Access to Public Areas

a. In new construction and major renovation work, all public areas must be made accessible including multi-leveled classrooms, sunken areas, loggias, raised platforms, and mezzanines.

iv. Doors and Door Openers

a. Provide automatic door operators on all primary entrances to a building. Where vestibules exist, ensure that there is an operator, or some other mechanism, within the vestibule so that if someone gets stuck in-between doors there is a way to open the doors automatically. This sensor should be programmed to open both doors.

b. Install infrared sensors, push button controls, proximity card readers and other door control devices at a height of 36-inches.

c. Provide a clear floor space at these door control devices that is level and located outside the swing of the door.

d. Do not install doors that are narrower than 36-inches wide or shorter than 84-inches tall. (ADA requires a minimum 32-inches clear.)

e. Avoid doors that swing out into corridors or accessible routes of travel. Exceptions include classrooms and other spaces that are required to open outward for emergency egress and electrical, telecom, mechanical rooms that are used infrequently. Doors that are required to open out into corridors or public spaces should be designed within alcoves when feasible.

f. Install magnetic hold open devices or high quality automatic door openers on internal doors and fire doors in corridors, and other areas accessible entrances and along accessible routes within buildings.

g. The preferred height for handles, pulls, latches, locks, and other operable parts on accessible doors is 39-inches above the floor.
v. Windows
   a. Provide adequate clear floor space at any operable window so that a person can approach and open the windows.

vi. Furnishings
   a. Where seating, benches, tables and other furnishings are provided, provide a minimum of one accessible unit for every five units or portion thereof.

F. Plumbing Elements and Facilities
   i. Restrooms and Toilet Rooms
      a. In new construction and major renovation, all restrooms shall be designed to be fully accessible.
      b. All restrooms shall be designed either without doors or if not possible, to have automatic door operators. (See Section 08 71 00 Door Hardware.)
      c. In addition to the required restrooms per applicable building code requirements, at least one single user restroom (also referred to as gender inclusive, assisted use, or family restroom) shall be provided. If only one restroom is provided, then it shall be located on the first floor of the building.
      d. All single user restrooms shall be provided with a Camden entry system. (See OSU Design & Construction Standards Section 08 71 00 Door Hardware.)
      e. In restrooms that include two or more toilets, provide at least one wheelchair accessible stall and one ambulatory accessible stall.
      f. In larger public restrooms containing six or more toilets, provide one wheelchair accessible stall and one ambulatory accessible stall for each six toilet stalls or portion thereof.
      g. If wall mounted water closets are specified, consider installing a bariatric rated unit for a minimum of 500 lbs in at least the wheelchair accessible user location.
      h. Provide 48-inches minimum clearance between stall doors and any wall or obstruction. (ADA allows 42-inches for latch side approach.)
      i. OSU Corvallis campus does not allow automatic flush valves. Where dual-flush valves are used, lever controls are acceptable, but must be located in an accessible location and per ADA.
      j. Ambulatory toilet stalls shall be designed to be 36-inches in width (ICC A117.1 allows 35”-37”).
      k. Install toilets so seat height is at 18” (ADA allows 17-inches to 19-inches) and centerline of toilet is 17-inches from wall (ADA allows 16-inches to 18-inches).
      l. Install grab bars with centerline of grab bar at 34-inches height. (ADA allows 33-inches to 36-inches.)
      m. Install vertical grab bar as per ICC A117.1
   ii. Lavatories
      a. In new construction, make all lavatories accessible.
b. Install ADA accessible faucet controls. (Automatic controls not recommended by OSU due to maintenance issues.)

c. Provide tempered water (120 degrees maximum).

iii. Urinals

a. Install ADA accessible flush valves. (Automatic controls not recommended by OSU due to maintenance issues.)

b. Where urinal partitions exceed 24-inches in length, provide 36-inches minimum width clear at urinal.

iv. Showers

a. Install roll-in showers that are 42” x 60” minimum. (ADA allows 30” x 60”.)

b. Provide a clear floor space of 36” x 60” minimum outside of transfer shower stalls and 42” x 60” minimum at roll-in shower stalls. (ADA allows 36” x 48” and 30” x 60”, respectively.)

c. Install shower seats at 18-inches height. (ADA allows 17-inches to 19-inches.)

d. Install shower controls at 43-inches (ADA allows 38-inches to 48-inches.)

e. Mount grab bars at 34-inches (ADA allows 33-inches to 36-inches.)

f. Provide vertical grab bar in roll-in showers.

v. Locker Rooms

a. Provide accessible lockers on accessible route.

b. Accessible lockers should be located close to the entrance to locker room and near showers.

c. Accessible lockers should be located within the 18-inches to 43-inches reach range and be furnished with lever handles.

d. All locker rooms shall be equipped with an accessible bench.

vi. Toilet Accessories

a. Mount toilet paper dispensers below grab bars at 29-inches and out from the front edge of the toilet centered a distance of 8-inches (ADA allows 7-inches to 9-inches). Ensure the operable part of the dispenser is at least 18-inches above the floor (ADA allows 15-inches) and that there is at least 1.5” from the top of dispenser to the bottom of the grab bar.

b. Mount toilet seat cover dispenser on opposite wall or partition from side grab bar. The opening should be at a maximum height of 43-inches.

c. Mount fixtures (including hand dryers, paper towel holders, and soap dispensers) with controls at 43-inches. (ADA allows up to 48-inches)

d. Locate paper towel dispensers and hand dryers in locations that are not within an accessible route of travel. Consider using a recessed unit that does not protrude from the wall more than 4”. (The OSU standard paper towel dispenser protrudes out from the wall approximately 9 inches and does not comply with ADA requirements if installed with open space below.)
e. The same applies to hand dryers.

f. If provided, install baby changing table so that the front edge is at 34” above the floor.

g. Mount mirrors with bottom edge of reflective surface no higher than 38” above the floor (ADA allows maximum of 40”) Provide full height mirrors, where possible.

vii. Drinking Fountains

a. Install dual-height accessible drinking fountains or water coolers near lecture halls, auditoriums and other high-use areas. (Option: two separate units)

b. Provide water bottle fillers on the lower unit.

c. Provide alcoves for drinking fountains. Wheelchair accessible drinking fountains typically extend out from walls. This creates a potential protrusion hazard.

G. Communication Elements and Features

i. Parking Signage

a. See Accessible Parking under Item C. General Site Elements above for accessible parking signage.

ii. Exterior Signage

a. When all entrances are not accessible, provide signage that directs people to the accessible entrances.

b. Accessible entrances shall have the International Symbol of Accessibility (ISA) signage installed.

c. Reserved for future use: standard exterior entrance ADA sign standards.

iii. Interior Signage

a. Provide room numbers on all rooms in both raised text and Braille.

1) In addition, provide room names in both raised text and Braille at all permanent rooms (where the name of the room is not expected to change). Consult with the project manager and the ADA coordinator in EOA, as needed, to determine these designations.

2) Raised text does not have to be the same as the visual characters, but they can be. The difficulty is, on some signs visual characters generally need to be larger to be seen from a distance, and they need contrast. Raised text generally should be smaller to be felt more easily, and does not need contrast. When these can be combined into one design (raised text that is smaller with good light/dark contrast) this is a good universal standard, for signage that needs larger visual characters create two signs or one sign that has both large visual characters and smaller raised characters.

b. Visual and tactile signage indicating the floor level should be provided at all stairwells.

c. Signs shall be non-glare.

d. Provide the International Symbol of Accessibility on all restroom signage. (ADA and OSSC does not require the International Symbol of Accessibility if all restrooms are accessible.)
e. Provide directional signage to the nearest accessible restroom when a restroom is not accessible and the closest accessible restroom is not within line of sight.

f. Provide Grade 2 Braille on all signage required to have Braille. This is an abbreviated form of Braille.

g. The base of all raised text and Braille is to be located between a height of 48” and 60” (New ADA requirement). Lower is generally more accessible.

h. Where pictograms are used, raised text and Braille should be located below the pictogram.

i. All doors with automatic door operators should have signage on the door indicating that it is an automatic door. The signage should be on both sides of the door.

iv. Tactile Exit Signs – Provide tactile exit signs wherever visual exit signs are required. The tactile exit signs should be located adjacent to the latch side of doors or openings at a height between 48-inches and 60-inches. Exit signs shall be provided as follows:

a. "EXIT" where exit signs lead to a safe exterior space.

b. "EXIT STAIR DOWN (or UP)" where exit signs lead to stairs leading to an exit.

c. "EXIT RAMP DOWN (or UP)" where exit signs lead to ramps leading to an exit.

d. “EXIT ROUTE” at locations where lit exit signs direct a person to an exit but not directly to a safe exterior space.

v. Fire Alarm Systems

a. Fire alarm strobes shall be located such that no two strobes are visible from the same location.

b. If due to Fire Code requirements, fire alarm strobes need to be located such that two or more strobes are visible from the same location, extra precaution should be taken to ensure that the strobes are perfectly synchronized.

vi. Assistive Listening Systems

a. Where sound systems are provided, assistive listening devices shall be installed as part of the system.

b. At least 25%, but no fewer than 2 receivers shall be hearing aid compatible.

c. The assistive listening system shall be as specified by the OSU Information Services Office of Academic Technology – Classroom Technology Services, and Disability Access Services.

H. Special Rooms, Spaces, and Elements

i. Classrooms

a. Design classrooms without ramps or lifts, whenever feasible.

b. The slope of walking surfaces shall not exceed 1:20.

c. If elevated stages or teaching platforms are provided, they shall be on an accessible route internal to the classroom.

d. Provide a minimum of 42" clearance between aisles that lead to accessible seating.
e. Wheelchair accessible spaces should be adjacent to an accessible route.

f. A clear line of sight to the instructor and media shall be provided at wheelchair accessible spaces.

g. In classrooms with occupancy of 100 or more, wheelchair and accessible seating should be dispersed to provide a variety of viewing angles. Where fixed furniture is installed, wheelchair accessible seating shall be dispersed to the top, middle, and bottom of the classroom.

h. All accessible spaces and furniture shall be provided with signage indicating that the space is reserved for people with disabilities.

i. Spaces for wheelchair users should be a minimum of 36-inches wide by 48-inches deep (60-inches deep, if side access).

j. Classroom Furniture shall comply with Section 12 56 33: Accessible Classroom Furniture.

ii. Kitchens

a. Where kitchen ranges or stove tops are installed, provide units with controls located near the front of the units.

b. Where a microwave is provided, locate the unit such that the microwave door and all controls are located at a height not exceeding 43-inches in height.

c. At kitchen counters, sink faucet controls shall be located within 20-inches of the front edge of the counter. Consider side mounted controls located within 16-inches of the front edge of the counter where feasible.

iii. Cafeterias

a. The tops of tray slides shall be located at a height of 33-inches (ADA allows 28-inches to 34-inches.)

b. Accessible self-service shelves and dispensing devices shall be located at a maximum height of 33-inches (ADA allows 15-inches to 48-inches or 44-inches over counters up to 25-inches deep.)

c. If dispensing devices are on a counter, the counter should be at a maximum height of 34-inches.

iv. Research Stations and Laboratories

a. Provide a minimum of one accessible workstation. Provide one accessible workstation for every twenty workstations or portion thereof.

b. Accessible work stations should have counters and sinks at 34” maximum height and compliant knee space.

c. At an accessible work station, locate sink faucet controls along the side of the sink within 16-inches of the front edge of the counter. The outflow of faucet spigot shall not be located more than 16” from the front edge of the counter.

d. Provide controls for fans, fume hoods, gas valves, etc. at a maximum height of 43-inches. (ADA allows 15-inches to 48-inches or 44-inches over counters up to 25-inches deep.)

v. Recreation Facilities

a. Fitness and Weight Room
1) Provide accessible fitness equipment that provides the same range of exercises and strength training provided by the rest of the equipment. Where feasible, provide some equipment that can be used by both able-bodied individuals as well as persons with disabilities.

2) Provide minimum 42-inches clearance between all pieces of exercise equipment.

b. Pools and Spas

1) Provide at least two accessible means of access into all pools. At least one of these means of access should be either a pool lift or a sloped entry.

2) Provide at least one accessible means of access into all spas. The accessible means of access should be either a pool lift, transfer wall or transfer system.
Section 01 35 43: Environmental Procedures and Requirements for OSU

1. Environmental Health & Safety (EH&S) MITIGATION REQUIREMENTS

Environmental Mitigation requirements may include, but are not limited to, procedures and standards to control.

A. Dust Control and Fugitive Emissions

   i. Construction project activity shall not cause or permit the emission of any particular matter at sufficient duration or quantity as to create a nuisance or observable deposition upon real property of another person.

   ii. Reasonable precautions to control particulate emissions can include but are not limited to:

       a. Use of water or chemicals for control of dust during demolition of structures, construction, or during grading of roads or clearing of land.

       b. Covering at all times when in motion, open bodied trucks transporting materials likely to become airborne.

       c. Full or partial enclosure of stockpiled materials.

       d. Dirt or debris spilled onto paved surfaces should be swept up immediately to reduce re-suspension of particulate matter caused by vehicle movement.

B. Odors

   i. Work that causes excessive odors shall be performed only after coordination with the OSU Project Manager. Filtering of air intakes may be needed to prevent odors and vapors from entering buildings.

   ii. In cases where unavoidable odors will be produced, Contractor shall provide seven (7) business days advance notice to the OSU Project Manager in order that adequate notice can be forwarded to building occupants. Work stoppage may occur if advance notification has not been coordinated or odors and vapors from the work are found to generate complaints from building occupants.

C. Protection of Existing Air Handling Systems

   i. Contractor shall be responsible for protection of the cleanliness of existing air handling systems at all times. This protection may include as needed:

   ii. During site work or building demolition, pre-filters shall be provided and maintained on all building outside air intakes and adjacent neighboring buildings at all times throughout the construction duration.

   iii. During any interior work that may create dust in the interior space and adjacent corridor/hallways, air filters shall be provided and maintained on all affected air return and exhaust grilles. Where air flow in or out of the space is not required, all air duct openings shall be temporarily sealed off with a suitable covering.

   iv. Upon completion of all Work affecting existing air handling systems, the Contractor shall remove all temporary filters, covers and associated parts and restore the system to its original operating condition unless otherwise stated elsewhere in the Contract Documents.
D. Ventilation during Painting or Other Finish Work
   i. The room/space shall be supplied with 100 percent outside air during painting and for a period of 72 hours following completion of painting.
      a. The air leaving the room/space shall be exhausted only to the outside, with no re-entrainment to any occupied spaces during painting and for a period of 72 hours following completion of painting.

E. Construction and Maintenance Isolation Requirements
   i. All construction, maintenance, and remodeling activities, regardless of size or scope, must be fenced, barricaded, or otherwise isolated to restrict entrance and to ensure the safety of those in the general area.
   ii. The contractor will provide all barricading, isolation, and fencing material. The contractor will also provide all appropriate warning and detour signs when sidewalks, exits, or roads are closed.
   iii. The contractor shall submit the OSU Construction & Maintenance Safety Form and OSU Site Safety Plan to the OSU Project Manager at least one week prior to commencing work. Both forms are accessible on the OSU EH&S website under Project Safety Packet.

2. HAZARDOUS MATERIALS
   A. Hazardous materials, at a minimum, refer to asbestos, lead, mercury, polychlorinated biphenyl (PCB), and containerized chemicals.
   B. On every project involving existing facilities, a hazardous materials survey shall be performed prior to any demolition. This survey will be performed by OSU Facilities Services or OSU Environmental Health and Safety (EH&S) or by independent consultants as directed by OSU Facilities Services or EH&S.
   C. The survey will provide an overview of typical surfaces and locations containing the hazardous material in question but may not specifically delineate every location where the hazardous material may be found. Under no circumstance shall demolition work occur prior to approval from OSU EH&S.
   D. All contractors are responsible to contacting OSU EH&S, via the OSU Project Manager or Construction Manager, prior to any construction activities or demolition of existing structures within an OSU building.
   E. If the Contractor observes or suspects the existence of hazardous materials in the structure or components of the building, the Contractor shall immediately stop work and notify the OSU Project Manager.
   F. Schedule ten (10) days of slack or "down" time for the removal of hazardous materials without penalty to OSU for the delay of the Contract.
   G. Contractor shall follow OSHA guidelines involving exposure to workers in addition to the requirements of DEQ and EPA.
   H. Removal of asbestos shall be performed by an OUS-approved asbestos contractor under the direction of OSU EH&S. Refer to Section 02 82 00 – Asbestos Remediation.
   I. Lead abatement projects shall be performed by OUS-approved lead abatement contractor under the direction of OSU EH&S. Lead abatement projects have the intent to remove (or encapsulate) lead surfaces to make them less hazardous. See Section 02 83 00: Lead Remediation.
J. Demolition of surfaces with lead-containing paint is NOT considered lead abatement. If contractors, for any reason, cannot perform demolition on lead-containing materials, a separate contractor will be hired by OSU for that work.

3. STORM WATER MANAGEMENT

A. Discharge of pollutants (any substance, material, or waste other than clear, uncontaminated storm water) into a storm drain system or a water body is prohibited by the Department of Environmental Quality (DEQ).

B. Any proposed new development or expansion of development along an open natural drainage way shall comply with OSU Zoning District Section 3.36.50.07 Drainage way Management Agreement. Where applicable, consider water quality and/or detention swales that use biological methods for water purification to address unavoidable post-development storm water sources.

C. Storm water runoff from loading dock areas shall be drained to a sanitary sewer system where feasible. Where sanitary sewer is not available, best management practices must be implemented.

D. All wastewater generated from water wash down and other cleaning activities within confined animal facilities and that contacts manure areas must be handled so as to not impair ground or surface water quality as defined by local jurisdiction.
Section 01 50 00: Temporary Facilities and Controls

1. SECTION DESCRIPTION

This Section specifies requirements for temporary services and facilities, including utilities, construction and support facilities, security and protection for projects.

2. REQUIREMENTS OF REGULATORY AGENCIES

A. Regulations: Comply with industry standards and applicable laws and regulations of authorities having jurisdiction.


C. Electrical Service: Comply with NEMA, NEC and UL standards and regulations for temporary electric service; install service in compliance with National Electric Code (NFPA 70).

D. Inspections: Arrange for authorities having jurisdiction to inspect and test each temporary utility before use; obtain required certifications and permits if required.

3. PROTECTION

A. Protect sidewalks, asphalt paving, concrete, trees, shrubs, and lawn areas at all times from damage resulting from construction activities. Refer to Section 01 56 39 Temporary Tree and Plant Protection for specific requirements related to vegetation.

B. Prevent materials from clogging catch basins and yard drains; leave drains clean and in proper working condition.

C. Protect Existing Irrigation Systems

i. In the event damage occurs to an underground irrigation system as a direct result of a Contractor’s activities, the Contractor shall repair/replace or be assessed a charge at the discretion of the OSU Project Manager.

ii. If repairs are to be made by the Contractor, the repairs will be inspected by the OSU Project Manager prior to backfilling.

iii. Any galvanized pipe that requires repair shall be repaired at a threaded coupling, not by use of a compression coupling.

D. Protect Existing Air Handling Systems

i. Contractor shall be responsible for protection of the cleanliness of the existing air handling system at all times. This protection shall include the following.

   i. During site work or building demolition, pre-filters shall be provided and maintained on all building outside air intakes and adjacent neighboring buildings at all times throughout the construction duration.

   ii. During any interior work that may create dust in the interior space and adjacent corridor/hallways, air filters shall be provided and maintained on all affected air return and exhaust grilles. Where air


flow in or out of the space is not required, all air duct openings shall be temporarily blanked off with plywood or sheet metal.

iii. Prior to starting any work, the Contractor shall record and submit to the OSU Project Manager, pressure readings across all existing air handler air filter banks before installation of new pre-filters.

iv. Upon completion of all Work affecting existing air handling systems, the Contractor shall remove all temporary filters, covers and associated parts and restore the system to its original operating condition unless otherwise stated elsewhere in the Contract Documents.

E. Security is the responsibility of the Contractor.
   i. Provide security and facilities to protect Work and existing facilities and OSU’s operations from unauthorized entry, vandalism, or theft.
   ii. Coordinate operations with OSU Project Manager.

4. DRAINAGE
   A. Verify that all rain drains in the construction areas are in working order and notify the OSU Project Manager in writing of any rain drains that are plugged, prior to the start of the Work.
   B. Start of Work will be considered as acknowledgment that all drains are clear and in good working order.
   C. All drains shall be left in a clean and proper working condition verified by camera inspection.

5. CONSTRUCTION PROJECT SAFETY
   A. Contractor shall submit to the OSU Project Manager, prior to signing the Contract, the completed "Construction Project Safety Form", Available on the OSU EH&S website. The Contractor shall manage a safe job environment for both the safety of all the people around the work site as well as the safety of OSU’s and general public's property.
   B. The Contractor shall provide and maintain suitable barricades, shelters, lights, and danger signals during the progress of the Work; they shall meet the requirements of the local building code and OSHA.

6. TEMPORARY UTILITIES
   A. Temporary Utilities
      i. Prepare a schedule indicating dates for implementation and termination of each temporary utility.
      ii. At the earliest feasible time, when acceptable to OSU, change over from use of temporary service to use of the permanent service.
   B. Conditions of Use
      i. Keep temporary services and facilities clean and neat in appearance.
      ii. Operate in a safe and efficient manner.
      iii. Take necessary fire prevention measures.
      iv. Do not overload facilities or permit them to interfere with progress.
v. Do not allow hazardous, dangerous or unsanitary conditions, or public nuisances to develop or persist on the site.

C. Electrical Service
   i. Service limited to 20 amp 120V circuits will be paid for by OSU.
   ii. Connection to the service shall be the responsibility of the Contractor, with OSU’s approval.
   iii. Coordinate with the OSU Project Manager.

D. Water Service
   i. Service in reasonable quantities for the Project will be paid for by the OSU.
   ii. Connection to the service shall be the responsibility of the Contractor, with the OSU’s approval.
   iii. Coordinate with the OSU Project Manager.

E. Existing Services

F. Do not interrupt any existing service without prior request and approval of OSU Project Manager to enable OSU to shut down any utility required by the Work.

G. A 96 hour notification is required prior to schedule utility shutdowns, but more lead time is often required to schedule around other critical activities.

H. Contractor shall not shut down utilities.

7. TEMPORARY SUPPORT FACILITIES

A. Temporary Sanitary Facilities
   i. Provide and maintain an adequate number of facilities for the use of all persons employed on the Work during construction.
   ii. Provide enclosed, weatherproof facilities with heat as required.
   iii. Use of new or existing OSU facilities will not be permitted.

B. Temporary Heat and Ventilation
   i. As necessary, provide temporary heat and ventilation required by construction activities, for curing or drying of completed installations or protection of installed construction from adverse effects of low temperatures or high humidity. Select safe equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce the ambient condition required and minimize consumption of energy.

C. Telephone Equipment
   i. Provide telephone communications at project site

D. Contractor’s Employee Parking
   i. Shall be limited to locations designated at the Pre-construction Conference.
8. TEMPORARY BARRIERS AND ENCLOSURES
   A. Provide barriers and fencing to prevent unauthorized entry to construction areas and to protect existing
      facilities and adjacent properties from damage.
   B. Provide six foot high commercial grade chain link fence around construction site as directed by OSU Project
      Manager; equip with vehicular and pedestrian gates with lock.
   C. Exterior Closures: Provide temporary secured, weather-tight closures at exterior openings, to permit
      acceptable working conditions and protection of the Work.
   D. Interior Closures:
      i. Provide temporary floor to ceiling partitions (not plastic sheeting) and ceilings as required to separate
         work areas from OSU occupied areas, to prevent penetration of dust and moisture into OSU occupied
         areas, to reduce construction noise, and to prevent damage to existing materials and equipment.
      ii. Paint surfaces exposed to view from OSU occupied areas.

9. ODORS
   A. Refer to Section 01 35 43, Environmental Procedures and Requirements

10. FIRE SAFETY
    A. Ensure that required exit routes remain visible and unobstructed while building is occupied.
    B. Abide by all fire safety requirements for buildings under construction, alteration or demolition as required by
        the 2014 Oregon Fire Code.
    C. An emergency telephone shall be provided on site. Cellular telephone equipment is acceptable.
    D. Fire Suppression Equipment:
       i. Install and maintain temporary portable fire extinguishers to protect against reasonably predictable and
          controllable fire losses. Comply with NFPA 10 "Standard for Portable Fire Extinguishers", and NFPA
          241 "Standard for Safeguarding Construction, Alterations and Demolition Operations".
       ii. Maintain equipment in working condition with current inspection certificate attached to each.
       iii. Locate fire extinguishers where convenient and effective for their intended purpose, but not less than
            one extinguisher on each floor at or near each usable stairwell.
       iv. Store flammable and combustible liquids in approved and labeled containers in fire-safe locations.
       v. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire protection facilities
          equipment, stairways, and other access routes for fighting fires.
       vi. OSU is a non-smoking campus. Prohibit smoking anywhere on campus property.
       vii. Provide continual supervision of welding operations, combustion type temporary heating units, and
            similar sources of fire ignition.
       viii. Strictly adhere to the OSU Fire Protection Outage Guideline when adjusting operability of installed fire
            protection systems.
11. CONSTRUCTION AIDS
   A. Scaffolding: comply with applicable OSHA requirements
   B. Material Handling Equipment:
      i. Provide necessary cranes, hoists, towers, or other lifting devices.
      ii. Use only experienced operators.
      iii. Remove equipment as soon as possible after task is ended.
      iv. Coordinate placement of such equipment with OSU Project Manager.
      v. Obtain required permits and meet requirement of governing authorities regarding applicable regulations.
   C. Materials or debris shall not be allowed to free fall from building.
   D. The use of chutes or conveyors must be approved by OSU Project Manager.

12. TEMPORARY CONTROLS
   A. Water Control
      i. Maintain excavations free of water.
      ii. Provide, operate, and maintain necessary pumping equipment.
   B. Temporary Traffic Control/Pedestrian Accessibility
      i. A continuous route for all pedestrians, including persons with disabilities and bicyclists, shall be maintained at all times. When existing pedestrian facilities are disrupted, closed, or relocated in a construction zone, temporary pedestrian facilities must be provided.
      ii. Temporary pedestrian facilities should be safe and accessible. There should be no curbs or abrupt changes in grade that could cause tripping or be a barrier to wheelchair use.
      iii. Signage shall be provided directing people to the temporary accessible route. The signage shall include the International Symbol of Accessibility.
      iv. Contractors shall not block temporary walkways with vehicles, equipment, construction materials, signs, trash, or other objects that might prohibit pedestrian passage.
      v. Construction equipment and equipment operation must be separated from any open walkways. At construction zones, pedestrian fences or other protective barriers shall be provided to prevent access into the construction area.
      vi. Street closures require a 96 hour notification prior to scheduled closure, but more lead time is often required to schedule around other critical activities. Such closure shall be coordinated by OSU Project Manager.

13. TEMPORARY TRAFFIC CONTROLS
   A. Temporary traffic control in construction zones and OSU events.
i. All temporary traffic control measures shall consider the least possible obstruction and inconvenience to the public and protect pedestrian and vehicular traffic.

B. Materials

i. All traffic control materials shall be new or like new condition, be in accordance with ODOT Standard Specifications and Drawings, meet ODOT qualified products list (QPL) standards, and be in accordance with the current Manual or Uniform Traffic Control Devises (MUTCD), Oregon Edition.

C. Construction/Workmanship

i. Flagger, barricades, signs and traffic control devices shall conform to current OSU Capital Planning and Development policies and the most recent edition of the MUTCD, published by the U.S. Department of Transportation, and shall be submitted to the Project Manager a minimum of two weeks prior to projected implementation plan for review.

ii. The Contractor shall provide and maintain all pedestrian and traffic control devices necessary to warn and protect the public on roads, streets, pedestrian paths, multi-use paths, construction easements, and all OSU property affected by work operations. In addition, the Contractor shall also provide all necessary flagger and guards necessary to warn and protect the public.

iii. The Contractor shall patrol the traffic-control area and reset all disturbed signs and traffic-control devices immediately and will remove or cover all non-applicable signs during period not needed.

iv. The Contractor shall notify the City emergency services as well as OSU Public Safety, prior to any traffic restrictions, closures and/or detours. Access for fire and emergency equipment for the protection of buildings, lives, and property shall be maintained at all times. The Contractor shall be liable for any damages which may result from his failure to provide such reasonable access.

D. Traffic control within the project

i. When necessary, public traffic shall be permitted to pass through the work area with as little inconvenience and delay as possible. Work zone and path of travel shall be clearly delineated.

ii. The Contractor shall be responsible for implementation and maintenance of a safe and accessible path of travel for all pedestrians, including those with disabilities, around and/or through the construction site for the duration of the construction period. Contractor shall provide an accessible path for pedestrian consistent with all local, state, and federal codes, including the Americans with Disabilities Act.

iii. The Contractor shall notify OSU a minimum of two weeks prior to any full or partial street closure or when access to facilities will be impaired via the project’s Project Manager. The Contractor shall be liable for any damages during the duration of the contact which may result from Contractor’s failure to provide proper traffic control.

E. Construction and maintenance of detours and road closures

i. Detours may be allowed if specifically approved by the Project Manager for the protection of the work or the safe passage of public traffic through the work area.

ii. No complete road closures will be permitted unless specifically approved by the Project Manager.

iii. The Contractor shall submit any closure or detour Signage Plans to the Project Manager for approval a minimum of two weeks prior to the closure of any OSU street or roadway.
iv. A signage plan which may include:

1) Detour signage at each end of the block which states: “Detour, Sidewalk Closed Ahead, Use Opposite Side of Street” to discourage foot traffic around the area of the actual sidewalk closure.

2) “Sidewalk Closed” signage, with caution flagging and barricades at the side of the closed portion of the sidewalk.

3) Where accessible ramps are closed, detour signage stating ‘Detour, Sidewalk Closed Ahead” shall be placed on barricades to obstruct the accessible ramp on the opposite side of the street.

4) All signs are the responsibility of the Contractor.

F. One-way traffic control

i. When detours are not available or practical, the Contractor shall confine operations to a width, minimum of 10-feet for vehicles and 5-feet for pedestrian path of travel. If in the judgement of the Project manager, one-way traffic is necessary, the Contractor shall provide flaggers as necessary to control the traffic.

ii. At the end of each day the Contractor shall leave the work in such condition that it can be traveled without damage to the work and without danger to the public.

14. OWNER OCCUPANCY

A. The Owner (OSU) will occupy surrounding area of construction site during the entire period of construction for the conduct of normal university operations. Cooperate with OSU Project Manager in construction operations to minimize conflict and to facilitate OSU’s usage especially in the following areas:

i. Restricted access and parking.

ii. Use of stairs.

iii. Storage space availability.

B. Conduct operations in such a way to ensure the least inconvenience to the university and general public, including:

i. Limitations and easements.

ii. Emergency vehicle access.

iii. Building access, day and night.

C. Preparation

i. Consult with OSU Project Manager to review jobsite areas required for field offices, material storage and stockpiles, equipment storage, access to different locations, etc.
15. PERFORMANCE

A. Confine equipment, apparatus, and storage of material to work limits. OSU will not be responsible for protection of materials and equipment from damage, pilfering, etc.

B. Install temporary facilities in such a manner that the installed work will not be damaged.

C. Protect installed Work and provide special protection where specified in individual specification sections.

D. Prohibit traffic or storage upon waterproofed or roofed surfaces

E. Do not use facilities of existing building unless authorized in writing by the OSU Project Manager

F. Keep facilities well maintained.
   i. Debris shall not be allowed to remain around the buildings during performance of Work, but shall be disposed of as rapidly as it accumulates.
   ii. On completion of Work, the buildings and grounds shall be left in a condition that is equal to or better than original condition.
   iii. In case of failure to do so, OSU may remove rubbish and charge the cost to the Contractor.

G. Relocate temporary facilities as required during job progress.

H. Clean, repair, resurface, or restore existing surfaces to their original, or better, condition, or completely replace such surfaces to match existing, where damaged by construction operations.

I. At Substantial Completion, clean and renovate permanent facilities that have been used during the construction period, including but not limited to:
   i. Replace air filters and clean inside of ductwork and housings.
   ii. Replace significantly worn parts and parts that have been subject to unusual operating conditions.
   iii. Replace lamps that are burned out or noticeably dimmed by substantial hours of use

16. PROJECT SIGNAGE

A. Contractor is permitted to post only one project identification sign based on the following example.
B. Advertising signs are not allowed on or within construction site or fencing.
Section 01 56 39: Temporary Tree and Plant Protection

PART 1: GENERAL

1. REQUIREMENTS

   A. The contractors shall furnish all labor, materials, equipment, and services necessary for the protection of existing trees and vegetation as required and as specified herein.

      i. The Contractor shall install tree protection fencing as detailed and shall prevent damage to shrubs, groundcover, trees, root systems, soil, bark, foliage, branches and limbs due to construction activities, including but not limited to:

         a. Soil contamination, erosion, and compaction.
         b. Excessive wetting, and ponding due to storm water, and construction run-off.
         c. Alteration of grade, stockpiling of soil, debris, and materials.
         d. Damage to soil, roots, bark, trunk, limbs, branches, and foliage.
         e. Prevent unauthorized cutting, breaking, skinning and bruising of roots, branches, and bark.

   B. The plans shall include annotation that indicates it is the responsibility of the General Contractor to repair, replace, or reimburse OSU for any damaged plant material within a Tree Protection Zone.

   C. All landscape materials shall be protected to ensure they are not damaged.

   D. All staging areas located on planting areas shall be covered with woven geotextile fabric and have a minimum six inch mulch bed placed over area prior to any staging of equipment or materials to prevent soil compaction.

   E. All vehicular or motorized equipment access to a staging area over turf shall be covered with woven geotextile fabric with a minimum of six inches of mulch bed placed over the area to prevent the compaction of soil.

   F. The General Contractor is responsible for removing all construction or construction related debris from the project site and adjacent landscape or shrub beds.

   G. The project site survey shall include accurate locations and diameters of existing trees as well as a sufficient number of spot elevations to determine the existing elevation of the tree root zone and root flare.

2. DEFINITIONS

   A. Tree Root Protection Zone (TRPZ): An area that generally extends from the base of the tree trunk beyond the drip line of the tree.

   B. Drip line: Outer perimeter of branches of any plant.

   C. Project Arborist: A certified arborist with the experience to conduct the required work outlined in this section shall be employed by the university.

   D. University Arborist: A certified arborist employed by or contracted by the university to inspect and oversee the daily construction activities to ensure the program developed by the project arborist is executed according to the tree protection plan.
3. **CALCULATING THE TREE ROOT PROTECTION ZONE**

   A. Measure the tree’s diameter at breast height (DBH), in inches. DBH is calculated using the circumference of the tree trunk at 4.5 feet above grade.

   B. Multiply the DBH by 1.5.

   C. Example = 7-inches DBH x 1.5 = 10.5-inches, or 7-feet DBH x 1.5 = 10.5-feet

   D. The result expressed in feet shall be the minimum radius of the TRPZ.

   E. For trees less than 8" in DBH, the TRPZ shall not be less than the diameter of the canopy drip line.

   F. For trees adjacent to buildings, steam tunnels and similar structures that roots won’t go through, the TRPZ shall have the same required size/square footage to protect tree roots.

      i. Example+ Tree requires 1.5-feet radius, TRPZ will start at tunnel and extend 10-feet past the 15-feet radius to compensate for root growth.

   G. For shrubs scheduled to remain the protection shall be the drip line of the existing plant or plant grouping.

4. **COORDINATION**

   A. The project arborist will coordinate with other trades and contractors affecting or affected by work of this section to ensure that tree protection measures are understood prior to work commencing.

   B. An on-site review of tree protection measures will be completed among the project arborist, Landscape Architect/Design Professional, contractor, OSU Project Manager, City of Corvallis, and OSU FS Landscape Manager or designee prior to any site work or grading is started.

   C. During this meeting the pre-construction evaluation of those trees identified to remain shall be completed.

   D. The contractor is responsible for maintaining all tree protection measures during all construction phases of the project.

   E. The TRPZ is not to be altered or opened for any work without written permission from OSU Project Manager and OSU FS Landscape Manager or designee. Project arborist must be onsite during any work performed inside TRPZ.

   F. The project arborist and OSU Project Manager and OSU FS Landscape Manager or designee shall be contacted immediately if any of the trees on site are damaged during the construction of the project. The project arborist in consultation with the OSU Project Manager and OSU FS Landscape Manager or designee will assess the damage to any tree and provide corrective measures, which may include pruning; tree wound repair, or even removal.

   G. Upon completion of the project the project arborist will contact the OSU Project Manager and review the post construction evaluation of the trees on the site.

   H. No tree shall be removed from the site without the completion of a tree condition report and prior notification and approval of the OSU Project Manager and OSU FS Landscape Manager or designee.

      i. Tree removal within the OSU National Historic District requires a Historic Tree Checklist to ensure that any trees being removed are not considered historic. An arborist report must accompany the Historic Tree Checklist.
PART 2: MATERIALS

1. FENCING
   A. The contractor is responsible for installing a tree protection fence around all the trees identified to remain on site prior to the start of any site work, grading, or staging of any equipment or materials.
   B. The tree protection fence shall be a galvanized chain link fence that measures a minimum of six feet high.
      i. The fence shall be secured using steel posts that are the same height as the fence.
      ii. The steel posts shall be driven no less than two feet into the ground, and be a minimum of ten feet apart.

2. SIGNAGE
   A. A highly visible sign shall be posted on the chain link fence demarking the area as a tree root protection zone. The sign shall remain posted and unobstructed until the project is completed.

PART 3: EXECUTION

1. SITE SURVEY
   A. Provide a copy of the completed site survey (see General Requirements 1.1.G) to the project consulting arborist and the Landscape Architect/Design Professional, prior to the development of the tree protection plan.

2. ASSESSMENT
   A. Pre-Construction Tree Assessment: Prior any site work, grading, staging of equipment, materials or any other mobilization of the project, the project arborist shall complete a pre-construction assessment report that outlines the physical conditions of the trees identified to remain on the site. The project arborist shall review the report with the OSU Project Manager and the OSU FS Landscape Manager or designee.
   B. The OSU FS Landscape Manager or designee shall provide written notification to the project arborist that the report has been reviewed and is acceptable prior to the mobilization of the project.
   C. The assessment report shall provide any specific tree protection measures required to ensure the health and vigor of the trees during the construction of the project.
   D. The assessment report shall also include a value appraisal of the trees completed according to the most recent edition of the Council of Tree and Landscape Appraiser standards.
      i. The value of the trees that are to remain will be provided to the contractor prior to the mobilization of the site to ensure the contractor is aware of the replacement cost of the trees as outline in the appraisal report.
   E. Tree Protection Areas: Prior any site work, grading, staging of equipment, materials or any other mobilization of the project the contractor shall establish the tree root protection zones as specified in the tree protection plan and install the specified fencing.
   F. This protection area shall be maintained by the contractor during all phases of construction and only removed upon demobilization of the site or substantial completion of project whichever is later
i. If, in the opinion of the Owner’s arborist, additional protection is required, the Contractor shall install as directed and without cost to the Owner.

G. In consultation with the OSU Project Manager and OSU FS Landscape Manager or designee, the project arborist shall recommend corrective measures for any tree damaged during construction,

i. Prior to any removal of a damaged tree the project arborist will ensure a replacement cost is determined for the damaged tree.

H. The Project Arborist shall complete a post construction assessment of the trees to determine the condition of the trees. The report shall be submitted to the OSU Project Manager and OSU FS Landscape Manager or designee for review and approval.

i. The OSU FS Landscape Manager or designee shall provide written notification that the post construction report has been reviewed and accepted prior to the close out of the project.

3. PROTECTION

A. There shall be no alteration or disturbance of existing grade of any kind within the TRPZ.

B. No alteration of drainage flow into the TRPZ shall be permitted without the written authorization from the project arborist.

C. No storage of construction materials, equipment or supplies of any kind shall be permitted within the TRPZ.

D. No disposal of any liquids of any kind shall be permitted within the TRPZ.

E. No movement of vehicles, equipment, pedestrians, etc. shall be permitted within the TRPZ.

F. No excavation or trenching shall be permitted within the TRPZ.

G. No tunneling under the TRPZ without prior written authorization from the project arborist and landscape coordinator.

H. No roots extending beyond the TRPZ shall be pruned or cut without prior authorization from the project arborist and the OSU FS Landscape manager or designee.

I. No exceptions of the tree protection measures shall be provided without written approval from the OSU Project Manager and the OSU FS Landscape manager or designee.

J. Comply with City of Corvallis requirements for tree protection.

4. PLANS

A. All site and landscape plans shall identify the trees that are to remain, the trees to be removed, the tree root protection zone, and protection fencing.

B. TRPZ should be identified on all plans that have work that touches the TRPZ zone.

C. Plans should be reviewed by the City of Corvallis.

5. TREE DAMAGE AND REPAIR

A. Upon notification of a damaged tree, the Project Arborist shall inspect the tree and assess the damage. The arborist shall outline in writing the corrective measures necessary to repair the damage.
B. If a tree is to be removed as a result of construction related damage then the cost of the removal and replacement and one year establishment care of the tree shall be the responsibility of the general contractor.

C. Tree Replacement

i. Up to 8” DBH: Same size as damaged tree, species selected by Landscape Architect/Design Professional after consulting with OSU Project Manager and OSU FS Landscape Manager or designee.

ii. Over 8” DBH: Compensate OSU as determined by value appraisal completed by project arborist according to the most recent Council of Tree and Landscape Appraiser standards.

iii. Replacement shrubs and groundcovers: Same size and quality as damaged shrub and groundcover, species selected by project Landscape Architect/Design Professional in consultation with the OSU Project Manager and OSU FS Landscape Manager.
Division 2: Existing Conditions

Section 02 41 00: Demolition
1. REQUIREMENTS
2. COORDINATION
3. SUBMITTALS
4. PRODUCTS

Section 02 65 00: Underground Storage Tank Removal
1. REQUIREMENTS
2. LICENSING
3. EXCAVATION AND MATERIAL HANDLING PLAN
4. SITE SAFETY AND HEALTH PLAN
5. PERSONNEL PROTECTION
6. FIRST AID AND EMERGENCY RESPONSE EQUIPMENT AND PROCEDURES
7. TEMPORARY CONTAINMENT OF EXCAVATED SOIL
8. EXCAVATION (See Section 31 00 00 – Earthwork)
9. TESTING
10. INSPECTIONS
11. CLOSURE REPORT (SITE ASSESSMENT REPORT)

Section 02 82 00: Asbestos Remediation
1. REQUIREMENTS
2. ASBESTOS AND OTHER HAZARDOUS MATERIAL

Section 02 83 00: Lead Remediation
1. REQUIREMENTS
2. LEAD BASED PAINT
Section 02 41 00: Demolition

1. REQUIREMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. For structures within the OSU National Historic District, an approved Historic Preservation Permit (HPP) for demolition may be required prior to the demolition of any building or structure. Consultation with OSU University Land Use Planning is required for all structures to confirm permitting process for demolition of state property (ORS 358.653). For structures within the OSU National Historic District, an approved Historic Preservation Permit (HPP) for demolition may be required prior to the demolition of any building or structure. The OSU National Historic District map may be found at: https://fa.oregonstate.edu/university-land-use-planning/resources-forms/osu-national-historic-district-map

C. Demolition and disassembly will not be allowed until it is coordinated with OSU’s designated representative.

D. Maintain free and safe passage to and from buildings during demolition.

E. Prevent movement or settlement of structures.

F. Provide and place bracing, shoring and underpinning, and be responsible for safety and support of structures and assume liability for such movement, settlement, damage or injury.

G. Cease operations and notify OSU’s designated representative immediately if safety of structure appears to be endangered. Take precautions to properly support structure. Do not resume operations until safety is restored.

H. All active utilities traversing the project site shall be protected and maintained, unless noted to be removed or abandoned.

I. When removing a structure or building, establish a safety perimeter or corridor that restricts public access during the demolition operation. Provide, erect and maintain barricades, lighting and guard rails as required to protect the public.

J. Any unearthed underground tank shall be removed in accordance with applicable Department of Environmental Quality regulations and standards. Contact the OSU designated representative immediately upon discovery of an underground tank or sub surface structure. (See Construction Standard Section 02 65 00)

K. On every project involving existing facilities, a hazardous materials survey shall be performed prior to any demolition. This survey will be performed by OSU Environmental Health & Safety (EH&S) OR by independent consultant as directed by EH&S. (See Construction Standards Section 01 35 43 Environmental Procedures)

L. On all projects involving existing concrete flooring, the contractor is responsible for utilizing Ground Penetrating Radar prior to core drilling to avoid existing utilities and structural elements.

M. All inactive underground pipes or structures that are removed, abandoned, or otherwise disturbed with the project and are able to convey water shall be capped with approved plug or non-shrink grout once determined abandoned by OSU Project Manager.
2. **COORDINATION**

   A. The Contractor is responsible for providing sufficient advanced warning of scheduled utility interruptions as established during pre-construction meeting.

   B. Cooperate with Oregon State University and utility companies whose work affects or will be affected by the demolition operations. It is the professional consultants’ and Contractors’ responsibility to ascertain and understand the rules, regulations and requirements of these authorities which affect the demolition process; notify them of conditions affecting their work, and disconnect or arrange for disconnection of utility services if required.

   C. The Design Professional or Contractor shall comply fully with all provisions of the local codes, laws and ordinances applicable to work of this Section, and other OSU plans and documents that relate to campus planning and development.

3. **SUBMITTALS**

   A. The Design Professional or Contractor shall be required to submit all the required documents identified in local codes and ordinances applicable to work of this Section, and/or during the pre-planning, pre-construction, and/or construction meetings with project review team.

   B. General submittal requirements are per OSU Division 1 Specifications, the Contract Documents, and the Construction Contract.

   C. Refer to Construction Standards 01 10 01 Administrative/Document Requirements and include:

      i. Proposed building or structure to be removed;

      ii. Proposed walls, building systems, structures, etc. to be demolished within an existing building;

      iii. An indication of how building systems (e.g., HVAC, electrical, gas, water, etc.) shall be capped where they were once connected to the portion identified for demolition;

      iv. Access route to a building or structure to be demolished;

      v. Tree Root Protection Zone (TRPZ) for trees immediately adjacent to the demolition site or access route to the demolition site.

4. **PRODUCTS**

   A. Salvaged materials

      i. OSU shall have the option of retaining ownership of any or all existing equipment, materials, and items removed under this Work.

      ii. Should OSU decide not to retain ownership of certain items removed under the work of this Section, those items shall become property of Contractor and shall be promptly removed from the Project Site.

      iii. Deliver items which remain property of OSU to a location, or locations designated by the OSU Project Manager.
Section 02 65 00: Underground Storage Tank Removal

1. REQUIREMENTS
   
   A. This Construction Standard covers the requirements for the removal and disposal of underground storage tanks and piping, backfill, products remaining in the tanks, contaminated soil and ground water, and related work in accordance with local, state, and federal regulations.

   B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

   C. The Contractor will provide all labor, materials and equipment as necessary to complete all work as specified herein.

   D. Work includes the removal and disposal of an underground storage tanks and piping, and excavation and disposal of contaminated backfill, soil and groundwater. In addition, the work will include the installation of any temporary fencing, barricade systems, or other means to keep the project site and work area safe and restricted from public access.

   E. Perform work in accordance with local, Oregon OSHA, and Oregon DEQ regulations

2. LICENSING
   
   A. The tank removal contractor, subcontractors, and personnel employed on the project shall furnish proof of and abide by the following as applicable:
      
      i. DEQ Underground Storage Tank Rules
      ii. Fed-OSHA and OR-OSHA rules, including HAZWOPER Certification
      iii. Submit training certification statements for personnel performing work in accordance with DEQ’s licensed “Service Provider” requirements.

3. EXCAVATION AND MATERIAL HANDLING PLAN
   
   A. Contractor or 3rd party consultant shall submit an Excavation and Material Handling Plan to OSU EH&S for approval.

   B. The Contractor shall furnish all labor, materials, necessary permits, reports, and equipment to complete the work as defined in the project scope.

   C. The plan shall address waste disposal that details transport and disposal methods for the: tank and piping, uncontaminated and contaminated backfill, soil and groundwater.

   D. Contractor shall arrange for the transport and disposal of the tank, piping, contaminated and uncontaminated backfill, soil and ground water in accordance with local, State, and Federal laws and requirements. Components of the Plan should address:
      
      i. Excavation: Describe the methods, means, equipment, sequence of operations and schedule to be employed in the excavation, transport, handling, and stockpiling of soil during underground tank removal and disposal operations.
      
      ii. Tank Removal: Describe methods, means, sequence of operations, and schedule to be employed in the pumping, cleaning, de-vaporizing, inspecting, removal, and disposal of underground storage tanks and piping.
iii. Soil and Groundwater Removal: Describe the phases of handling the contaminated backfill, soil and ground water. Include methods of excavating, handling of contaminated material, safety precautions and disposal requirements.

E. Prior to commencing work, the Contractor is responsible for obtaining waste disposal approvals from DEQ, OSU EH&S and the local jurisdiction as applicable.

F. The Plan shall specify final destination and modes of transport for all materials removed from the site.

G. Contractor shall address over-excavation and groundwater removal plans, and soil and groundwater confirmation sampling based on consultant and OSU EH&S recommendations for site cleanup levels or regulatory standards set by DEQ.

4. SITE SAFETY AND HEALTH PLAN

A. The Contractor shall prepare a Site Safety and Health Plan (SSH Plan) in accordance with all applicable local, State and Federal laws and requirements for the work described herein.

B. The Contractor shall submit a Site Safety and Health Plan (SSH Plan) to OSU EH&S prior to commencing work. The SSH Plan will include:

C. A site map, indicating points of entry and access routes to the project site from adjacent streets.

D. A list of emergency phone numbers and points of contact for fire, hospital, police, ambulance, OSU EH&S, and other necessary contacts.

E. A route map that details the directions to the nearest emergency medical facility.

5. PERSONNEL PROTECTION

A. All personnel assigned to perform work as described herein have the responsibility to have and appropriately use the necessary personal safety equipment and protective clothing.

B. No one is permitted on the project site without the required and appropriate personal safety equipment and/or protective clothing.

C. All personnel and equipment shall be decontaminated as needed before exiting the project site.

D. All personnel working at a project site will have completed documented OSHA HAZWOPER training, as well as any additional training to ensure workers properly know how and when to use personal safety equipment/clothing.

6. FIRST AID AND EMERGENCY RESPONSE EQUIPMENT AND PROCEDURES

A. The appropriate emergency first aid equipment for treatment of exposure to site physical and chemical hazards shall be readily accessible.

B. The Contractor shall clearly post at the job site:

   i. A list of emergency phone numbers and points of contact for fire, hospital, police, ambulance, OSU EH&S, and other necessary contacts

   ii. A route map that details the directions to the nearest emergency medical facility

   iii. EH&S shall be contacted immediately in the cases of accidents, unforeseen events, or any other incidents that need immediate attention due to a safety or health risks and/or concerns.
7. TEMPORARY CONTAINMENT OF EXCAVATED SOIL
   A. EH&S shall designate and approve the location of any temporary soil containment area proposed for use by the Contractor.
   B. The excavated soil shall be placed on an impervious barrier and covered with 10mil or greater polyethylene sheeting and shall be so constructed as to not allow any off-site discharge/migration via air, water, or any other means.
   C. The area will be restored to a pre-project state upon completion of the project.

8. EXCAVATION (See Section 31 00 00 – Earthwork)

9. TESTING
   A. Soil and groundwater confirmation sampling for the purposes of environmental characterization and compliance with applicable regulatory standards will be performed by contractor or third party consultant per DEQ regulations. Contractor or third party consultant to coordinate sampling times with OSU EH&S.
   B. Testing of the tank, piping, soil and ground water for purposes of waste characterization and disposal will be the responsibility of the Contractor.

10. INSPECTIONS
    A. The Contractor shall arrange for all required inspections in accordance with all applicable permits, and local, state and federal laws and requirements.

11. CLOSURE REPORT (SITE ASSESSMENT REPORT)
    A. The Contractor shall provide EH&S a Closure Report that includes the field reports, records, inspections, laboratory reports, environmental sampling results, and other documents obtained and/or created during the completion of the work described herein.
    B. The Closure Report shall contain a description of the site and work completed, including tank removal procedures, equipment used, dates work was performed, tanks and associated tank equipment, backfill, soil, and groundwater that was removed and disposed of.
    C. The Report shall address/include at minimum:
       i. Site plan showing location of tank and associated piping/equipment, surrounding features, and the limits of the excavation.
       ii. All paperwork documenting the proper disposal of the tank and piping, contaminated backfill, soil and groundwater and any other supporting documents that are required to comply with local, state, and federal laws and regulations.
       iii. Environmental sampling results presented in table form and compared to applicable regulatory standards. These results should confirm the vertical and lateral extent of any contaminated soil and groundwater and should also confirm that any remaining soil and groundwater at the site meets applicable state and/or federal regulatory standards.
       iv. A site map showing the location of soil and groundwater samples that were collected and submitted for laboratory analysis during the tank removal and site closure process.
v. Completion of DEQ required tank closure reports. OSU EH&S may request additional information upon review of the Report.
Section 02 82 00: Asbestos Remediation

1. REQUIREMENTS

   A. On every project involving existing OSU facilities, the OSU Project Manager of the project team shall request that OSU Environmental Health & Safety (EH&S) perform a survey for the existence of asbestos.

   B. No removal of building materials or building systems shall occur without the inspection for asbestos-containing material by EH&S/Facility Services Asbestos Inspector or by an independent consultant as directed by EH&S/Facility Services Asbestos Inspector.

   C. All asbestos containing material that needs to be removed in support of any project will be coordinated by EH&S/Facility Services Asbestos Inspector under separate contract. Exemptions for OR-OSHA Class 2 asbestos work can be made by the University.

2. ASBESTOS AND OTHER HAZARDOUS MATERIAL

   A. OSU has made a reasonable attempt to locate and identify asbestos or other hazardous material that may be encountered during the course of the Work.

   B. If the Contractor observes or suspects the existence of asbestos, polychlorinated biphenyl (PCB) or other hazardous materials in the structure or components of the building, the Contractor shall immediately stop work and notify the OSU Project Manager.

   C. The OSU Project Manager will arrange for the removal of asbestos, polychlorinated biphenyl (PCB) or other hazardous materials as required by EH&S by separate contract.

   D. Schedule ten (10) days of slack or "down" time for the removal of hazardous materials without penalty to OSU for the delay of the Contract.
Section 02 83 00: Lead Remediation

1. REQUIREMENTS

   A. LBP (lead-based paint) in this section refers to levels of lead in paint defined by state and federal regulations. Current definition is 1.0 mg/cm² painted surface or 0.5% by weight (5000 mg/kg) of a sample of ALL layers of paint.

   B. On every OSU project involving existing OSU facilities, the project team shall request a LBP survey from OSU Environmental Health & Safety (EH&S) prior to project bidding. The project team will provide a reasonably detailed scope of work to direct the survey.

   C. Surveys will be performed by EH&S or an independent consultant directed by EH&S.

   D. All projects that require LBP to be REMOVED from surfaces will include an LBP sub-project coordinated by EH&S and Facilities Services under separate contract.

   E. OSU will be responsible for disposal of all removed LBP.

   F. Surfaces that do not have LBP can be handled by any contractor or university personnel.

   G. Surfaces with detectable concentrations of lead, but below the regulatory definition of LBP, must be handled in accordance with OR-OSHA rules. Contractors are responsible for performing this type work as part of their contract. Isolation of such projects must prevent migration of lead into occupied areas.

   H. Surfaces containing LBP that will be removed or demolished, without removing paint, are the sole responsibility of Contractor to perform in accordance with OR-OSHA rules. Isolation of such projects must prevent migration of lead into occupied areas.

   I. Contractor will be responsible for disposal of all removed components containing LBP under direction of EH&S. Sampling and special disposal may be required for certain waste streams.

   J. All Contractors working on LBP surfaces in child-occupied facilities must be lead-certified, regardless of scope of work. Contractor shall consult with OSU EH&S prior to starting work to review isolation, notifications, and cleanup plans and to observe clearance monitoring.

2. LEAD BASED PAINT

   A. OSU has made a reasonable attempt to locate and identify lead or other hazardous material that may be encountered during the course of the Work. If levels are found, the following conditions apply.

   B. Contractor shall remove paint as specified for surface preparation and capture removed material for disposal.

   C. Contractor shall follow OSHA guidelines involving exposure to workers.

   D. OSU will provide containers for Contractor’s use at project site.

   E. Contractor shall comply with the requirements of DEQ and EPA and shall submit a lead abatement plan.

   F. Contractor shall separate lead contaminated material from effluent and water.

   G. OSU will dispose of lead paint and effluent resulting from stripping operation.

   H. Soil contaminated by stripping operations shall be replaced with topsoil.
Division 7: Thermal and Moisture Protection

Section 07 10 00: Roofing and Waterproofing
1. GENERAL REQUIREMENTS
2. FALL PROTECTION
3. MANUFACTURER QUALIFICATIONS
4. ROOFING
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6. DRAINAGE
7. LOW SLOPE ROOFING
8. METAL ROOFING
9. STEEP ROOFING
10. FLASHING AND COUNTERFLASHING

Section 07 72 00: Roofing Accessories
1. GENERAL
Section 07 10 00: Roofing and Waterproofing

1. GENERAL REQUIREMENTS

A. All roof designs and specifications shall be reviewed and approved by OSU’s Project Manager & Facilities Services.
   i. All roof projects completed in the OSU National Historic District must be coordinated with the University Land Use Planning unit of Capital Planning and Development.

B. Roof designs may involve a plan review focused on building loss prevention, which involves submitting preliminary construction documents and incorporating recommendations from OSU’s Risk Management and Property Loss Control Engineering Consultants. Coordinate submittal with OSU’s Project Manager.

C. Roof repair and replacement projects within the OSU National Historic District will likely require approval by HPP application.

D. Indicate applicable American Society for Testing and Materials (ASTM) specification in this section.
   i. Fire resistance shall be based on ASTM E-108. (ASTM E-108 relates to the external fire classification only. Fire resistance of internal materials should be rated non-combustible or Class 1.)

E. Indicate applicable Oregon Structural Specialty Code, latest edition

F. Indicate applicable Underwriters’ Laboratory (UL)
   i. Fire resistance based on UL-790 (This is an external fire rating only. Internal ratings should also be rated non-combustible or Class 1. If following FM standards, Class 1 is all that FM would accept for approval of a FM Assembly.)

G. Indicate applicable Factory Mutual (FM) specifications
   i. Wind uplift criteria based on FM 1-90 rating.
   ii. Roof deck securement and above-deck roof components on FMDS 1-29, Roof Deck Securement and Above-Deck Roof Components.
   iii. Perimeter Flashing can be based on FMDS 1-49, or an appropriate ANSI/SPRI ES-1 rating, allowing shop fabricating. (FMDS is more limiting that the ANSI/SPRI standards.)

H. Indicate applicable National Roofing Contractors Association standards.

I. Provide roof information sign at each roof access point. Provide a 8 ½-inch x 11-inch acrylic shielded waterproof sign with mechanically closed cover (tool required to open cover). Provide the following information on the sign (under the cover). Minimum font size is 11 point.
   i. Roof Type:
   ii. Roof Manufacture:
   iii. Roof Manufacturer Contact Information:
   iv. Roofing Contractor:
   v. Roofing Contractor Information:
vi. Install/Substantial Completion Date:

vii. Warranty Number:

viii. Warranty Expiration:

ix. Roof Area:

x. Contact Facilities Services work coordination center 541-737-2969 prior to making any roof penetrations.

J. No new clay tiles roof are permitted

K. Combustible roofing material shall not be stored inside an occupied building without written approval from the EH&S Fire & Life Safety group.

L. A serviceable 10 lb. ABC fire extinguisher to be present at all roofing operations.

M. A hot works permit (per OSU Standard) shall be provided at all roofing operations where hot works is present; including welding, cutting brazing, and all torch operations.

N. All work described in this standard shall comply with the current editions of the codes as adopted by the local jurisdiction and the latest edition of the International Building Code.

O. Waterproofing systems shall be used at all building planters, plaza decks, and penthouse and mechanical equipment.

P. Any and all overflow drainage from roof shall be managed in accordance with applicable municipal code requirements (including but not limited to the adopted Plumbing Code).

Q. Moisture control:

i. Install condensation control/ vapor retarders as required per the needs of the roof system.

ii. All attic and/ or under deck ventilation shall be installed as required to control moisture.

R. Testing for water tightness and material performance may be required at OSU’s discretion prior to OSU’s acceptance of roofing and drainage systems. Obtain acceptance of testing method from Owner and roofing materials manufacturer.

S. Refer to OSU Construction Standard 22 30 00 for additional information on Roof Drains.

2. FALL PROTECTION

A. All roofs requiring maintenance must have fall protection from one of the following methods, or a combination thereof:

   i. Parapet wall [preferred] 42” per OSHA building codes

   ii. Guardrails [minimize visibility of the guard rails from the ground or adjacent buildings]

B. Tie-offs (providing specialized equipment and access from roof hatches) are prohibited unless safety requires an alternative method beyond the two approved options above. Tie-off system as an alternative must be pre-approved via a Deviation Request to be approved by OSU Facility Services as coordinated by the Project Manager.
i. Structures of four stories or greater shall be equipped with roof tie off systems that allow for routine window cleaning on those stories four stories or greater.

3. MANUFACTURER QUALIFICATIONS

A. The Manufacturer’s Roof System Warranty shall include: Single source not less than 20 years, No Dollar Limit (NDL), for labor and material for entire system, including the roof system and other related systems.

B. Manufacturer shall have manufactured products continuously by same company for a period of time not less than ten years.

C. Manufacturer shall not be in any form of bankruptcy.

D. Manufacturer shall be the primary manufacturer of the membrane system.

4. ROOFING

A. The existing architecture of the building shall be accommodated.

B. Install attic draft stops as required by Building Code.

C. For renovations, all roofs shall be provided with code compliant fall protection systems parapet, railing, or tie-offs. (Tie-offs only approved by an approved Deviation Request and if the approved options are not possible).

D. For new construction, mechanical equipment located on roof must be screened by the parapet or screen wall or installed in a penthouse.
   i. Roof-mounted equipment should be secured in accordance with the latest version of ASCE7 or the locally adopted version of ASCE 7.

E. All roofs require access for maintenance of equipment, roof drains, etc.
   i. Provide walking/tread pads from point(s) of egress to the roof to point(s) requiring maintenance. The walk pads shall be placed in the design, such that all locations requiring maintenance are accessible from the walking surfaces.
   ii. The walking tread pad material must be manufactured by the roof system manufacturer.

F. All roofs shall be constructed or installed in a manner that provides for positive drainage without ponding or the occurrence of standing water to a drain per all applicable building code requirements and related specifications and standards.

G. New roofs may have an FM Roof Navigator (RoofNav) assembly number included as part of the description.

5. ROOF INSULATION

A. Provide separation board suitable for attachment to structure to provide a base for roofing or insulation and to provide for required fire ratings.

B. All insulation assembly shall meet thermal and fire rating requirements and shall be approved in writing by the roofing manufacturer.

C. Insulation overlay shall be designed and suitable for the roofing material.

D. Insulation should be Class 1, non-combustible, and FM approved.
E. If insulation boards are adhere to the deck, maximum board size should not exceed 4x4 feet.

F. Insulation R-Value shall be 20% better than the requirement of the current Oregon Energy Code

6. DRAINAGE

A. Provide required slopes to drain to primary roof drain in structure, unless otherwise approved by OSU’s Project Manager.

B. Provide tapered insulation and crickets as required to achieve drainage requirements.

C. Ballasted extruded polystyrene inverted insulation system shall meet FM and UP UL requirements. (Note that polystyrene for drainage sumps or similar will not meet FM standards for roofs.)

D. Install vapor retarder, as required, as part of the roofing assembly. Ensure the vapor retarder is permitted per the selected FM RoofNav listing.

E. Fasten, adhere, stagger, offset to provide a proper base for roofing and to meet FM and UL requirements.

F. All fasteners shall be increased by 50% in number at all perimeter locations and at corners. (This is not a generic rule for wind design and may be determined on a case-by-case basis.)

G. Install only as many above-deck components as can be covered each working day. Seal loose roof cover edges at the end of each day to minimize moisture damage. Do not allow water to run in steel deck ribs under completed roof sections.

7. LOW SLOPE ROOFING

A. Applied Locations

i. Use on low slope concrete, steel, wood or insulated roof decks.

ii. Minimum ¼” per foot slope to maximum 1” per foot slope to drain. ½” per foot is preferred.

iii. Other slopes may be considered and approved by OSU’s Project Manager, if necessary.

iv. Special securement may be required on slopes exceeding ½” per foot.

v. Roofing material needs to be coved up above overflow drains.

B. Applications

i. Elastomeric Membrane Roofing:

   a. Provide Vapor Barrier appropriate to roofing system. (If choosing to go with an FM roof, the vapor barrier should be listed and allowed by FM RoofNav.)

   b. Substrate: Separation board, insulation system, overlay board assembly as required to meet all codes, including (energy, wind uplift, and fire rating), and to meet manufacturer requirements for suitable roofing base.

   c. Material: EPDM to be first choice on all new and replacement roofs.

      1) EPDM (Ethylene Propylene Diene Monomer) fire rated 90 mils minimum thickness, with 145 mils preferred FLEECEBACK style ONLY, in largest sheets possible.

      2) Ensure EPDM membranes are not directly exposed to gasoline, oil, solvents or animal fats.
d. Application: Fully adhered.

e. Terminations: All perimeters and roof penetrations at vertical surfaces.

ii. Modified Bituminous Membrane Roofing (only permitted with OSU Facilities Services written approval via a Deviation Request form as coordinated by the Project Manager).

a. Provide Vapor Barrier appropriate to roofing system. (If roof is to be FM-rated, include FM RoofNav listing.)

b. Substrate: Insulation system, overlay board assembly as required to meet all codes, including (energy, wind uplift, and fire rating), and to meet manufacturer requirements for suitable roofing base.

c. Material: SBS (Styrene-Butadiene-Styrene)

d. Application: Cold Adhesive

C. Seams

i. Protective Coating: Elastomeric as approved by membrane manufacturer.

D. Standards


iii. UL – Fire Hazard Clarifications, Class A.

iv. FM – Roof Assembly Classifications (FMDS 1-28, 1-29, 1-49) – Class 1-90.

v. OSSC, Chapter 15 – Roof Assemblies and Rooftop Structures.

vi. NFPA 220

vii. Approved Manufacturers: Siplast, Carlisle and Firestone or approved equal.

E. Hot Asphalt Roofing

i. Use of new hot asphalt roofing system is not allowed on new and replacement roofs. Major repairs for hot asphalt roofing systems – must plan and mitigate for odors entering building air intakes, building windows and/or adjacent buildings as needed. University’s representative to confer with EH&S on mitigation plan prior to work being commenced.

F. Ballast roofing systems on new and replacement roofs is not allowed.

8. METAL ROOFING

A. Applied Locations

i. Use on low slope framing and steel or wood roof decks, minimum three inch (3”) per foot slope. (If the roof is over wood, it will not be FM or have a RoofNav listing.)

ii. System: Sealed standing seams with concealed fastening and provision for expansion and contraction.

iii. Pre-coated Galvanized Steel: 24 gauge minimum core steel, G90 galvanized, Kynar coated.
iv. Underlayment: Rosin paper slip sheet, 30# asphalt saturated felt and rosin paper, self-adhering underlayment, special underlayments when required by design or manufacturer’s insulation system.

v. Standards
   d. ASTM A361 – Standard Specification for Zinc Coated Steel Sheet.
   e. ASTM A308 – Standard Specification for Terne Coated Steel.
   g. ASTM UL580 – Tested for Wind Uplift, Class 90 Rated.
   h. ASTMSMACNA Architectural Sheet Metal Manual.
   i. FMDS 1-29, Roof Deck Securement and Above-Deck Roof Components (This standard will not apply if the decking is wood. Use UL listings if necessary.)

vi. System
   a. Standing seams or approved design with concealed fastening system; provisions for expansion and contraction.

vii. Warranty:
   a. Provide 50-year Manufacturer’s warranty
   b. Manufacturer’s standard warranty for color

viii. If applicable, include FM RoofNav assembly number.

ix. Shall have approved snow guard or snow retention system installed.

9. STEEP ROOFING
   A. Applied Locations
      i. Use on steep slope wood roof decks, minimum three inch (3”) per foot pitch.
   B. Materials
      i. Shingles
         a. Self-sealing Architectural asphalt or SBS (Styrene-Butadiene-Styrene) modified bitumen, polyester/fiberglass or fiberglass reinforced, mineral granule surfacing, minimum 245# per 100 square feet, CertainTeed Grand Manor or approved.
         b. Shingle shall be moss protected and have minimum 50-year manufacturer’s warranty.

      ii. Underlayment
a. 30# asphalt saturated roofing felt or breathable underlayment as approved by OSU’s Project Manager

b. 1 layer for pitches of 4:12 and steeper

c. 2 layers for pitches of 3:12 to 4:12

d. Self-adhering underlayment for pitches less than 3:12

e. Self-adhering underlayment at all valleys, eaves and rakes

f. Pitches of less than 4:12 are not recommended.

iii. Standards


iv. Warranty

a. Manufacturer’s standard 50 year material warranty

b. Manufacturer’s standard warranty for color

v. Provide ventilation under sheathing as required by code.

vi. Insulation

a. Insulation is not permitted directly below shingles.

b. Insulation to be designed and constructed to allow roofing material to function properly throughout warranty period.

10. FLASHING AND COUNTERFLASHING

A. Systems

i. Flashing and counter flashings, gutters and downspouts, copings, wall metal as required for the application.

ii. Standing, water shedding, sealed and soldered seams as required for the application.

iii. Expansion joints or other provisions for expansion as required.

iv. Back metal with felt as required.

v. Note that ANSI/SPRI requires a 1.6 safety factor. If it is determined to meet an FM assembly, FM will require a 2.0 safety factor.

B. Materials: As required by application, compatible with roofing materials.

i. Metals
a. Pre-coated Galvanized Steel: 24 gauge minimum core steel, G90 galvanized, Kynar coated.
b. Terne Coated Carbon Steel: Gauge as required for application.
c. Terne Coated Stainless Steel: Thickness as required for application.
d. Stainless Steel: Thickness as required for application.
e. Copper: Sixteen (16) ounce minimum.
f. Lead: Four (4) pound.

ii. Underlayment

a. 30# asphalt saturated roofing felt and rosin paper.
b. 15# where approved by OSU
c. Other breathable underlayment as approved by OSU and self-adhering underlayment.

iii. Warranty

a. Two-year installation warranty after final acceptance
Section 07 72 00: Roof Accessories

1. GENERAL
   A. Fall protection – Reference Fall Protection section in Section 07 10 00 Roofing and Waterproofing
      i. During the design phase, request a voluntary consultation with OSHA via EH&S to review fall protection requirements/needs.
      ii. OSHA requirements for fall protection and safety railings at roof perimeters are to be followed.
      iii. Fall protection systems are required on every new roof and every re-roofing project if not already present.
   B. Preferred locations for tie-off mounts are on vertical walls or parapets. Horizontal locations that require additional deck and/or roofing penetrations shall be avoided.
   C. Snow & Ice Protection
      i. Design roofs to protect people from ice and snow slides from building roofs. Assure that all walks and building entries are safe distances from slide zones.
      ii. Ice and Snow Guards shall be installed above pedestrian walkways on metal roofs.
   D. Solar Arrays
      i. Installation of photovoltaic (PV) arrays or solar panels on top of buildings should follow guidelines outline in FM Data Sheet 1-15, Roof-Mounted Solar Photovoltaic Panels, NFPA 780, Standards for Lightning Protection Systems (Chapter 12 specifically pertains to lightning protection of solar arrays.)
      ii. Be aware of the following safety hazards when looking into PV array installation:
         a. Electric shock and arc flash,
         b. Inhalation exposure (HazMat),
         c. Falls from roofs,
         d. Slip and trip hazards,
         e. Increased wind loads on roof design, and
         f. Increased wind loads on roof design.
      iii. In general, most common concerns are:
         a. Ensuring there are adequate aisles/walkways/access on the roof. Typical recommendations are a six-foot wide aisle every 100 feet. This creates a grid from which hoses and fire fighters can access the area.
         b. Provide electrical safety provisions to protect fire fighters including ways to disconnect the power to the transformers or inverters fed from the PV system.
         c. Provide clearances around the following:
            a) Roof Access Points: 36-inches
b) Roof Pathways: 48-inches  
c) Pathways to all Mechanical Equipment: 48-inches  
d) Roof Drains: 18-inches

E. Roof lighting for access hatches and pathways shall be provided to ensure a minimum of 5 foot candles is provided along roof access pathways. The lighting shall be controlled by a manual on/off switch with a 1-hour timer.

F. Hose bibs shall be provided on all new and renovated roofs. Hose bids shall be provided at each main roof level with a maximum spacing of 150-feet. Low slope, flat roofs may only have one hose bib.

G. Reflective markings shall be provided on all trip and head hazards on roof access pathways, including but not limited to vent stacks, guy wires, conduits and mechanical ductwork. Trip hazards between 0-feet and 2-feet shall be marked and head hazards between 4-feet and 6-feet shall be marked with reflective markings.
Division 8: Openings

**Section 08 05 00: Common Results for Openings**
1. REQUIREMENTS

**Section 08 31 00: Access Doors and Panels**
1. REQUIREMENTS

**Section 08 50 00: Windows**
1. REQUIREMENTS

**Section 08 71 00: Door Hardware**
1. REQUIREMENTS
2. PRODUCTS
Section 08 05 00: Common Results for Openings

1. REQUIREMENTS

   A. All electronic access devices shall be Hirsch compatible.
   B. All entry devices must be capable of being overridden by an Oregon State University Master Key.
   C. All entrances shall be designed with appropriate air locks.
   D. All entrances shall have a built in mat and/or dirt catch system.
   E. All main entrances to new buildings or buildings that are significantly renovated shall include a fully automatic door at main entrance.
   F. All other doors to new buildings shall be ADA accessible. Refer to Construction Standard 01 10 02 Accessibility Best Practices for OSU.
      i. The doors shall have proximity sensors placed at an accessible and appropriate location and centered 33 inches from the finished floor.
      ii. All doors shall have levers and power assist if over 5 pounds force is necessary to open.
      iii. Door operating hardware shall be in an easily and fully accessible location.
   G. University Housing & Dining Services has separate requirements for door operating hardware for its facilities. Design teams are to incorporate the UHDS standards for work on UHDS facilities. The OSU Project Manager will provide contact information for UHDS.
Section 08 31 00: Access Doors and Panels

1. REQUIREMENTS

   A. Provide access panels in non-accessible ceilings wherever there is equipment or a device that needs maintenance (valves, dampers, junction boxes, terminal units, etc.).

   B. Access panel sizes shall be sized to accommodate the removal of largest piece of equipment in that space. The location of access panels shall be reviewed by the OSU Project Manager and the applicable shop/s to ensure the location is accessible for maintenance and operation requirements.

      i. Access panel shall be, at a minimum 36” X 48” where the equipment or device is less than 18” from the finished ceiling.

      ii. Use 36” x 48” access panels where the equipment or device is more than 18” from the finish ceiling and where equipment or device has a panel or door that needs to be opened or removed for service.

      iii. Use a minimum of 8” x 8” access panels in walls to access valves or other appurtenances.

   C. Locate access panels directly under or in front of the equipment or device’s service/maintenance panels, doors, belts, filters, etc.

   D. Final location of access panel shall be determined on site by OSU Project Manager, EH&S construction safety officer, and Facilities Services prior to installation.
Section 08 50 00: Windows

1. REQUIREMENTS

A. Windows must meet the Oregon State Energy Code requirements and the requirements of the State Energy Efficiency Design model for the building.

B. All windows to be Tinted low "E" glass.

C. All Window frames shall have a thermal break.

D. No wire-glass windows are permitted.

E. All window glass/glazing shall have minimum 5-year warranty.

F. To prevent energy waste, all spaces with operable windows must have window- HVAC interlock to prevent HVAC system operation with windows open.

G. If the building for which windows are being replaced is located within the OSU National Historic District, the windows are subject to the requirements of the City of Corvallis Land Development Code, Chapter 2.9 – Historic Preservation Provision.
Section 08 71 00: Door Hardware

1. REQUIREMENTS

   A. Any key locking devices e.g., programmers, interrogators, junction boxes, etc. must be capable of accepting a SFIC.

   B. The main entry of each new building must be equipped with a Knox Box for emergency access by the local jurisdiction’s Fire Department.

      i. For renovation projects the OSU Project Manager is responsible for contacting the local jurisdiction’s Fire Marshal to determine of the installation of a Knox Box is required.

   C. All exit devices shall be approved by the OSU Access, Lock and Key Shop (AL&KS) prior to installation.

   D. Fully automatic doors for main entrance, ADA accessible doors for all other doors should have proximity sensors placed at an accessibly appropriate location and centered 33 inches above finished floor surface.

   E. OSU AL&KS shall make provisions for pinning for lock cylinders.

   F. For all remodel projects, the existing hardware shall be matched with existing building hardware unless that hardware is no longer available. If unavailable refer to the OSU AL&KS.

   G. All new buildings will be put on the Cormax Key System.

   H. Partial renovations which only require some rekeys will be placed on the building’s existing system.

   I. Major renovations which will require the majority of the doors to be rekeyed need to be evaluated by the OSU Access, Lock and Key Shop for system selection prior to ordering cores.

   J. University Housing and Dining Services has its standards for residential and dining halls. Contact the OSU Project Manager for referral to University Housing and Dining Services.

   K. If the building for which door hardware is being replaced is located within the OSU National Historic District, the exterior door hardware is subject to the requirements of the City of Corvallis Land Development Code, Chapter 2.9 – Historic Preservation Provision.

   L. Any deviations to be approved with the OSU Access Lock & Key Shop per the Deviation Request Process via the Project Manager.

2. PRODUCTS

   A. Exit Devices

      i. Any mechanical exit device (crash bar) shall be Von Duprin 99 series. For questions, see OSU Access Lock & Key Shop.

      ii. Ensure minimum ADA clearances with door in open and closed position. See Construction Standards 01 10 02 Accessibility Best Practices for OSU.

   B. Lock Sets

      i. All cores will be provided by the Access Lock and Key Shop.
ii. If mortise lock sets are specified they shall be supplied with BEST 7 PIN SFIC CYLINDER, housings with Rhodes lever in 626 finish.

iii. If cylindrical lock-sets are specified, they need to be prepared to receive BEST 7 pin SFIC REMOVABLE cores with Rhodes lever in 626 finish.

iv. Lock functions – Series Numbers
   a. Classroom
      1) Classroom Locks are not allowed on campus for emergency security reasons. See Keyed Entry.
   b. Passage
      1) Schlage Cylindrical ND10SBD-RHO-626
      2) Schlage Mortise L9010-06A-626
   c. Storeroom
      1) Schlage Cylindrical ND80BD-RHO-626
      2) Schlage Mortise L9080BD-06A-626
   d. Keyed Entry
      1) Schlage Cylindrical ND53BD-RHO-626
      2) Schlage L9056BD-06A-626 with an ADA thumb turn.

v. SFIC Rim & Mortise housings must be Schlage brand. Use SFIC cores for all locks devices and key switches.
   a. Rim Cylinder
   b. Mortise Cylinder
   c. Dummy Rim

vi. Standard Hardware Finishes
   a. Satin Chrome – 626 (US26D)
   b. Any deviations to be requested through a Deviation Request Form via the Project Manager and approved the OSU Access Lock & Key Shop.

C. Door Closers
   i. LCN 4040
   ii. Any deviations to be requested through a Deviation Request Form via the Project Manager and approved the OSU Access Lock & Key Shop.
      a.

D. Hinges
i. Any doors taller than 84-inches are required to have two intermediate hinges instead of one (exceptions to be approved via Deviation Request via the Project Manager and approved by Facilities.)

E. Automatic Door Operators

i. Installed on all primary public entrances and public restrooms.
   a. DormaKaba ED100
   b. LCN 4600 Series
   c. Any deviations to be requested through a Deviation Request Form via the Project Manager and approved the OSU Access Lock & Key Shop.

F. Automatic Door Operator Actuators

i. MS Sedco #216 Touchless Switch
   ii. Provide MS Sedco 59H push button control in high traffic corridors where people passing by may inadvertently trigger the door operator.
   iii. An alternate to the MS Sedco 59H in busy corridors is the Ingress’R 36” tall wall switch which allows activation by pressing or bumping the device anywhere along the 36” length.
   iv. Any deviations to be requested through a Deviation Request Form via the Project Manager and approved the OSU Access Lock & Key Shop.

G. Single-User Restroom Door Control

i. Camden CX-22 Dual Function Relay
   ii. Two CM-AF500 Single Gang Annunciators printed with:
      a. OCCUPIED WHEN LIT
      b. LOCKED WHEN LIT
   iii. Camden CM-400WR/8 Mushroom Push Switch with 4 ½” X 4 ½” faceplate printed with PUSH TO LOCK
      a. Separate this Push Switch and the MS Sedco #216 Touchless Switch by a minimum of 24” with the PUSH TO LOCK switch farthest away from the door to avoid nuisance activation of the touchless sensor when occupant attempts to lock the door. Both switches to be within reach range as required for accessibility.
   iv. CX-MDC Surface Mount Door Contacts
   v. Von Duprin 6210 electric strike.
   vi. Schlage Mortise L9080BD-RHO-626
   vii. Where more than one single-user restrooms are provided in close proximity to each other, a minimum of one restroom shall be provided with this hardware.
   viii. Any deviations to be requested through a Deviation Request Form via the Project Manager and approved the OSU Access Lock & Key Shop.

H. Access Control – reference Section 28 13 00.
Division 9: Finishes

Section 09 51 00: Acoustical Ceilings
1. REQUIREMENTS

Section 09 60 00: Flooring
1. REQUIREMENTS

Section 09 90 00: Painting and Coatings
1. REQUIREMENTS
2. APPROPRIATE PAINT APPLICATION BY AREA
Section 09 51 00: Acoustical Ceilings

1. REQUIREMENTS

A. Commercial grade ceiling assembly meeting current Oregon adopted building codes.

B. All supporting components must be certified as UL approved.

C. Ceilings and mechanical/electrical equipment coordination

   i. Light fixtures, ceiling mounted diffusers (or grilles) and other openings in the ceiling must be supported in compliance with Oregon current IBC Standards 25-2.

   ii. Coordination with mechanical, electrical, and plumbing equipment is required when laying out ceiling grids and supports; no mechanical, electrical, or plumbing access should be blocked.

   iii. 10-inches from the suspended ceiling to the bottom of equipment & ductwork is required for ceiling tile removal.

D. Supply & install Armstrong Cortega No. 823 or No. 895, 2' X 4' ceiling panels as minimum standard. Other 2' x 4' ceiling panels styles to be as approved by OSU. Armstrong Prelude XL Fire Guard 15/16" is approved by ICBO.

   i. Porous ceilings (tiles and/or systems) are not to be used in ‘wet’, clean, or sterile applications.

   ii. For renovation projects, match adjacent room/primary building 2' x 4' ceiling panel styles when possible.

E. T-bar ceilings shall be full size T's - need to be fire rated 15/16" grid heavy duty.

F. Install seismic joint clips, e.g. Berc clips, with all wall angles.

G. Provide 12 gauge minimum wire.

H. Provide 1/4 "wedge anchors in concrete ceiling. Powder driven anchors are prohibited.

I. Overstock Materials: 5% of each type of acoustic tile and/or panel installed.
Section 09 60 00: Flooring

1. REQUIREMENTS

A. All floor coverings must be asbestos free.

B. Material manufactured overseas shall be certified to be asbestos free prior to delivery. Low VOC adhesives shall be used for flooring installation.

C. Indoor hallways, classrooms, elevators, dining rooms -- vinyl tile, rubber, terrazzo, polished concrete, or linoleum flooring. Restrooms -- Ceramic or seamless flooring. Modular carpet is acceptable in classrooms needing acoustic dampening.

D. Resilient Flooring: Chemical-use laboratories, glass wash or other areas where liquids are used or stored shall have watertight flooring. Provide seam sealed sheet vinyl or linoleum flooring or equivalent with at least a 4-inch continuous cove. Flooring material to be compatible with the chemicals or other materials to be used or stored and to be a tested and recognized flooring material for the anticipated use.

E. Modular carpet (carpet tiles) should be used. No wall-to-wall carpet shall be installed. The number of transitions from hard to soft flooring shall be minimized. Avoid installing carpet on concrete below grade, or on basement floors, or in high use hallways. Carpet tiles in high traffic areas need to be glued down.

F. Color will be determined on a case by case basis; however, attempts should be made to coordinate the existing color scheme. Extra materials overage of 2-5% will be provided. Materials should require minimum maintenance and should comply with industry cleaning standards methods.

G. No raised flooring floor coverings.

H. Underlayment: Follow the manufacturer’s requirements where wood underlayment is required under carpet, or sheet goods. Engineered plywood underlayment with screw anchoring minimum 12” on center (O.C.) in field and minimum 10” O.C. at seams and edges.

I. Polished or stained concrete in public areas shall be considered. Unfinished or unsealed concrete flooring or stairways are prohibited inside buildings.

J. Concrete sealer shall be applied to concrete slabs where fully adhered modular carpet, resilient flooring or tile will be installed. No sealer is required of other floor coverings.

K. Flooring choices must take into consideration traction and slip-resistant properties to minimize incidents.

L. Stair treads: Provide non slip color contrast material at stair nosing per ADA standards. Flat and smooth rubber tile or sheet flooring is preferred; no raised disc or dots.

M. Walk-off mat systems: integral to a recessed floor require Owner approval. If approved, the walk-off mats are to be Contractor Furnished Contractor Installed (CFCI).
Section 09 90 00: Painting and Coating

1. REQUIREMENTS

   A. Plans shall designate color and sheen to be used.

   B. Coat/seal all items prior to installation as much as possible; special consideration(s) required in occupied buildings. At pre-construction meeting define plans to reduce impact to building users regarding application of finishes, paints, adhesives, etc.

      i. All Surfaces shall be primed prior to the application of minimum two finish coats of paint

      ii. Apply at dry thickness of 1.5 mil per coat

   C. Paints should be selected for maximum durability (infrequent repainting) and minimum environmental and human impact for the given application. Consider ventilation, exposure to physical damage, vandalism potential, liquids, likely maintenance frequency, etc.

   D. Water based finishes only for interior and onsite applications.

   E. The following paint manufacturers are acceptable:

      i. Benjamin Moore: Aura, Advance, or Natura

      ii. Flecto (UHDS)

      iii. Miller: Evolution, Premium

      iv. Pittsburgh

      v. Rust-Oleum

      vi. Sherwin-Williams

   F. OSHA Safety Colors:

      i. All colors should conform to OSHA and ANSI specifications and are available in IronClad Quick Dry Industrial Enamel (071).

   G. Low VOC materials are to be used; zero VOC when available. Paint containing 5 grams/liter or less is considered "Zero VOC", according to the EPA Reference Test Method 24. On new construction or major remodels, follow applicable LEED criteria for low or zero VOC paint. Low VOC < 50 grams/liter

   H. The finish manufacturer’s recommendations for acceptable moisture ranges prior to application / installation shall be followed. Moisture testing on concrete, substrate, etc. is required prior to installation of finishes and results must be submitted to the OSU Project Manager.

   I. Covering or painting of any signs, labels, identification, etc. requires replacement.

   J. Provide schedule of colors and finishes including: manufacturer, product, color names and numbers, sheen level, and other specific identifying information.

   K. Within the OSU National Historic District it is not permitted to paint over or retouch murals that are 50-years old or older, or to paint over existing architectural features, such as signs, or previously unpainted metalwork, brickwork, stonework and masonry.
2. APPROPRIATE PAINT APPLICATION BY AREA

A. Interior surfaces
   i. OSU requires ceilings and walls in general purpose areas (offices, classrooms, conference rooms, break rooms, lobbies, hallways, etc.) to receive low or zero VOC paint.
   
   ii. Acceptable products:
       a. Benjamin Moore: Aura, Advance, or Natura
       b. Miller: Evolution, Premium
       c. Sherwin-Williams: Duration, SuperPaint, Emerald
   
   iii. Doors, door frames, hand rails, corner trim, floors, certain lab surfaces and other areas exposed to high or frequent impact may receive higher durability products, satin sheen at a minimum. These products may or may not be low or zero VOC.
   
   iv. Eggshell paint shall be used on ceilings. Walls shall have minimum eggshell sheen. Higher use areas shall have higher sheen applications to allow for cleaning.

B. Exterior surfaces
   i. Exterior surfaces should be painted with products appropriate for the substrate and exposure to weather, vandalism, graffiti and other elements.
   
   ii. Minimum 15 year durability paint on all exterior surfaces. Acceptable paints include Benjamin Moore Aura; Miller Evolution-exterior; and Sherwin Williams Duration.
   
   iii. Exterior metal accessories and/or furnishings shall be galvanized or powder coated; no painted finish. Include Kynar 500® resin - polyvinylidene fluoride (PVDF)
       a. Galvanized when accessories are poured in place and/or not removable for refinishing.
       b. Powder coated when accessories are removable for refinishing.

C. Pavement Markings
   i. Refer to OSU Construction Standard Section 32 10 00 Item E. Pavement Markings for information
Division 10: Specialties

Section 10 14 00: Signage
PART 1: EXTERIOR SIGNS
1. GENERAL
2. TYPES OF EXTERIOR SIGNAGE
PART 2: INTERIOR SIGNS
1. REQUIREMENTS
2. TYPES OF INTERIOR SIGNS

Section 10 26 16: Toilet, Bath and Laundry Accessories
1. REQUIREMENTS
2. PRODUCTS
3. LAB AREAS

Section 10 60 00: Interior Trash/Recycling Stations
1. REQUIREMENTS
Section 10 14 00: Signage

PART 1: EXTERIOR SIGNS

1. GENERAL

A. Oregon State University requires an effective system of visual communication that projects a uniform institutional identity, while at the same time integrating well with the present and future campus environment. The following requirements identify how exterior signage will be applied to the OSU Corvallis campus. All exterior signage shall be reviewed and approved by University Land Use Planning.

B. The design and placement of exterior signs on OSU Corvallis campus are regulated by both the City of Corvallis Land Development Code and OSU’s Sign Plan. See https://fa.oregonstate.edu/cpd/osu-sign-plan on the OSU Capital Planning & Development, University Land Use Planning. All signage, permanent and temporary, shall comply with the OSU Sign Plan and the City of Corvallis Land Development Code Chapter 4.7 - Sign Regulations or other applicable state and local regulations if outside the jurisdiction of City of Corvallis.

C. Signage within the OSU National Historic District shall comply with City of Corvallis Land Development Code Chapter 2.9 – Historic Resources. Installation of exterior signs within the OSU National Historic District shall be coordinated through University Land Use Planning with Capital Planning and Development.

D. Permanent signs required by building code shall be installed consistent with applicable regulations, standards, and guidelines.

E. No exterior signs shall exceed 200 square feet in area.

F. Signs shall not be attached to any light pole or light fixture.

G. Installation of signposts requires site-specific utility locate requests, in order to preserve campus infrastructure (irrigation, tunnel system, etc.)

H. Variations from the OSU Design and Construction Standards and the OSU Sign Plan must be approved in writing by the University Land Use Planning Manager (via Design & Construction Standards Deviation Request form).

2. TYPES OF EXTERIOR SIGNAGE

A. Monument Signs

i. Each building or facility shall have only one (1) monument sign and it shall only indicate the official building name and street address.

ii. The monument sign shall be free-standing and located on the street that the building’s addressed off of, near the main entrance, oriented perpendicular to the street, and shall be setback at least two (2) feet from face of curb.

iii. The type face Sabon shall be used for all monument signs and the address shall be 6 inches minimum in height per the Oregon Fire Code.

iv. The Oregon State University logo (or any other logo) shall not be added to monument signs.

v. The following diagram illustrates the standard size for the primary identification sign.
B. Primary Building Identification
   
i. Primary building identification is typically an attached sign located at the recognized main entrance to the building or facility.

   ii. Primary building identification shall only indicate the official building name.

   iii. The minimum separation between primary identification signs shall be at least 100 feet.

   iv. The Oregon State University logo (or any other logo) shall not be added to the primary facilities identification signs.

   v. Sign design, including font, to be reviewed and approved by University Architect, ULUP Manager, and University Relations & Marketing (URM) as coordinated by the Project Manager.

C. Street and Parking Signage
   
i. Location and type of street signposts and signs must be approved by Capital Planning & Development.

   ii. Street signage shall comply with the Manual on Uniform Traffic Control Devices (MUTCD) and the Oregon Supplement to the MUTCD.

   iii. The OSU campus standard post is Unistrut Telespar 2-inch. x 2-inch, 12 feet., 14 gauge galvanized steel, quick punch, and painted OSU standard site furnishing colors. Refer to OSU Construction Standards 32 33 00 Site Furnishings. Post substitutions must be approved by Capital Planning & Development (in writing via Design & Construction Standards Deviation Request form).
a. Preference should be given to locating signs outside of paved areas. Posts located outside hardscaped areas shall be installed using Tapco V-Loc Post Anchor for square 2-inch by 2-inch posts, model 200-VS3 with 30-inch leg length. Backfill material shall be amended with a mixture of concrete and compacted to provide rigidity and stability to the installation. All signs shall be installed level and plumb.

b. Posts located in hardscaped areas shall be located outside of the minimum effective width (refer to Section 34 00 00 Transportation, Figure x: Pedestrian Facility Size). Posts shall be core drilled and installed using Tapco V-Loc post anchor for 2-inch x 2-inch posts, model 200-VS1. Posts set in new concrete may be wet-set using Tapco V-Loc post anchor model 200-VS1A. V-Loc frames shall be installed flush to the finished grade. When the post is placed in concrete, the concrete shall not cover the V-Loc wedge. All signs shall be installed level and plumb.

c. Surface mounted signposts for street signage are acceptable only for temporary use as approved by OSU Capital Planning and Development. Posts located in sidewalks and walkways shall be located outside of the minimum effective width as noted on the Pedestrian Facility Size map (refer to Section 34 00 00 Transportation, Figure x: Pedestrian Facility Size).

iv. Signposts for parking shall be the OSU campus standard post. Parking signage must meet MUTCD requirements for mounting height. Location and type of parking signpost and signs must be approved by OSU Transportation Services.

a. Surface mounted signposts are acceptable for parking signage as approved by OSU Transportation Services. Posts located in sidewalks and walkways shall be located outside of the minimum effective width (refer to Section 34 00 00 Transportation, Pedestrian Facility Size).

D. Directional Signs

i. Directional signs are permanent and provide direction to parking lots, buildings, and athletic and/or event facilities within a specific location and include the following requirements:

a. Directional signs shall not be attached to any historic building. (Refer to the OSU Historic Preservation Plan Design Guidelines.) This includes ADA signage providing direction to accessible entrances.

b. Refer to OSU Construction Standards Section 01 10 02 Accessibility Best Practices for OSU for accessible entrance directional signs.

E. Illuminated Identification

i. Illuminated signage is limited to locations or buildings that have student activities during the evening, and for way finding for emergency services.

ii. Illuminated signage may include neon signage to call attention to buildings that provide OSU approved commercial food service, OSU and student supported entertainment activities, and athletic or special events that promote campus-wide activities. These types of events or activities may include coffee shops, brew pubs, football stadiums, or conference centers.

iii. Neon signage requested for designated resources in the OSU National Historic District shall be governed by City of Corvallis Land Development Code Chapter 2.9 – Historic Resources.

iv. Illuminated signage may include marquee signage. Marquee signage must be placed in a location that has minimal impact to any adjacent intersecting streets.
v. Illuminated and neon sign requests must be submitted to the Campus Planning Committee for approval.

F. Banners
   i. Banners shall be mounted to Historic Light Pole with dual arms in either a single or double arm arrangement (See Division 26- Exterior Lighting, Diagram 26 00 00 C).
   ii. Banners shall be permitted in an approved location identified by the OSU Sign Plan and as approved by University Relations and Marketing (URM).
   iii. When banners are installed in approved locations that do not currently have light poles with banner arms, banners and mounting hardware shall be installed along the length of the block. University Marketing and University Land Use Planning staff will review and approve the proposed spacing of banners and banner mounting arms.

G. Construction Job Sign
   i. Refer to OSU Construction Standard 01 50 00 Temporary Facilities and Controls

H. Welcoming/ Information Kiosks
   i. Per ES&A’s copyright design available at Eugene Sign & Awning Company, 89975 Prairie Road, Eugene, OR 97402:
      a. Custom cabinet
      b. Steel posts
      c. Map Panels
      d. Down Lighting
      e. Appurtenances
      f. See Front and End / Sign Layout drawing:
PART 2: INTERIOR SIGNS

1. REQUIREMENTS

A. OSU has an interior sign system that is consistent with all new and remodeled campus buildings constructed since 1991.

B. The signs shall be a vandal resistant system, meet existing ADA regulations and OSU requirements for graphic clarity. Sign colors are left up to the building design professional team as long as there is enough light/dark contrast between background and characters; however the size, shape and style will remain consistent with other interior building signage.

   i. The OSU logo is 2-inches x ¾-inches and is not raised.

   ii. Overall interior sign thickness is 3/8-inches.

C. All signage shall follow the 2010 ADA Standards for Accessible Design and OSU Design & Construction Standards Section 01 10 02 Accessibility Best Practices for OSU.

   i. Provide room signs to be ADA compliant and show both permanent names and room numbers in Braille and tactile lettering. Review permanent room names with Project Manager and EOA manager.

D. Provide room numbers on all rooms.

E. The use of self-luminous exit signs containing radioactive material is prohibited unless specifically approved by Environmental Health & Safety (EH&S).

F. See typical OSU interior room signage summary of types at the end of this section. Coordinate with Project Manager and University Marketing.
2. TYPES OF INTERIOR SIGNS

A. Exit Signs
   i. Tactile Exit Signs: Refer to Section 01 10 02 Accessibility Best Practices for OSU.

B. Stairwell Floor Level Signs
   i. Refer to Section 01 10 02 Accessibility Best Practices for OSU for signage requirements for floor level designation in stairwells.

C. Room Hazard Signage
   i. Utilize Module 8.11 (wall mount) to accommodate an 8.5 in. x 11 in. insert; inserts to be provided by the Project.
   ii. Signs to be mounted at each room entrance
   iii. Signs to be 49 in. high (to sign bottom) on door knob side and below room number signage

D. Emergency Evacuation Sign
   i. All campus buildings shall have building evacuation signs posted on every occupied floor.
      a. The signs shall be posted at all stairway and elevator landings and immediately inside all public entrances to the building.
      b. The insert for the holder shall conform to the following criteria to comply with state regulations:
         1) Show floor plan for the level on which it is placed. It should be easy to see immediately by someone entering that floor of the building.
         2) Place signs no more than 4 feet above finished floor.
         3) Make sign’s lettering at least 3/16 inch high in a sans-serif font. The words shall be in sharp contrast to the background and easy to read.
         4) Include emergency procedure information for those with disabilities.
         5) Indicate the locations of exits and fire alarm pull stations.
         6) If there are elevators on the floor, state they are not to be used during emergencies.
         7) Other pertinent information may be added to the sign, such as location of fire extinguishers, hazardous material spill kits, or emergency preparedness equipment.

E. Restroom signs
   i. For multi-stall gendered restrooms, in addition to existing ADA design standards:
      a. Signs shall include the language “MEN” or “WOMEN” only, utilizing raised characters in uppercase sans serif fonts.
      b. Include the proper contracted (Grade 2) Braille for “MEN” or “WOMEN”.
      c. Ensure pictograms correspond with the features of the restroom. In addition to a gender specific pictogram, include pictograms for common features, such as: Toilet, Urinal, Shower, OSU standard
wheelchair icon (sinks are implied), and a separate changing table sign if such facilities are included.

d. Sufficient contrast is important, specific color combinations are not specified.

ii. For multi-stall non-gendered restrooms, in addition to existing ADA design standards:

a. Signs shall include the language “MULTI-STALL RESTROOM” only, utilizing raised characters in uppercase san serif fonts.

b. Include the proper contracted (Grade 2) Braille for “MULTI-STALL RESTROOM”.

c. Ensure pictograms correspond with the features of the restroom, and do not include a gender pictogram of any kind. Common Pictograms to include: Toilet, Urinal, Shower, OSU standard wheelchair icon (sinks are implied), and a separate changing table sign if such facilities are included.

d. Sufficient contrast is important, specific color combinations are not specified.

e. Below are examples of pictogram arrangement, not a comprehensive list of all possible combinations of pictograms.

<table>
<thead>
<tr>
<th>Accessible Multi-Stall Restroom with only Toilets</th>
<th>Accessible Multi-Stall Restroom with Urinal(s) and Toilet(s)</th>
<th>Accessible Multi-Stall Restroom with Toilet(s) and Shower(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accessible Multi-Stall Restroom with a Urinal(s), Toilet(s), and Shower(s)</td>
<td>Non-Accessible Multi-Stall Restroom with Toilet(s) and Shower(s)</td>
<td>Changing Table Sign to be used in combination with Multi-Stall Restroom sign, when provided</td>
</tr>
</tbody>
</table>
iii. For all single-user restrooms, in addition to existing ADA design standards:

a. Signs shall include the language “SINGLE-USER RESTROOM” only, utilizing raised characters in uppercase san serif fonts.

b. Include the proper contracted (Grade 2) Braille for “SINGLE-USER RESTROOM”.

c. Ensure pictograms correspond with the features of the restroom, and do not include a gender pictogram of any kind. Common pictograms to include: Toilet, Urinal, Shower, OSU standard wheelchair icon (sinks are implied), and a separate changing table sign if such facilities are included.

d. Sufficient contrast is important, specific color combinations are not specified.

e. Below are examples of pictogram arrangement, not a comprehensive list of all possible combinations of pictograms.
3. OSU Interior Signage – Room Sign Summary (updated June 2024)

### #1

- **Overall**: 8 1/2" x 2 1/2" x 3/8"
- **Paper Insert**: No paper insert

All frames include the University logo (except #2).

### #2

- **Paper**: 8 1/2" x 3"
- **Overall**: 8 1/2" x 4" x 3/8"

Room number and name are ADA compliant, tactile and accompanied by braille. Room numbers and braille are required on doorway signage.

### #3

- **Paper**: 8 1/2" x 3"
- **Overall**: 8 1/2" x 6" x 3/8"

Each frame (except for #1) allows for an updateable paper insert behind a clear/non-glare acrylic. Paper inserts are ordered through OSU Printing and Mailing.

### #4

- **Paper**: 8 1/2" x 5 1/2"
- **Overall**: 8 1/2" x 8 1/2" x 3/8"

### #5

- **Paper**: 8 1/2" x 11"
- **Overall**: 8 1/2" x 14" x 3/8"

### #6

- **Paper**: 11" x 17"
- **Overall**: 11" x 20" x 3/8"
- Height extends to accommodate room name and braille
- OSU logo 2" x 3/4"
Sample inserts for #2 or #3
(Name plates)
8 1/2"x 3" paper

Sample inserts for #5
(Suite entrances, office hours, etc.)
8 1/2"x11" paper

Sample inserts for #6
(building information, directional information, etc.)
11"x17" paper

International Affairs
Administrative Program Assistance
and Office Manager
International Agreement
and Delegation Coordinator
Analyst Programmer

Front Desk located at
Suite 130 – First Floor

University Plaza
Employment Center

Office Hours:
Monday through Friday
8 a.m. to 5 p.m.

Global Opportunities (OSU GO) 130
Human Resources at University Plaza 100
International Affairs 130
International Services 130

University Administrative Business Center (UABC) – Finance 100
University Plaza Employment Center 150

2nd Floor
- Activities and Athletics Business Center (AABC) – Finance 231
- GIS Water Solutions 203
- International Affairs 231
- Conference Room 203
- Office of Global Opportunities 260
- University Shared Services Enterprise (USSSE) 203

Elevator

First Floor
- Global Opportunities (OSU GO) 130
- Human Resources at University Plaza 100
- International Affairs 130
- International Services 130
- TelMark – a division of David Evans and Associates 150
- University Administrative Business Center (UABC) – Finance 100
- University Plaza Employment Center 150

Second Floor
- Activities and Athletics Business Center (AABC) – Finance 230
- GIS Water Solutions, Inc. 200
- International Affairs 200
- Conference Room 200
- Office of Global Opportunities 200
- Athletics and Athletics Business Center (AABC) – Finance 230
- Faculty-Staff Programs 200
- College of Global Programs 200
- University Shared Services Enterprise (USSSE) 200

Third Floor – You Are Here
Agricultural Research Foundation 320
Oregon Sea Grant 250
Section 10 28 16: Toilet, Bath and Laundry Accessories

1. REQUIREMENTS

A. Floor drain
B. Ceramic, Seamless floor, or Polished Concrete
C. Keyed hot water hose bib under sink
D. Wall-mounted partitions, preferred
E. Isolation valves
F. This Design Professional to show location, elevations, and correct size of bathroom accessories on plans. Refer to Construction Standards 01 10 02 Accessibility Best Practices for OSU. Some equipment may need to be recessed to comply.
G. Built-in dispensers will not be allowed
H. All restrooms (Women’s, Men’s, Uni-sex, Gender-neutral/inclusive, Family) to provide a Sanitary Napkin Dispenser.

2. PRODUCTS

A. Toilet seat cover dispenser, Georgia Pacific white #57710 ½ fold (Owner Furnished, Contractor Installed (OFCI))
B. Dispenser, soap – Georgia Pacific Blue Ultra 53057). Owner Furnished, Contractor Installed (OFCI)
C. Roll towel dispenser, Georgia Pacific Blue Ultra Mechanical, Black, #59589. Owner Furnished, Contractor Installed (OFCI) (See OSU Construction Standard 01 12 00 Accessibility Best Practices for OSU)
D. Sanitary Napkin Dispenser - Contractor Furnished, Contractor Installed (CFCI). Sanitary products to be free, unscented, and of various sizes. Manufacturer/Model – EVOLGEN EV4, Item 88HSCEVNT4 Mini No Touch Dual, White Metal. (Note, these dispensers protrude >4” and cannot be located within path of travel; therefore, strategic locations to be confirmed to meet accessibility requirements.)
E. Sanitary receptacle – Rubbermaid 6140 wall mount white, plastic. (Owner Furnished, Contractor Installed (OFCI))
F. Toilet paper dispenser, roll – Georgia Pacific Pro 56784 Compact roll. (Owner Furnished, Contractor Installed (OFCI))
G. Electric hand drying equipment when approved by OSU Project Manager.
   i. Operation
      a. No heating element, high velocity air (aka compression or motor heated air)
      b. Touch free activation via infrared sensor
      c. 15 seconds or faster drying time
      d. 85 dB or lower sound level; some sound sensitive areas or where there are no restroom doors may need to receive equipment with maximum 77 dB sound power level
e. Optional air filtration provided at OSU’s request

ii. Electrical
   a. 1400 watts or lower operating power consumption
   b. 110-120V, 208-240V or 220-240V compatibility, depending on application
   c. Standby power consumption of 2 watts or lower

iii. Construction
    a. Housing should minimize maintenance needs and retain clean appearance under low maintenance conditions. Acceptable housing materials include ABS plastic, stainless steel and aluminum

iv. Warranty minimums: 5 year parts, 1 year labor

3. LAB AREAS
   A. Towel dispensers as needed for laboratory operations
      i. Roll towel dispenser, Georgia Pacific Blue Ultra Mechanical, Black, #59589.
      ii. Paper towel dispenser, single-fold Georgia Pacific 56701.
Section 10 60 00: Interior Trash/Recycling Stations

1. REQUIREMENTS

A. General: The standard is to centralize recycling and trash bins. The goal of the “All in the Hall” program is to increase recycling by providing equal opportunity to recycle or landfill waste. To achieve this, recycling must always be paired with trash, and because placing a recycling bin in every classroom isn’t feasible, trash cans are removed from the classrooms and replaced with convenient, centralized waste receptacles that are all in the hall.

i. No trash bins will be placed or remain in lecture classrooms and the All in the Hall units will capture each direction of student traffic to and from the affected classrooms.

ii. Indoor units will need wall space above for three 11-inch x 17-inch informational recycling signs.

iii. If trash bins are found during regular servicing that have been moved from elsewhere in the building, the custodial service provider is to remove them. Likewise, Campus Recycling will remove recycling bins that have been left in the collection bin area.

B. Placement: Placement of centralized All in the Hall standard bins require a review of building use, pedestrian traffic, waste and recycling generation, and logistical considerations including fire prevention, accessibility, and other safety issues. OSU Campus Recycling staff are the responsible staff to conduct a study of the building and building use and be the primary group for installation, bin signage, and communications to staff and faculty.

i. Campus Recycling will identify bin placement location(s) followed by review of these locations by the following OSU stakeholders: Procurement, Contracts, and Materials Management; Facilities Services: Capital Planning and Development; current OSU custodial contractor services group; the OSU Fire Life Safety Consultant; the Office of Equal Opportunity and Access; and the University Administrative Business Center.

ii. All waste units must meet the OSU Design & Construction Standards Section 01 10 02 Accessibility Best Practices for OSU.

C. Interior Trash/Recycling Stations are Owner Furnished and Owner Installed (OFOI). The Design Professional is to design the locations and note the stations as OFOI.

D. Equipment Standard: Combined 3-hamber “Vantage Triple” receptacle, manufactured by Busch Systems. (Contact: 705-881-9297). Sorting configuration may be any combination of chambers for sort separating bottles & cans, mixed paper, reusable food containers (i.e. “Eco2Go”), or compost, depending on the current Campus Recycling program requirements. These receptacles hold Rubbermaid 23 gallon lightweight “slim jims,” and locking swinging doors that meet fire code for exterior use, and are constructed as per the graphic below.
2. Interior Bottle & Can Recycling Bin

A. General: Standard bins to collect glass bottles and jars that contained food or beverages, tin, steel, and aluminum cans and plastic bottles and jugs. Guidelines for what is currently accepted or recycling as “bottles & cans” can be found on OSU Campus Recycling “Resources” web page.

B. Placement: Placement of standard bottle & can bins generally require a review of building use, pedestrian traffic, waste and recycling generation, and logistical considerations including fire prevention, accessibility and other safety issues. OSU Campus Recycling staff are the responsible staff to conduct a study of the building and building use and be the primary group for installation, bin signage, and communications to staff and faculty.

   i. Campus Recycling will identify bin placement location(s) and communicate options with stakeholders including current building occupants and may also include as needed the following OSU stakeholders: Procurement, Contracts, and Materials Management; Facilities Services: Capital Planning and Development; current OSU custodial contractor services group; the OSU Fire Life Safety Consultant; the Office of Equal Opportunity and Access; and the University Administrative Business Center.

   ii. All waste units must meet the OSU Construction Standards Section 01 10 02: Accessibility Best Practices for OSU.

C. Equipment Standard: Rubbermaid 23 gallon light weight “Slim Jims” (SKU FG354060BLUE) blue body and green lid (SKU: FG269288GREEN) manufactured by Rubbermaid Commercial Products. Distributers include Amazon, Lowe’s, Uline, Home Depot, Grainger and Staples. Check with Campus Recycling before ordering as they may have inventory of these bins and lids.

3. Interior Paper Bag Stand

A. General: Standard bag stand bins to collect: office paper (copier and printer paper, file folders, note paper, computer paper, brochures, junk mail (envelopes, letters, catalogs, etc.), greeting cards (no foil or glitter), magazines, newspaper, phonebooks, paperback books, spiral or bound notebooks, paper bags, white/graph/brown packing paper, paperboard (heavy, non-corrugated paper such as cereal boxes).
Guidelines for what is currently accepted for recycling as “Mixed Office Paper” can be found on OSU Campus Recycling “Resources” web page.

B. Placement: Standard paper bag stand bins generally require a review of building use, pedestrian traffic, waste and recycling generation, and logistical considerations including fire prevention, accessibility and other safety issues. OSU Campus Recycling staff are the responsible staff to conduct a study of the building and building use and be the primary group for installation, bin signage, and communications to staff and faculty.

i. Campus Recycling will identify bin placement location(s) and communicate options with stakeholders including current building occupants and may also include as needed the following OSU stakeholders: Procurement, Contracts, and Materials Management; Facilities Services: Capital Planning and Development; current OSU custodial contractor services group; the OSU Fire Life Safety Consultant; the Office of Equal Opportunity and Access; and the University Administrative Business Center.

ii. All waste unite must meet the OSU Construction Standards Section 01 10 02: Accessibility Best Practices for OSU.

C. Equipment Standard: 14 gallon “Bagit Original” 100$ recycled polycarbonate (10% post-consumer content), heavy duty woven polypropylene fabric with drawstring, double stitched handle at bottom of bag. Dimensions: 15-inch by 8-inch deep by 28-inch high hung either as single bag or double bag on freestanding rack. Color: yellow or white. Equipment is sold by Bagit System: www.bagitsystem.com, (503) 538-8180. Before ordering, check with Campus Recycling as they may have an inventory of bags and racks available.
Division 11: Equipment

Section 11 53 13: Laboratory Fume Hoods
1. REQUIREMENTS

Section 11 53 53: Biological Safety Cabinets
1. REQUIREMENTS
2. CLASSES AND TYPES OF BIOLOGICAL SAFETY CABINETS
3. SPECIALTY HOODS AND LOCAL EXHAUST/SNORKEL HOODS
Section 11 53 13: Laboratory Fume Hoods

1. REQUIREMENTS

These requirements apply building-wide.

A. Each hood or local exhaust system used to control exposure of humans to hazardous chemicals, radioactive materials, or other detrimental materials must be approved at the pre-design phase and after installation by Environmental Health & Safety (EH&S).

B. Hoods shall be of the latest design, good quality, and produced by a reputable manufacturer. Basis of design to be Labconco or approved equal as reviewed & approved by EH&S, via the OSU Project Manager.

C. Auxiliary air hoods that have the makeup air supplied at the hood face shall not be used.

D. Ductless hoods shall not be used for protection against chemical or radioactive materials. HEPA-filtered enclosures can be used for low-hazard particulates.

E. Hoods shall be constructed of appropriate materials resistant to chemicals and heat, and compatible with the anticipated use.

F. Exhaust velocity at the hood face will be DESIGNED to 90-120 linear feet per minute (LFPM) at a sash height of 18 inches above the lower air foil.

G. Exhaust velocity at the hood face will be BALANCED to 90-120 LFPM for standard fume hoods and at least 10 fpm over the manufacturers minimum flow recommendation for low fume hoods at a sash height of 18 inches above the lower air foil.

H. Each hood must have an electronic flow indicator with digital readout visible to the hood user. Monitor type must allow for two-point calibration without changing hood flow. Calibration of the flow monitor will be performed during room balancing. Monitors with plug-in transformers must have a duplex outlet provided on top of the hood.

I. Hood exhaust shall be separate from non-lab building exhaust systems. Hood exhaust can be used as part of the required lab exhaust volume.

J. Hoods used for perchloric acid, high levels of radioactive isotopes, extreme hazard carcinogens, or pathological materials shall be exhausted separately from general laboratory fume hoods.

K. Hood exhaust ducts shall be negatively pressurized within the building.

L. No diversion caps (e.g., “china hat”) are allowed on hood stacks. Rain prevention extensions shall be used where rain intrusion is a potential problem. Design details are available from EH&S.

M. Exhaust duct will terminate 16 feet above highest walking surface used for routine maintenance purposes. This determination includes all surfaces within 50 feet of stack.

N. Booster exhaust fans in hood exhaust ducts shall not be used inside the building envelope.

O. Backflow prevention devices shall not be installed in ducts as the only means to prevent reverse airflow.

P. Hood filters will not be used unless absolutely required.

Q. Filter boxes will be located to allow safe and efficient access for filter change, and design will allow for safe bag-in/bag-out procedures.
R. An adjustable gate damper (knife damper) must be provided in the individual branch duct serving each hood. It should be located such that the hood user cannot easily change the setting.

S. Room balance and room-to-room balance shall be maintained throughout operating range of hoods.

T. Outside air supply will be adjusted relative to exhaust air to make up for hood exhaust.

U. When there are multiple hoods in a building use make-up and heat recovery systems and/or variable volume exhaust systems, where practicable, to maintain energy efficiency. Heat recovery system components must be able to withstand exposure to chemical exhaust without use of filters.

V. A building-wide system shall monitor and control building static air pressure.

W. Hood interior lighting is to be uniform within the work cavity, as available from manufacturer.

X. Light fixtures to be accessible and maintainable externally to the hood cavity.

Y. Light fixture type is to be LED type with electronic ballast.

Z. A label on each fan unit will identify all room numbers of fume hoods served. A separate label, applied on primary side of approach, will be provided with the wording “Caution – Fume Hood Exhaust”.

AA. Room identification labels are to be indelible, non-fading and installed on the north side of exterior housings whenever possible.

BB. Terminal duct sizing will provide a minimum velocity of 3000 LFPM vertical discharge.

CC. Fan vibration isolators and flexible duct connections will be used at all fan installations. Duct connections will be made using chemical-resistant materials.

DD. Noise at position of hood user will not exceed 84 dBA with system balanced for use.

EE. New hood installations will include listed chemical storage base cabinets. Wherever possible, both corrosive and flammable cabinets will be installed.

FF. Fume exhaust ductwork

i. Ducts must be designed with materials compatible with use. The type of ductwork to be used is subject to OSU project review team assessment.

ii. Design for maximum pressures developed by the exhaust system with a 25% safety factor.

iii. Duct will be welded stainless steel in interior building spaces, except for some specialized acid wash-down applications where welded plastic will be used.

iv. Exterior roof extension will be stainless steel.

GG. Each hood or local exhaust system used to control exposure of humans to hazardous chemicals, radioactive materials, or other detrimental materials needs to have motor external of the duct system.

HH. Provide at least one accessible fume hood in each lab.

2. FUME HOOD PLACEMENT

A. Fume hoods should be located away from activities or facilities, which produce air currents or turbulence. Locate away from high traffic areas, air supply diffusers, doors and operable windows.
B. Fume hoods should not be located adjacent to a single means of access to an exit. Recommend that hoods be located more than 10 feet from any door or doorway.

3. FUME HOOD INSTALLATION

A. Laboratory hoods shall not have an on/off switch located in the laboratory. Exhaust fans shall run continuously without direct local control from laboratories.

4. FUME HOOD FIRE SUPPRESSION SYSTEMS

A. Automatic fire extinguishing systems shall be provided in chemical fume hoods if a hazard assessment determines that an automatic extinguishing system is required for the chemical fume hood. Then the applicable automatic fire protection system standard shall be followed. All automatic fire protection systems will comply with NFPA 45 7.10.2-7.10.4.
Section 11 53 53: Biological Safety Cabinets

Note fan not in stream of exhaust

1. REQUIREMENTS

   A. All biological safety cabinets shall meet the specifications within the most recent edition of the National Sanitation Standard 49 – Class II (Laminar Flow) Biohazard Cabintery.

   B. The following biological safety cabinet manufacturers are currently approved for campus:

      i. Baker, Nu-Aire, and Forma or equal. Manufacturer’s specifications for specific model types shall be submitted to OSU EH&S for pre-approval. The OSU Project Manager will acquire written pre-approval from OSU EH&S for any “equal” substitution via a Deviation Request Form.

      ii. Biosafety cabinet face velocity shall be maintained at the optimum face velocity for the type of cabinet being used.

      iii. Each cabinet shall be equipped with one front mounted manomeric gauge or digital equivalent indicating the differential pressure across the filter.

      iv. The noise level as measured 12 inches in front of the cabinet and 15 inches above the work surface shall not exceed 67 dBA.

      v. All biosafety cabinets must be tested per National Sanitation Foundation (NSF) Standard 49 or manufacturer’s specifications after installation and annually thereafter. The University’s Representative should forward the testing results to OSU EH&S for review.

   C. Class II Type B biosafety cabinets must be installed on a dedicated stainless steel exhaust system. Consult with EH&S if Class II Type B biosafety cabinets are being considered.

   D. Exhaust in-place HEPA filters must be of the bag-in/bag-out type, and installed to allow for safe and efficient filter change.

2. CLASSES AND TYPES OF BIOLOGICAL SAFETY CABINETS

   A. Class II Type A1 cabinets (formerly designated Type A)

      i. Maintain minimum average inflow velocity of 75 fpm through the work access opening;

      ii. Have HEPA filtered down flow air that is a portion of the mixed down flow and inflow air from a common plenum (i.e., a plenum from which a portion of the air is exhausted from the cabinet and the remainder supplied to the work area);

      iii. May exhaust HEPA filtered air back into the laboratory or to the external environment through an exhaust canopy; and

      iv. May have positive pressure contaminated ducts and plenums that are not surrounded by negative pressure plenums.

      v. Type A1 cabinets are not suitable for work with volatile toxic chemicals and volatile radionuclides.

   B. Class II, Type A2 Cabinets (formerly designated Type B3)

      i. Maintain a minimum average inflow velocity of 100 fpm (0.5 m/s) through the work access opening;
ii. Have HEPA filtered down flow air that is a portion of the mixed down flow and inflow air from a common exhaust plenum;

iii. May exhaust HEPA filtered air back into the laboratory or to the environment through an exhaust canopy; and

iv. Have all biologically contaminated ducts and plenums under negative pressure or surrounded by negative pressure ducts and plenums.

v. Type A2 cabinets used for work with minute quantities of volatile toxic chemicals and tracer amounts of radionuclides required as an adjunct to microbiological studies must be exhausted through properly functioning exhaust canopies to the exterior.

C. Class II, Type B1 Cabinets

i. Maintain a minimum average inflow velocity of 100 fpm (0.5 m/s) through the work access opening;

ii. Have HEPA filtered down flow air composed largely of uncontaminated recirculated inflow air;

iii. Exhaust most of the contaminated down flow air through a dedicated duct exhausted to the external atmosphere after passing through a HEPA filter; and

iv. Have all biologically contaminated ducts and plenums under negative pressure or surrounded by negative pressure ducts and plenums.

v. Type B1 cabinets may be used for work with minute quantities of volatile toxic chemicals and tracer amounts of radionuclides required as an adjunct to microbiological studies if work is done in the direct exhausted portion of the cabinet, or if the chemicals or radionuclides will not interfere with the work when recirculated in the down flow air.

D. Class II, Type B2 Cabinets (sometimes referred to as “total exhaust”) 

i. Maintain a minimum average inflow velocity of 100 fpm (0.5 m/s) through the work access opening;

ii. Have HEPA filtered down flow air drawn from the laboratory or the outside air (i.e., down flow air is not recirculated from the cabinet exhaust air);

iii. Exhaust all inflow and down flow air into the external atmosphere after filtration through a HEPA filter without recirculation in the cabinet or return to the laboratory; and

iv. Have all contaminated ducts and plenums under negative pressure or surrounded by directly exhausted (non-recirculated through the work area) negative pressure ducts and plenums.

v. Type B2 cabinets may be used for work with volatile toxic chemicals and radionuclides required as adjuncts to microbiological studies.

E. Class III Cabinets (Glove Boxes)

i. A totally enclosed, ventilated cabinet of leak-tight construction. Operations in the cabinet are conducted through attached rubber gloves. The cabinet is maintained under negative air pressure of at least 0.50 in. w.g. (120 Pa). Down flow air is drawn into the cabinet through HEPA filters. The exhaust air is treated by double HEPA filtration or by HEPA filtration and incineration.

ii. A glove box may also be required for special applications using highly toxic, extremely reactive or regulated carcinogens.

iv. Reactive chemical work may require a glove box positively pressurized with inert atmosphere during reactions.

3. SPECIALTY HOODS AND LOCAL EXHAUST/SNORKEL HOODS

A. General

i. Histology hoods, specimen, welding and other local exhaust specialty hoods require a minimum operating face velocity of 100 fpm with a range of 100-120 fpm. Higher values may be required based on setup. Design will be coordinated with EHS.

ii. An audible/visual flow alarm may be required depending on intended use.

B. Placement

i. Locate biological safety cabinets at least six feet from doors and high-traffic areas and away from open-able windows, fume hoods, or other draft producing laboratory equipment. Locate so that air supply/exhaust diffusers do not affect airflow at the BSC face (laminar diffusers preferred). If more than one BSC will be installed, situate BSCs across from each other rather than adjacent.

ii. Provide at least 12-inches of clearance above the BSC for testing and decontamination of HEPA filters. Set six inches out from the rear wall to allow for cleaning and adequate air return.

iii. Biological safety cabinets that are hard-ducted or connected by a thimble connection to the ventilation system must be designed so the duct work does not interfere with air flow or block access to the exhaust filter for testing of HEPA filter integrity.

iv. Biosafety cabinets and fume hoods to be seismically anchored.
Division 12: Furnishings

Section 12 00 00: Furnishings
1. MAINTENANCE, COMMON WORK RESULTS, SCHEDULES

Section 12 20 00: Window Treatments
1. GENERAL

Section 12 35 53: Laboratory Casework – Flammable and Corrosive Storage
1. GENERAL

Section 12 40 00: Furnishings and Accessories
1. OFFICE, TABLE, FURNISHING ACCESSORIES, RUGS AND MATS

Section 12 50 00: Furniture
1. GENERAL
2. SYSTEMS FURNITURE
3. GENERAL FURNITURE
4. DESK/TASK SEATING

Section 12 56 33: Accessible Classroom Furniture
PART 1: GENERAL
1. NUMBER OF ACCESSIBLE SEATS
PART 2: PRODUCTS
1. LUMBAR SUPPORT CHAIRS
2. BARIATRIC CHAIRS
3. CHAIRS FOR INTERPRETERS/TRANSCIBERS
4. WHEELCHAIR USER SPACES
5. CLASSROOM TABLES
6. TABLES FOR LOBBIES AND STUDY AREAS
Section 12 00 00: Furnishings

1. MAINTENANCE, COMMON WORK RESULTS, SCHEDULES
   
   A. All items are to be commercial grade; NO residential grade.
   
   B. All items taller than 6 feet must be secured to building structure to prevent tipping. Freestanding cabinets and bookcases should be evaluated for height and weight to determine if they should be secured to the wall using common earthquake restraint practices.
   
   C. Clear or natural wood finishes are preferred.
   
   D. No furniture, including systems furniture panels, may cover radiators, valves, environmental controls, equipment, data and electrical outlets, etc.
      
      i. If building system and mechanical equipment items are obstructed by furniture, the department shall be responsible for the cost to remove and/or disassemble furniture to access equipment.
   
   E. Adjustable Wall Shelving:
      
      i. Rail, bungee, or strapping systems should be incorporated to restrain shelving contents.
      
      ii. Vertical Standard: Knap & Vogt 85 double slot, heavy duty; 4ft length typical.
      
      iii. Bracket: Knapp & Vogt 185 double bracket, heavy duty; 12in depth typical.
Section 12 20 00: Window Treatments

1. GENERAL

A. Solar roller-shades with 10% open weaves are preferred for exterior windows.

B. Manual shade control is preferred, with continuous bead cord; locate cord on most convenient side for user operation.

C. Electric controls or motorized shades to be used only where accessibility is an issue, Owner review and approval required. No remote controls.

D. Fabric draperies require FS Maintenance approval.

E. Metal and plastic Venetian or ‘mini’ blinds are allowed if OSU Department agrees to accept cost of proper cleaning at regularly scheduled intervals.

F. NO paper, fabric, or wood blinds unless approved by Campus Planning and Development and Facilities Services.
Section 12 35 53: Laboratory Casework – Flammable and Corrosive Storage

1. GENERAL

   A. Flammable storage cabinets must be UL listed and/or FM approved.
   B. Flammable storage cabinets are not required to be ventilated. If cabinet is to be vented, it must be ducted into the fume hood exhaust system above the fume hood trim damper. Ducting material must be nominal 2” black pipe.
   C. Corrosive chemical storage cabinets (acids and bases) require venting. It is acceptable to vent under-hood corrosive cabinets into hood interior through the countertop. Ducting material shall be schedule 40 PVC.
   D. New fume hood installation will include flammable and/or corrosive base cabinets
   E. Laboratory casework for flammable and corrosive storage shall be reviewed and approved by OSU EH&S.
   F. Flammable cabinets should be equipped with self-closing doors in accordance with 2021 NFPA 1 Section 66.9.4.3.
   G. Laboratories that may exceed 8 gallons of class I Flammable liquids must have at least one flammable storage cabinet.
   H. Multi-bay laboratories that are shared by multiple PI’s should have a waste accumulation area in a central location in the main lab that includes at least one flammable cabinet. Contact EH&S to see if the laboratory qualifies for an accumulation area.
Section 12 40 00: Furnishings and Accessories

1. OFFICE, TABLE, FURNISHING ACCESSORIES, RUGS, and MATS
   
   A. Interior walk-off mats are Owner Furnished Owner Installed (OFOI):
   
   B. Walk-off mats integral to a recessed floor require approval by Campus Planning and Development and Facilities Services. If approved, the walk-off mats are to be Contractor Furnished Contractor Installed (CFCI).
   
   C. Purchase of Trash and Recycling bins for general department spaces, offices, and under desks are the responsibility of individual offices and departments.
Section 12 50 00: Furniture

1. GENERAL

A. Stationary workstations in the office/laboratory setting should provide adequate surfaces for ergonomic arrangement of the computer keyboard/pointing device, monitor, and document/work holders.

B. Stationary workstations shall follow good ergonomic principals providing height adjustable work surfaces, openings adequate for leg and knee clearances and sufficient overhead space to allow adjustments to vertical equipment placement.

C. ANSI/Human Factors and Ergonomics Society (HFES) 100 – 2007 (or most current version) - “Human Factors Engineering of Computer Workstations.”

D. Desk Ergonomics: Desks that are not height adjustable or have limited desk space shall have the option of attaching an adjustable keyboard and mouse tray or platform.

E. Keyboard & Mouse Ergonomics:
   
   i. Where feasible, adjustable keyboard trays shall be of a one piece, uni-board design, adjustable for height and angle, and possess an angle adjustment knob that does not interfere with leg movement.

2. SYSTEMS FURNITURE

A. Shall be height adjustable in maximum of 1 inch increments.

B. Work surface height shall range from 24 inches to 36 inches from floor to top of the work surface for seated work.

C. Shall provide for attachment of a keyboard and mouse tray / platform as an option.

D. Powered-panel systems furniture is to be avoided. Components without built-in wiring are preferred for ease of reconfiguration.

E. If powered-panel systems are approved and installed, the department making the purchase is required to cover costs for any future reconfiguration that requires electricians. (If panels are powered or data is run through them, data and power must be separated by separate divider channels in panel bases, rails, or poles. Licensed electricians and data professionals must pull cable and make connections.)

F. Spaces designed to accommodate systems furniture must provide adequate power in perimeter walls, ceiling fed power poles, and/or floor-boxes to accommodate components without built-in wiring.

G. Systems panels taller than 66 inches requires review and approval by Campus Planning and Development.

3. GENERAL FURNITURE

A. Freestanding furniture and Systems Furniture should be evaluated for height and weight to determine if they are to be secured to the wall using common earthquake restraint practices; 6 feet or taller shall be secured to structure.

B. File cabinets that are taller than three drawers must include an internal counter weight.

C. Wood furniture construction should utilize lap joints, dove-tails, etc. vs. inadequate glue and dowel only methods. No particle board construction. Contract/commercial grade furniture only, no residential-grade wood furnishings unless authorized and approved by Campus Planning and Development.
D. Fabrics used are to be contract/commercial grade (no residential grade fabrics) with appropriate ratings for intended use by ASTM, NFPA, UL, UBC, and Wyzenbeek testing, lightfastness, and appropriate clean-ability.

E. Weight capacity must be specified by the manufacturer and be appropriate for intended use.

F. Upholstered furnishings to be contract/commercial grade. No residential-grade upholstered furnishings unless authorized and approved by Campus Planning and Development.

4. DESK/TASK SEATING

A. Minimum adjustability shall include seat height, back height & angle, seat pan angle, and arm rest height and width.

B. Seat pans should be adjustable in depth, available in various sizes, and wider than the hip breadth of the user.

C. Seat backs should provide for proper fitting lumbar support.

D. Arm rests must be detachable.

E. Casters should be appropriate for the floor surface; hard or carpet.

F. Chair bases must have a 5-star caster configuration.

G. Chairs must swivel 360°.

H. Vendors should allow for trial use of a prospective chair.
Section 12 56 33: Accessible Classroom Furniture

PART 1: GENERAL

Classroom furniture is an important element in creating classrooms. The purpose of these standards is to provide a resource to ensure access for students, faculty, and visitors with disabilities to classrooms at OSU. The following standards were developed using the 2010 ADA Standards for Accessible Design, recommendations in Access for Everyone: A Guide to the Accessibility of Buildings and Sites and through research on current furniture types that meet the requirements and work well for the vast majority of users. Implementation of these standards will greatly reduce the need for moving furniture each term to accommodate students.

1. REFERENCES

   A. 2010 ADA Standards for Accessible Design
   C. The United States Department of Labor, Occupational Health and Safety Administration (OHSA)
   D.

2. NUMBER OF ACCESSIBLE SEATS

   A. Each classroom shall have at least* the following, in addition to requirements in the 2010 ADA Standards for Accessible Design (See ADA requirements for wheel chair user eating, left hand armrests, and work surface, knee and toe clearances.):

      i. One (1) – Lumbar support chair
      ii. One (1) – Bariatric-rated chair
      iii. Two (2) – Chairs for interpreters & transcribers
      iv. One (1) – Height adjustable table
      v. One (1) - Chair for instructor.
      vi. Companion chairs/seating shall be provided per Sections 221 and 803 of the 2010 ADA Standards for Accessible Design.
      vii. Additional lumbar support chairs, bariatric chairs, and height adjustable tables should be considered in large classrooms/lecture halls. Exact numbers shall be determined with OSU during design.

PART 2: PRODUCTS

1. LUMBAR SUPPORT CHAIRS

   A. Users with back injuries may have difficulty sitting for long periods of time, especially in hard non-ergonomic chairs. Sitting in non-ergonomic chairs may exacerbate pain and make it difficult for people with disabilities to utilize the classroom space. Lumbar support chairs should have the following specifications as defined by the Office of Occupational Health and Safety Administration (OHSA) i:

      i. A backrest that conforms to the natural curvature of the spine.
ii. Armrests should be soft, chairs without armrests allow for users of larger size (bariatric) to use the same seating.

iii. A stable base that can support users up to 300 lbs.

B. Examples of Lumbar Support Chairs (similar to images below – manufacturer/product below is no longer available).

2. BARIATRIC CHAIRS

A. Users of larger stature need larger seating than is provided in classrooms to be able to participate in classes. Ergonomic chairs without arms provide the necessary size for this. To be rated a bariatric chair the weight capacity should be at least 500 lbs.

3. CHAIRS FOR INTERPRETERS/TRANSCRIBERS

A. Two (2) chairs for interpreters and/or transcribers shall be provided in all classrooms.

B. These chairs shall have no armrests or wheels, with a padded base and lumbar support backrest.

C. The design for the classrooms should include a provision for secure storage of the interpreter/transcriber chairs close to the front of the classrooms.

4. WHEELCHAIR USER SPACES

A. If writing surfaces are provided to non-accessible spaces, wheelchair spaces shall be provided with comparable writing surfaces. It is preferable to provide multiple options for type of writing surface and seating location. In areas where space allows, tables meeting the 2010 ADA Standards for Accessible Design are preferable.

B. In rooms where space does not allow or in rooms where fixed tablet arm chairs are used, tablets without a chair attached shall be provided.

C. Tablet arm tops must meet reach range requirements and operability requirements in the 2010 ADA Standards for Accessible Design.

D. When elements such as power, data ports, microphones, etc. are provided to non-accessible spaces, an equivalent element shall be provided to the accessible spaces.

E. Example of tablet arms for wheelchair user spaces:
i. Stand-alone Wrimatic Tablet by Sedia Systems

ii. ADA tablet arm base by KI. According to KI, “The tablet can be changed to match the particular product for each project. So, if they have a room with Lancaster seating, a Lancaster tablet board would be used to match off the rest of the tablet boards.”

5. CLASSROOM TABLES

A. Table Clearances

   i. Width: Provide minimum 36 inch width for a single wheelchair user or 66 inch width to accommodate two wheelchair users.

   ii. Knee Space Height: Provide minimum 30” high. (The 2010 ADA Standards for Accessible Design require at least 27 inches.)

   iii. Knee Space Depth: Provide minimum 19” deep knee space clear of any obstructions.

       a. The space under the table top shall be unobstructed (i.e. no crossbar supports)

   iv. Fixed tables

       a. Where fixed tables are provided, the bottom of the table top should be minimum 30 inches in height. (The 2010 ADA Standards for Accessible Design require at least 27 inches.) The table top must be no higher than 34 inches.
B. Adjustable Tables

i. Adjustable tables should not have a crossbar underneath, as this prohibits a wheelchair user from pulling all the way under the table. These tables should be at least 66 inches wide to allow for two users and/or companions, and should be height adjustable from at least 25 inches to 40 inches.

ii. Controls: There are four types of controls on adjustable tables: top-crank, side-crank, hydraulic assist and electric.

a. Electric or hydraulic controlled tables are preferred.

b. If electric or hydraulic tables are cost prohibitive or power is not available, side-crank tables should be provided. Top-crank tables shall not be used.

c. On side-crank tables, the crank mechanism should fold under the tabletop so it can be hidden under the table to reduce possible breakage and prevent the possibility of tripping or snagging clothes.

d. Cranks should be metal instead of plastic to prevent possible breakage and need for more constant maintenance.

e. Cranks should not be removable.

iii. Images of Adjustable Table

![Crank should be metal and non-removable](image1)

![No crossbar](image2)

Crank height adjustable table with lumbar support and oversized chair

Crank height adjustable table
6. TABLES FOR LOBBIES AND STUDY AREAS

A. Where tables are provided in lobbies, study areas, and similar spaces, a minimum of one in five tables shall be accessible meeting the clearance requirements stated in 5 above. Where fewer than five tables are provided, at least one shall be accessible.

B. In general, pedestal tables are not considered accessible because of inadequate clear space below the table.
Division 13: Special Construction

Section 13 20 00: Special Purpose Rooms

1. SPECIAL PURPOSE ROOMS
Section 13 20 00: Special Purpose Rooms

The following information is for specific room and space types and is in addition to standards listed in Divisions 01 – 34.

1. SPECIAL PURPOSE ROOMS: Controlled environment; Fabricated Rooms; Vaults
   A. Specialty use areas can include laser rooms, high radioisotope use or biosafety Level 3 or animal biosafety Level 2 or 3. Due to their complex nature, design requirements for specialty use areas should be discussed with EH & S to determine specific needs. Design requirements will vary depending on user activity and the nature of work.
   B. Minimum personnel access opening size allowed is either 24-inches x 30-inches or the minimum emergency access required by fire rescue standards; whichever is greater.
   C. No mixing storage tanks.
   D. No acid treatment tanks.
   E. Refer to the Appendix for specific special purpose room requirement
Division 14: Elevators

Section 14 20 00: Elevators
1. NON-PROPRIETARY CONTROLS
2. ENGINEERED ELEVATORS
3. HYDRAULIC ELEVATORS
4. TRACTION ELEVATORS
Section 14 20 00: Elevators

1. NON-PROPRIETARY CONTROLS
   A. Elevator controls and equipment must be non-proprietary. All site specific service tools (aka interface/machine room monitoring tools) shall be provided upon completion and turnover of elevator. The service tool shall be readily accessible to the OSU elevator shop if future purchase and replacement is necessary. The service tool shall allow full access to fault codes and maintenance related parameters, and shall allow complete and thorough maintenance service and testing to be performed by the OSU elevator shop. The service tool shall have no restrictions and must come with a user’s manual that effectively communicates to a qualified mechanic how to use the controller and/or tool, and also defined and explains all respective error codes, including required fixes. This Tool shall allow OSU to check on and change parameters and program the elevator. The service tool shall remain property of Oregon State University.
   
   B. The elevator must be able to be fully maintained by OSU Facilities and replacement parts shall be readily available for purchase.
   
   C. Complete and ALL documentation pertaining to the elevator shall be included upon completion and turnover of elevator. This documentation shall be readily available to OSU Facilities if future replacement is needed.

2. ENGINEERED ELEVATORS
   A. Work included: Installation of a new engineered HYDRAULIC elevator complete as described in this standard.
   
   B. Code Compliance
      i. Completed elevator shall comply with current applicable national, state, local municipal, safety and ADA code (ASME A17.1).
   
   C. Submittals
      i. Submittal requirements are per OSU Division 1 Specifications, the Contract Documents, and the Construction Contract.

   D. Quality Assurance
      i. Elevator installer is responsible for quality assurance and insuring that all systems related to the elevator are complete and functioning properly.

   E. Use of Elevator
      i. The elevator shall not be used temporarily for building construction purposes unless specifically allowed by the Owner. General contractors shall be responsible for damage and repairs.
      
      ii. If the contractor is allowed to use the elevator prior to substantial completion of the project, the warranty and service period shall not be compromised and shall begin after final inspection by the State of Oregon and when Oregon State University takes possession of the entire building and is no longer used for construction purposes.

   F. Maintenance
      i. Starting at the time of substantial completion of the complete project, provide complete systematic inspection and maintenance of the elevator for a period of twelve (12) months. Furnish trained experts
and equipment to check, adjust, lubricate, and otherwise maintain the elevator in operation without defects or deterioration. Replace or repair materials and parts which become defective or deteriorated for any reason except through abuse or misuse by OSU. This time frame will start with final inspection of the elevator by the State of Oregon and at the time of substantial completion. The Maintenance Control Program to be provided by the original equipment manufacturer (OEM) and a copy is to be left in the elevator machine room after 12-month warranty expires (will be under separate contract from construction contract).

G. Preferred elevator controls manufacturers are:
   i. Elevator Controls
   ii. Motion Control Engineering
   iii. Smartrise
   iv. Elevator Controls Corporation

H. Attributes
   i. Operation: Selective Collective
   ii. Control: Microprocessor based. Elevator controls to include emergency battery lowering device.
   iii. Car Roller Guides (ELSCO or equivalent) No slide guides
   iv. Door Operator: GAL MOVFE Linear. All other must be preapproved by the OSU elevator shop.
   v. Fixtures: Innovation Industries
   vi. Signals: Illuminated car and hall operating buttons, illuminated by light emitting diodes. Tamper proof.
   vii. Door detector shall be model Janus Panachrome 3-D, any others must meet approval of OSU elevator shop, and must have a separate control box not incorporated with any other device
   viii. Car telephone shall be model no. Janus PSB phone, line powered
   ix. Provide emergency access in all hoist way entrances and include Tri-Lok device to restrict unauthorized access to hoistway.
   x. Car enclosure-shall have a vandal resistant stainless steel (5WL) on all car doors and car operating panelCar fan and car lighting shall be on a timer to prolong the life these devices. This timer activated every time a call is placed.
   xi. Door Closers: SmarTork
   xii. Provide oil cooler to heavy use hydraulic elevators.

I. Environmental Considerations
   i. Ambient temperature: 50° F to 90° F (Provide Mechanical temperature control; such as exhaust fan, HVAC, etc. as required per the State.)
   ii. Humidity: not over 95% humidity
   iii. Vent machine room to outside to remove hydraulic fluid odors from building
iv. Elevator pits shall have a sump pump, no exceptions.

J. Operation, Equipment and Function

i. Controller: Microprocessor base. Dedicated permanent status indicators shall be provided on the controller to indicate the following: when the safety circuit is open, when the door locks are open, when the elevator is operating at high speed, when the elevator is on independent service, when the elevator is on fireman’s service, when the elevator is out of service, when the elevator is on high speed, when the elevator is on independent service, when the elevator is on fireman’s service, when the elevator is out of service, timer has elapsed or when the motor limit timer or valve timer has elapsed. In addition, provide means of displaying other special or error conditions that are detected by the microprocessor. The elevator shall not require the functioning or presence of the microprocessor to operate on car top inspection or hoist way access operation (if provided) in order to provide a reliable means to move the car if the microprocessor fails.

ii. The elevator controller shall utilize a microprocessor based logic system and shall comply with (ASME 17.1) safety code for elevators. The control equipment shall have all control parameters stored permanently on erasable programmable read-only memories (EPROM), and shall have permanent indicators to indicate important elevator status as an internal part of the controller. The system shall provide comprehensive means to access the computer memory for elevator diagnostic purposes without need for any external devices. Systems that require hook-up of external devices for trouble-shooting must include device, and any operating manuals required to effectively use said device.

iii. The design of the controller must match the fixture design.

K. Door Equipment

i. GAL MOVF Linear Door Operator, GAL door rollers, door hanger tracks (car and hall) door pick-up assemblies, gate switch, and door locks. Any variation must be preapproved by the OSU elevator shop.

ii. All doors shall have 1-1/2 hour label or other identification acceptable to governing authorities.

iii. Provide adjustable nylon guide (by Nylube or Adams Elevator Equip. Co.)

iv. Heavy duty doors. Provide door skin on both sides of elevator doors.

L. Position Indicator

i. Provide tamper resistant CE position indicators on all floors mounted in the floor station and in the COP.

a. Smoke Detectors and Fire Protection

ii. Smoke and heat detectors shall be compatible and tie into building fire system.

iii. Provide heat detectors and shunt trip to all machine rooms that are sprinkled.

iv. If the building is sprinkled and elevator is hydraulic, provide a sprinkler head in the pit. If located below 24-inches from pit floor no heat detector is required. Review with building and fire codes for most restrictive.

M. Car Operating Panel (COP) & Fixtures.

i. Flush mounted Car operating panel shall be mounted in the car return panel and shall contain the devices required for the specified operation. The buttons and devices shall be of the easy readability type and the floor designation buttons shall become illuminated when pressed and shall stay illuminated until the floor call is answered. Provide continuous hinge on panel for easy access to
internal components. Locate hinges on side of panel nearest wall of the elevator. The car operating shall contain the floor designations, and all the controls and features indicated below.

a. Car position indicator, illuminated with light emitting diodes
b. Fan key switch
c. Emergency stop key switch
d. Independent service key switch
e. Firefighter service key switch
f. Light key switch
g. Hostway access
h. All switches shall be keyed with EX 511-514 and FEO-K1 for fire service
i. Alarm bell pushbutton type
j. Door Hold (DH) pushbutton type
k. Engraved capacity plate and elevator designation
l. Emergency light test
m. Emergency phone shall be Janus PSB line powered phone only
n. Elevator shall be equipped with a hands free intercom with base station in the lobby and additional station in any remote machine room when required by code.

o. Duplex GFCI Outlet

ii. Adjust and Balance
   a. Make necessary adjustments of equipment to ensure elevator operates smoothly and accurately

iii. Protection
   a. Locate and protect movable equipment and controls in such a way that they can only be operated by authorized persons

iv. Inspections
   i. Obtain and pay for inspections and permits and make sure test is as required by regulations of authorities.
   ii. Final inspection shall be after all new equipment is installed and operating correctly.
   iii. Inspect installation in accordance with ASME-A17.2
   iv. Deliver test certificates and permits to Owner

v. Operation and Maintenance
   i. Instruct Owner’s personnel in proper use, operations and daily maintenance of elevators, including all manuals i.e. adjusters manuals needed to work on the system.
ii. Training shall be provided on new elevator include operation of service tool and servicing of elevator.

    1) Make final check of each elevator operation, with OSU elevator mechanics present or their representative) and just prior to date of substantial completion. Determine that control systems and operating devices are functioning properly. Work with OSU Project Manager/Construction Manager to schedule OSU elevator mechanic (or their representative).

N. Cleaning

i. All hydraulic elevators shall not be of the roped hydro type. Remove all trash and debris from site during elevator installation.

ii. Clean and all elevator surfaces, removing all dirt, dust, spots, and scratches. Any damage shall be repaired or replaced as directed by owner, at no cost to owner.

iii. Prior to substantial completion, remove protection from finished or ornamental surfaces and clean and polish surfaces with due regard to type of material.

iv. Remove tools, equipment and surplus materials from site.

v. Paint car frame and hoist way equipment, pit floor and machine room floor.

3. HYDRAULIC ELEVATORS

A. Solid State Motor Starter

i. Provide a Siemens soft start w/ fault contactor to limit current inrush during starting and to provide gradual acceleration of the motor. Motor starting shall not be initiated by mechanical contacts.

B. Hydraulic Jack

i. All hydraulic elevators shall not be of the roped hydro type

ii. All hole less jacks shall not be inverted

iii. Install plunger-cylinder units plumb and accurate

iv. Install schedule 40 PVC auxiliary casing with bottom completely sealed. Size casing for minimum 1.5” clearance to all jack assembly components

v. Install piping without routing underground. Where not possible, route piping through schedule 40 PVC before back filing

vi. Hydraulic hose for sound deadening is not permitted

vii. All underground pipe is to be installed with PVC sleeve

C. Hydraulic Power unit

i. A Maxton valve shall be installed. All other must be preapproved by the OSU elevator shop.

ii. Power unit shall be submersible. Installing dry units must be preapproved by the OSU elevator shop.

iii. The power unit shall have a shut off valve which will isolate the oil reservoir to enable servicing of the power unit. A shut off valves shall be located in the machine room and in pit.
iv. A suitable muffler designated to withstand the high pressures shall be installed in the power unit in a blowout proof housing. Provide MEI Silencer gas charged muffler.

D. Elevator Pit Hydraulic Oil Return Pump

i. These may not be necessary and to be reviewed as a case by case basis. Review with OSU Facilities (via Project Manager) and Elevator Contractor of Record.

ii. Drip Pan Return Pump: 120V fractional h.p. pump suitable for pumping of hydraulic fluid. Furnish pump with float activated on/off switch.

iii. Provide self-contained pump and reservoir to return oil to machine room tank.

4. TRACTION ELEVATORS

A. Traditional machine room set up at top of hoist way (No MRL)

B. Hoist ropes shall be of high grade and not be smaller than ½” or metric equivalent.

C. No greater than 2:1 rope configuration, preferably 1:1 (No 4:1).

D. Speed shall not exceed 200 fpm. Speed over 200 fpm must be preapproved by the OSU elevator shop.

E. A Mechanical brake pick shall be provided (in the event of an open brake coil).

F. Traction machine shall be gearless by Hollister Whitney.
Division 21: Fire Suppression Systems

Section 21 10 00: Water-Based Fire Suppression Systems

1. PROTECTION REQUIREMENTS
2. REFERENCES
3. IDENTIFICATION
Section 21 10 00: Water-Based Fire Suppression Systems

1. PROTECTION REQUIREMENTS

A. Codes, Standards, and References

i. All materials and workmanship shall comply with all applicable Codes, Specifications, Local and State Ordinances. Water-based fire suppression systems may involve a plan review focused on building loss prevention, which involves submitting preliminary construction documents and incorporating recommendations from OSU’s Risk Management and Property Loss Control Engineering Consultants. Coordinate submittal with OSU’s Project Manager.

ii. In case of conflict between the contract documents and the requirements of any Code or Authority Having Jurisdiction (AHJ), the most stringent requirement shall apply.

B. Design Criteria

i. All spaces in the building must be fully protected by fire sprinklers in accordance with NFPA-13, 13R, or 13D, whichever is applicable. This requirement includes all spaces below suspended ceilings and above suspended ceilings where combustible materials are or are intended to be located. Plastic piping, telephone cabling, and plastic ductwork are examples of combustibles. All equipment must be UL listed and in the latest edition of the Factory Mutual (FM) Approval Guide.

ii. In addition to the requirements of NFPA-13, the rulings and interpretations of the local Fire Marshal and the requirements of OSU must be incorporated into the design. This may include adherence with Insurance Guidelines found in Factory Mutual Data Sheets.

iii. Preference is given to wet-pipe sprinkler systems. Dry-pipe systems shall be permitted when conditions cannot be reliably maintained about 40 deg. F, and where permitted by the AHJ.

iv. Verification of Hydraulic Information:

a. Systems shall be based on hydraulic designs that include a minimum 10-psig safety margin to allow for deterioration in available static and residual pressures in the water supply.

b. The Design Professional shall consider hydrant or fire pump flow test information obtained within the last 12 months as the water supply basis for the sprinkler system design. Older flow test data should not be used.

c. The Design Professional shall confirm that hazard classifications / density requirements conform to OSU’s insurance underwriter’s requirements and AHJ.

C. Piping, fittings, and joints

i. Piping shall meet applicable ANSI or ASTM requirements and shall be marked with the manufacturer’s name on each length.

ii. Joints shall meet applicable ANSI and ASTM requirements.

iii. Underground fire protection service piping shall be ductile iron thickness class 53 or 52, ANSI A21-51 with cement-mortar lining per ANSI A21.4.
iv. Piping for sprinkler systems and standpipe systems shall be Schedule 40 black steel conforming to ASTM A53. Seamless piping shall be used wherever possible. If seamless piping is used, then the seam shall be installed on the top of the pipe.

v. Wet sprinkler piping shall be provided with automatic or manual air relief vents at high points of the system. (Similar to Potter Model PAV, with strainer and a ball valve in-line immediately upstream to facilitate servicing or replacing without impairing the sprinkler system.)

D. Valves

i. All valves shall be installed in locations and orientations which are readily accessible for system service, maintenance, modifications, etc. Valves shall not be obstructed by, or located above piping racks, cable trays, etc. and shall be easily accessible. Access panels shall be provided, where necessary, for service and operation.

ii. Pressure-reducing valves shall discharge to floor drain via piping.

E. Dry Sprinkler Systems must be resettable externally by a plunger. For sensing Waterflow and Low Air, must use Potter PS10-2A for Waterflow and Potter PS40-2A for Low Air. If an accelerator is needed, Reliable Accelerator B1 must be used.

i. Nitrogen generators are not to be used in place of air compressors.

F. Signage for room containing main fire sprinkler controls shall have label, “FIRE SPRINKLER CONTROLS’ in red one inch high letters on white background.

i. Signage shall also be required for the fire department connection per the OFC, fire extinguishers, and fire pump room.

ii. Each system riser shall be fitted with design criteria placard in accordance with NFPA 13. Placards to be updated with design changes.

G. If at all possible, locate sprinkler riser in a mechanical room with direct outside access. Ensure that room is heated by a permanent fixed means or electrical heat source. Electrical heating tapes shall not be considered as an acceptable alternative means for freeze protection.

H. Indicate the location of all standpipe, tamper switches and flow switches. Provide a riser diagram showing major components, inspector’s tests, auxiliary drains and low point drains.

I. All valve controlling water supplies for sprinkler systems of portions thereof, including floor control valves, shall be located for convenient access and operable from the floor level or another location approved by the Fire Marshal. All sprinkler valves and controls shall be labeled: FIRE SPRINKLER CONTROLS”. Signage with red one inch letters and white background is preferred.

J. Sprinkler FDC shall be located forty (40) feet from structure when possible and location pre-approved by the Corvallis Fire Department. Connection shall be labeled as to what the connection actually serves, i.e. "Wet sprinklers and wet standpipe”.

K. Locate Backflow Preventers inside building. Otherwise in an exterior vault.

i. Required backflow preventer manufacturer: Febco
L. Do not use riser mounted air compressors. Use the largest air compressor allowed by code. Air compressor shall be hardwired with a protected circuit, or if plugged in, install a system that secures the plug into the outlet.

M. The use of self-luminous exit signs containing radioactive material is prohibited unless specifically approved by Environmental Health & Safety (EH & S).

N. All Exit signs and Egress lighting must be on a dedicated Generator or UPS circuit or approved by the Alarm Shop.

O. Install an exterior water flow bell in a location that is in direct line of sight of the fire department connection and shall have a “IF BELL RINGS, CALL 9-1-1” sign attached.

P. All auxiliary drains, low point drains & inspector's tests to be piped to ground level and accessible without the use of a ladder and piped to exterior if possible or an UPC approved floor sink with 3” drain.

Q. Firestopping of Penetrations
   i. Every penetration should be sealed by an appropriate method that not only preserves the fire/smoke rating of the penetrated construction but also sustainably prevents the entry and passage of insects and rodent pests.
   
   ii. The provisions of section 714 of the OSSC shall govern the materials and methods of construction used to protect through penetrations and membrane penetrations of horizontal assemblies and fire resistance-rated wall assemblies.
      
      a. Listed penetration firestop systems shall be installed in accordance with the manufacturer’s installation instructions and the listing criteria.
      
      b. Non-fire rated assemblies: Noncombustible penetrating items that connect not more than five stories are permitted provided that the annular space is filled to resist the free passage of flame and the products of combustion with an approved non-combustible material.

R. Impairments and Safeguards
   i. Safeguarding of the building during demolition, alteration, and construction shall be a joint cooperative efforts involving the entire project team, including the fire protection contractor, fire alarm contractor, the general contractor / construction manager, owner, and AHJ.
   
   ii. The contractor shall ensure proper building protection and safeguarding at all times in accordance with all applicable codes, standards, and regulations, including but not limited to the OSSC, OFCE, and the current edition of NFPA 241 Standard for Safeguarding Construction, Alteration, and Demolition Activities.
   
   iii. During times when the existing, modified and/or new building fire protection systems are impaired, the contractors shall provide appropriate safeguarding of the renovation work area, to include temporary heat detection or adequate alternate protection through the spaced as coordinated with, and approved by, the project fire prevention program manager, building manager, construction manager, insurance underwriters (when applicable) and all authorities having jurisdiction.
   
   iv. Safeguarding shall also apply to all related phasing, shut-downs, swing spaces, temporary facilities and relocations, etc. Detection shall be located and installed in accordance with the products’ listing and manufacturer’s instruction and shall be tested and maintained until such time that the permanent
building protection is restored. Alternative safeguarding such as, but not limited to, fire watch personnel, or temporary fire protection systems, may be considered if acceptable to the project manager and AHJ. Refer to, and coordinate with, fire alarm systems documents, and safeguarding and impairments notes and specifications. Coordinate with fire alarm system contractor and all other trades.

a. Temporary detection shall be provided while portions of the existing fire protection or alarms systems are impaired or out of service for an extended period (generally 8-hours or more) during construction, alternation, and demolition activities.

b. Temporary notification equipment shall include ADA compliant combination audible/visual notifications appliances where required by Code.

c. All temporary alarm devices shall be connected to the building fire alarm system and shall function as permanent until replaced with final systems components.

d. Bagging, or the temporary covering of smoke detectors, shall not be allowed during construction unless specifically permitted by the AHJ.

S. The Contractor shall be required to submit a complete demolition, alteration, construction, phasing and impairment plan to include the information above, a schedule of project milestones and related work and an anticipated schedule for installation, impairments, programming and all phases of final testing and completion of the work. This plan shall be coordinated with all AHJs, the project fire prevention program manager, Project Manager/Construction Manager, and shall include any and all information, drawings, and graphics to meet the approval of the AHJs. The Contractor shall provide fire watch personnel or temporary protection as reuses by any AHJ, the Project Manager, or the relevant insurance underwriters.

T. Integrated Testing

i. When two or more fire protection or life safety systems are interconnected, the intended response of subordinate fire protection and life safety systems shall be verified when required testing of the initiating system is conducted. Integrated testing shall be conducted in accordance with NFPA 4 for high-rise buildings and smoke control systems.

2. REFERENCES


B. NFPA13-Installation of sprinkler systems.

3. IDENTIFICATION

A. Provide labels and flow direction arrows on mains and cross mains every 20 feet.
Division 22: Plumbing

Section 22 05 00: Common Work Results for Plumbing
1. GENERAL
2. MATERIAL
3. EXECUTION AND QUALITY CONTROL

Section 22 30 00: Plumbing Equipment
1. GENERAL
2. BUILDING SYSTEM
3. SANITARY SEWER SYSTEMS
4. STORM DRAINAGE SYSTEM
5. NATURAL GAS SYSTEMS (FUEL GAS)
6. BUILDING SYSTEM
7. MANUFACTURERS

Section 22 40 00: Plumbing Fixtures
1. GENERAL
2. MATERIAL

Section 22 45 00: Emergency Plumbing Fixtures
1. REQUIREMENTS
2. EMERGENCY EYE WASH
3. EMERGENCY SHOWERS
4. LOCATION OF EMERGENCY EYE WASH AND/OR SHOWER

Section 22 60 00: Gas and Vacuum Systems for Laboratory and Healthcare Facilities
PART 1: GENERAL
1. GENERAL REQUIREMENTS
PART 2: SYSTEM
1. COMPRESSED AIR
2. LAB VACUUM SYSTEM
3. GAS SYSTEM
4. CHEMICAL SYSTEMS
5. REVERSE OSMOSIS DEIONIZED WATER SYSTEM
Section 22 05 00: Common Work Results for Plumbing

1. GENERAL
   A. All systems to have redundant features to provide continuity of service during maintenance and/or repair.

2. MATERIAL
   A. Pipe Identification
      i. See Division 09 for Painting.
      ii. Pipe labels:
          a. Pipe labels shall be water proof and permanently affixed to pipe. Label will be color coded in accordance Oregon Administrative Rules 952-001-0070 based on utility being carried by the pipe. Label shall have flow direction arrow preceding utility name.
          b. Labels shall be located generally at the following locations in pipe system:
          c. Wall, ceiling and floor penetrations,
          d. Points of equipment connection,
          e. Access panels,
          f. Visible flow divisions (i.e. tees, crosses, etc.).
   B. Access Panels
      i. Access panels are required in each situation where items requiring maintenance are located above a concealed ceiling or wall.
      ii. Use screwdriver actuated locks.
      iii. Access panel sizes shall allow for easy access for maintenance. Verify size with OSU Project Manager.
      iv. Access panel locations shall be indicated on contract drawings.
      v. Access panels are not required in lay-in ceilings, but identify appropriate tile with color button, cleated through, located on the adjacent ceiling grid. Use color code of principal service.
   C. Piping
      i. Piping shall be pitched and valves installed to facilitate complete drainage of the system.
      ii. All piping run within the building shall be run concealed in the finished portions of building in pipe spaces, ceilings or furred chases and exposed only in mechanical rooms and where shown on the drawings.
      iii. No pipe shall pass in front of or interfere with any openings, door or window. Head room in front of openings and doors shall in no case be less than the top of the opening.
      iv. Piping shall not pass exposed through electrical rooms or be erected over any switchboard or other electrical gear.
v. Pipe sizes shall be indicated on the plans at each change in direction and at all branch take off locations.

vi. Provide two-inch clearance between insulated piping and other obstructions.

vii. Unions:
   a. No union shall be placed in a location which will be inaccessible.
   b. Unions shall be installed adjacent to all equipment for repair and replacement.

viii. Electrolysis Control:
   a. Electrolysis control between dissimilar materials shall be achieved through the use of brass nipples and a brass union. Dielectric unions shall not be installed.

ix. Sleeves:
   a. All pipes passing through wall or floor construction shall be fitted with sleeves. Each sleeve shall extend through its respective floor, wall or partition and shall be cut flush with each surface unless otherwise specified. Sleeves shall be two pipe sizes larger than the pipe when un-insulated and of sufficient size to allow for the insulation without binding. Floor sleeves in mechanical rooms shall extend 4 inches above finished floor, all other spaces minimum one inch above finished floor.
   b. Sleeves in bearing walls, masonry walls, masonry partitions, and floors shall be standard weight steel pipe finished with smooth edges. For other than masonry partitions, through suspended ceilings and for concealed vertical piping, sleeves shall be No. 22 USG galvanized steel.
   c. Where pipes pass through waterproofed floor or walls, design of sleeves shall be such that waterproofing can be flashed into and around the sleeves.
   d. Sleeves through exterior walls below grade shall have the space between pipes and sleeves caulked watertight.
   e. Install one-piece chrome-plated escutcheon plates with set screw at sleeves for all pipes exposed in finished areas.
   f. The annular space between sleeves and pipe shall be filled with fiberglass insulation and caulked in non-fire rated situations.
   g. Where pipes pass through fire-rated floors, walls, or partitions, the use of a UL approved system for through penetrations is required. The annular space around the pipes shall be packed with mineral wool or other noncombustible material and sealed at each exposed edge to maintain the rating of the system in accordance with the through penetration sealant manufacturer’s recommendations.

x. System and Equipment Drains:
   a. All piping shall be arranged to completely drain the system. Drain locations shall be located at all system low points.
   b. Where sectionalizing valves are installed, a drain shall be installed on downstream side of valve to drain that section of the system.
   c. All cooling tower drains and overflow are to be piped to sanitary system (not onto roof).
d. All system and equipment drains are to be piped to a floor drain.

xi. Welding:
   a. All welding shall be done in accordance with the AWS.
   b. All boiler, pressure vessel, and gas piping welding must be done by certified welders as required by applicable codes.

xii. Valves:
   a. All valves on any one project shall be the product of one manufacturer.
   b. Locate valves in accessible locations, not more than six feet above the floor, if frequently used, and with a union on the downstream side of threaded end valves.
   c. Balancing valves shall be a type that can be used for shut-off without disturbing balancing point setting.
   d. Where possible, valves shall be installed with valve bonnet in an upright position to prevent deterioration or corrosion of bonnet and packing. Valve handles shall face toward the direction of flow when in the open position.
   e. For 3-inch and larger, use butterfly valves. (Wafer valves are prohibited.) For 3-inch and smaller use ball valves. Globe valves will be used for flow modulation.
   f. Ball valves equipped with “characterizing disc” may be used for throttling purposes in lieu of globe valves. Design Professional shall prequalify with Facilities via the OSU Project Manager/Construction Manager the use of these valves.
   g. Specialty valves shall be employed where appropriate, such as check valves on a pump discharge, pressure regulating valves for equipment requiring lower-than-available system pressure, solenoid valves, etc.
   h. Valve body materials shall be compatible with piping system materials.
   i. Flanged or threaded end valves are preferred.
   j. Pump Valves
      1) All constant speed circulating pumps shall include a separate shut off valve, balancing valve, and check valve. Triple duty valves are not allowed.
      2) Balancing valves shall not be used on pumps equipped with variable speed drives.
   k. Shutoff Valves
      1) Isolation shutoff valves shall be installed at each piece of equipment, terminal unit, and each branch takeoff to facilitate shutdown for repair. Positive shutoff balancing valves with memory may satisfy this requirement at terminal units.
   l. Balancing Valves
      1) Balancing valves shall be installed in all 3-way control valve bypass lines and at all flow meters.
2) Gate valves shall be limited to shutoff service only. Gate valves shall not be used in a throttling application. Globe valves or ball valves shall be used.

m. Check Valves

1) Where check valves are required, check valves shall be installed on the equipment side of all shutoff valves to facilitate servicing the check valve.

n. Drain Valves

1) Drain valves shall be a minimum of 3/4" with hose end connection.

3. EXECUTION AND QUALITY CONTROL

A. Pressure Tests:

i. All piping must be tested prior to receiving insulation.

ii. Test pressures shall be minimum 1 1/2 times system operating pressure or as specified by the Design Professional.

iii. During the test each joint shall be visually inspected.

iv. Pressure tests must be witnessed and acknowledged in writing by the Owner’s Facilities representative via the OSU Project Manager.

B. Piping Systems Disinfection

i. Before being placed into service, all new water lines, except those used exclusively as fire lines, shall be disinfected in accordance with AWWA standards. Final connections to existing water lines shall not be made until this procedure is completed satisfactorily.

II. The University shall be notified in advance of the date and time that the disinfection is to begin. The University shall witness the process.
Section 22 30 00: Plumbing Equipment

1. GENERAL

A. Domestic Water System - System Requirements

   i. Reliability

      a. Adequate volume and pressure of water must be available at all times. On-site pressurization should be considered if the city supply is not reliable. Prior to the start of design work, contact the City of Corvallis Water Department to determine their requirements and pressures.

   ii. Capacity

      a. System capacity shall be based on peak flow demand rates of the plumbing system, make-up to HVAC equipment, and process water requirements.

   iii. Pressure

      a. A minimum domestic pressure of 40.0 psig is required at the most remote use points.

      b. If the public system cannot furnish this, provide booster pumps in mechanical room with drain.

      c. Maximum water pressure within a building should not exceed 80.0 psi.

      d. Provide multiple pressure-regulating assemblies with a full line size bypass with isolation valves.

      e. Coordinate the location for easy maintenance.

   iv. Design velocities

      a. To assure a quiet piping system, design velocities shall not exceed those noted below. Piping sized according to the velocities above still must not exceed the allowable pressure drops specified in the Uniform Plumbing Code, per the current Oregon amendments.

      b. Max. velocity

         1) Mains mechanical rooms: 10 ft. per sec.

         2) Mains and branches in other areas: 8 ft. per sec.

   v. Routing

      a. Route site fire and water lines to avoid other utilities, vaults, and trees.

      b. Coordinate routing with the landscaping plan to verify that no piping is within ten feet of any new tree and outside the drip line of any existing trees.

2. BUILDING SYSTEM

A. Risers and mains

   i. For ease of maintenance, locate risers and mains at or near an exterior wall in an accessible location, such as a mechanical equipment room, storage room, or custodial room.

      a. A main shut-off valve shall be installed on the riser before any branch take-off.
b. Pipe runs below the building floor slab shall be avoided, except for short branch lines serving “island” fixtures.

ii. In multi-story buildings, locate a shut-off valve on the branch feeding each level.
   a. In addition, provide sectional valves for each self-contained or special purpose area, to permit a localized shut-down without affecting other parts of the system.
   b. Provide shut-off valves for each toilet room.
   c. Provide an access door in the toilet room with the shut-off valves toilet rooms.

B. Backflow Prevention
   i. All potable and non-potable water, such as lines labs, HVAC equipment, cooling water, or other water make-up systems to equipment shall have a pressure-reducing type backflow preventer (RPBP) installed in parallel (duplex) located in an accessible location.
      a. A floor sink or other approved fixture shall be nearby to receive piped discharge from the RPBP.
      b. Back-flow protected lab water shall be identified differently from those serving domestic purposes, such as drinking fountains, kitchens, and rest rooms, etc.
   ii. Kitchen equipment with chemical injection systems (i.e. dishwashers, hood wash systems, beverage systems) require a pressure-reducing type backflow preventer (RPBP) located in an accessible location. A floor sink or other approved fixture shall be nearby to receive piped discharge from the RPBP.
   iii. All potable and non-potable building supply water shall be protected by two (2) backflow preventers (BFP), installed in parallel to allow for testing or repair of the device without shutting off the building’s water supply. Provide unions or flanges on both sides of the device.
   iv. Required backflow manufacturer: Febco

C. Water hammer protection
   i. A sealed chamber-type, maintenance free, water hammer arrester shall be installed upstream of all solenoid valves, flush valves, water mixing valves or other quick-closing valves.
      a. The size, quantity, and location are to be as recommended by the manufacturer of water hammer arrestors.
      b. Simple air-chamber type units are not acceptable.

D. Trap primers
   i. Electronic trap primers shall be provided to protect the trap seal of infrequently used fixtures (generally floor drains). Manufacturer: PPP.
      a. A single trap primer may be used to serve more than one fixture.
      b. A manifold provided by the trap primer manufacturer shall be provided. Provide access for inspection or locate trap primers exposed.
      c. Provide a shut-off valve on the water supply line to the primer.
      d. Locate trap primers in an easily accessible location.
E. Water heating
   i. Provide steam to hot water generators for domestic hot water.
   ii. Specifications:
       a. The hot water temperature at any fixture shall not exceed 120 deg. F, as per plumbing code. Generate water at temperatures necessary to attain 120 deg. F at taps. Provide a recirculating system controlled by Honeywell Aquastat Controller. Special use areas such as kitchens and certain labs may require higher temperatures.
   iii. Selection of water heater capacity shall be based on the recommendations of the ASHRAE Handbook for Hot Water Systems or on other standard engineering practices.
   iv. Use the Oregon Plumbing Specialty Code for sizing pipe.
   v. Some areas or equipment may require higher temperatures than the 140 deg. F, recommended above, such as cafeterias, kitchens, etc. In such cases, a separate heater or local booster heaters of appropriate capacity shall be used.
   vi. Use of electric instantaneous units may be used at remote isolated locations. Preferred manufacturers:
       a. Controlled Energy Corporation, Powerstar, Powerstream, or Ariston with a minimum five year warranty.
   vii. When tank electric water heaters are pre-approved by the Facilities Maintenance Manager via the OSU Project Manager, pre-approved manufacturers are RUUD Brand. Tank shall be commercial grade and shall carry a minimum 10 year-manufacturer’s warranty.

F. Fixtures
   i. Refer to OSU Construction Standard 22 40 00 for Plumbing Fixtures requirements and standards.

G. Piping Materials
   i. Use Type L copper for all domestic and industrial cold, hot water, and hot return lines. All main lines shall be copper. Pex can be used. 1 ½-inches and smaller in concealed locations and supported as per manufacturer spec. If Pex is used it shall be either the Rahau or Uponor (Wirsbo) systems.

H. Valves
   i. Select valves for the appropriate function:
       a. Ball valves or butterfly valves for shut-off or sectionalizing service, globe valves for flow modulation.
       b. Specialty valves shall be employed where appropriate, such as check valves on a pump discharge, pressure regulating valves for equipment requiring lower-than-available system pressure, solenoid valves, etc.
       c. Flanged or threaded end valves are preferred.
       d. Locate valves in accessible locations, not more than six feet above the floor, if frequently used, and with a union on the downstream side of threaded end valves.
   ii. Provide each valve with a brass disc not less than 1-1/4-inches diameter engraved with numbers, piping service, and normal operating position (i.d. NO, NC) corresponding to valves shown on diagrams.
a. Fasten discs to valves with #14 brass wire or #16 brass jack chain.

iii. Galvanized piping shall not be used in any water system.

I. Insulation

i. Insulation is required for all hot water piping, cold water and industrial cold water piping.

ii. Insulate horizontal portions of rain water piping above ceilings or finished soffits in areas where there is a possibility of condensation.

iii. Provide flexible molded vinyl insulation kit on exposed waste and supply piping below ADAAG lavatories and sinks.

J. Accessories

i. Pipe line accessories such as unions, pressure or temperature test plugs, flow sensors, gauges, flexible connectors, etc. shall be employed as appropriate to assure a well-functioning, easy-to-maintain system.

ii. Expansion joints or expansion loops shall be installed on long, straight runs to compensate for thermal expansion of the pipe whenever the calculated expansion is +/- 1/8 inch or more. Spacing and location shall be based on the maximum probable temperature fluctuation and the thermal coefficient of the pipe material.

K. Supports

i. For parallel pipe runs, trapeze-type supports shall be spaced to suit the smallest pipe in the group. Spare room for 20% future pipe lines should be reserved.

ii. Hanger spacing shall also be coordinated with the supporting steel overhead. Hangers shall be of sufficient strength to support the pipes and contents plus 200 pounds. Metallic pipes shall not be in direct contact with hangers or the supporting structure.

iii. Provide seismic bracing according to SMACNA requirements.

3. SANITARY SEWER SYSTEMS

A. Design Criteria

i. Capacity

a. All calculations for pipe capacity shall be based on the current Plumbing Code. Cooling tower blowdown will also discharge into the sanitary sewer system.

b. Verify and obtain written approval from the OSU Project Manager that the existing downstream sanitary sewer mainline has capacity for the new sanitary sewer system based on peak flows.

ii. Slope (pitch)

a. Slopes of sanitary sewer lines within a building are set by code.

b. Verify that design considerations are acceptable to local jurisdictions and obtain approval prior to proceeding with design work.

iii. Tests
a. Sanitary sewer systems are tested per code, generally tested at 10 feet of head for a period of 4.0 hours with no visible loss of water.

b. The exceptions are pumped portions, which should be tested at 1 1/2 times the pump head.

B. Routing
   i. Route site sanitary lines to avoid other utilities, vaults, and trees.
   ii. Coordinate routing with the landscaping plan to verify that no piping is within ten feet of any new tree and outside the drip line of any existing trees.
   iii. Include continuous #14 tracer wire with all exterior sewer installations. Tracer wire should be secured and reachable from finished grade at manhole and cleanout facilities.

C. Material
   i. Hubless cast iron or SCH 40 DWV PVC is acceptable.
      a. Below-grade portions of piping shall be hubless cast iron or SCH 40 DWV PVC to a point five feet beyond the exterior face of the building.
      b. Specify (2) two band fittings above grade and (4) four band below grade.

D. Freeze Protection
   i. The minimum depth of pipe cover must be three feet, or one foot below the frost line, whichever is greater.

E. Exterior sewer systems
   i. Manholes
      a. All drop connections at manholes must be approved by the OSU Project Manager.
      b. Manhole steps are to be installed.
      c. Continuous tracer wire must be reachable from finished grade inside the manhole cone.
   ii. Cleanouts
      a. Cleanouts shall be two-way except at dead-end lines.
      b. Stand pipe should match the primary pipe size up to (6) six inches maximum.
      c. Tracer wire must be reachable from finished grade within the cleanout cover.

F. Building sewer systems
   i. Vents
      a. Provide vents in accordance with code. To reduce the number of roof penetrations, collect vents in the ceiling or attic space.
   ii. Cleanouts
      a. In addition to code requirements, provide cleanouts at major pipe junctions. Avoid locations such as lobbies, conference rooms, private offices, or other special areas.
iii. Floor drain system
   a. Provide traps and vent at all floor drains directly connected to the sanitary sewer. Pipe runs should be located between columns to avoid footing pressure zones.

iv. Distribution of floor drains shall be:
   a. In mechanical equipment rooms at appropriate points to collect discharge or drainage from equipment.
   b. Near water heating equipment.
   c. In each toilet room.
   d. At each emergency shower.

v. Drains serving outdoor wash pad areas, trash enclosures, loading docks or other areas that could conceivably generate contaminated rain-water runoff and/or contaminated process water shall be plumbed to the sanitary sewer system. Plumbing code requirements may dictate the use of a fixed roof, diking or slope control to minimize rain water collection.

4. STORM DRAINAGE SYSTEM

A. Design Criteria
   i. Slope
      a. Provide an engineering analysis to determine a pipe size, considering flow, velocity, and available fall. Design for pipe with space capacity.

   ii. Tests
      a. Same as the sanitary sewer system.

   iii. Routing
      a. Route site storm lines so as to avoid other utilities, vaults, and trees.
      b. Coordinate routing with landscaping plan to verify that no piping is within ten feet of any new tree and outside the drip line of any existing trees.

B. Exterior Drainage System
   i. Manholes
      a. Manhole steps are to be installed.
      b. Continuous tracer wire must be reachable from finished grade inside the manhole cone.

   ii. Cleanouts
      a. Cleanouts shall be two-way except at dead-end lines.
      b. Stand pipe should match the primary pipe size up to 6 inches maximum.
      c. Tracer wire must be reachable from finished grade within the cleanout cover.

   iii. Materials
a. Corrugated pipe (e.g. ADS) shall not be used for storm water drainage with the exception of detention facilities and open channel culverts.

C. Building Drainage System

i. Roof drains, overflows, gutters
   a. Cast iron or bronze roof drains shall be distributed to serve approximately equal areas.
   b. An overflow drain shall be located within five feet of each roof drain with the rim two inches above finished roof surface.
   c. Overflow drains shall be connected to an independent drainage system, discharging at a point visible from the outside.
   d. Discharge locations shall be selected so as not to spill or splash over or down the exterior walls of the building so as to avoid unsightly staining.
   e. Pipe sizing for the overflow pipe system is to be the same as for the roof drains.

ii. Roof Drains: Provide minimum 4” diameter drainpipe wherever feasible to minimize obstructions. Provide cleanouts and access panels for drain lines routed through walls, interior spaces, and outside the building.
   a. Provide removable scupper covers with sufficient flow to minimize leaf obstructions.
   b. Provide removable, cleanable debris screen at roof drain

iii. Rainwater leaders
   a. Materials for the roof drainage and overflow piping are to be identical.
   b. Hubless cast iron or galvanized steel pipe is acceptable. Vertical drops shall be located adjacent to exterior walls.
   c. Below-grade portions of piping shall be SCH 40 DMV PVC to a point five feet beyond the exterior face of the building.
   d. Specify (4) four band fittings above and below grade.
   e. One vertical leader may serve only one roof drain.
   f. Extend rainwater leaders below the grade and connect it to an on-site storm drainage system or run it to the site civil piping system.

iv. Sump Pumps
   a. For small, independently drained areas (area ways, ramps, loading docks), a small local sump and pump will be required if no gravity connection to the mains is possible.
   b. The simplest arrangement shall be employed, utilizing a small, cast-in-place sump with submersible pump(s). Sloping surfaces shall direct rainwater to the sump.
   c. In areas where a build-up of rainwater is not critical, a single pump is acceptable. In other situations or as designated by local jurisdiction, duplex pumps shall be used.
   d. Pumps shall be controlled by integral or separate level sensors.
1) Duplex pumps are to have an automatic alternating arrangement.

2) An additional level sensor shall be provided at all sumps to signal high liquid level alarm conditions.

e. An oil/water separator shall be provided prior to the sump pumps where required, as designated by the local jurisdiction.

D. Landscape Drains in shrub beds.

i. All landscape drains in shrub beds must have a concrete collar installed around the drain inlet to prevent debris from entering the drain.

5. NATURAL GAS SYSTEMS (FUEL GAS)

A. Design criteria

i. General

a. Natural gas shall be considered the primary fuel for kitchen cooking equipment.

ii. Pressure

a. The gas pressure is normally located by the seven-inch water column on the downstream side of the gas meter.

iii. Capacity

a. The capacity of the system is the total connected load from all present and future use points.

iv. Piping

a. The pipe above grade shall be:

   1) Threaded or welded black steel where located inside a building
   2) Galvanized steel where exposed to the weather.

b. The pipe above grade, when exposed, shall be painted with paint suitable for corrosion protection.

B. Valves

i. Valves shall be readily accessible and located as designated by code and local utility company requirements.

ii. Provide valves at each capped stub out for future extension, and at each piece of equipment. Request the local utility company to provide a valve upstream of the gas meter.

C. Accessories

i. Provide a gas pressure regulator with a built-in internal relief and low-pressure cut-off, or for large demands, a gas pressure regulator with an internal relief and separate low-pressure cut-off.

ii. Vents shall be provided from each pressure regulator. Vents shall run independent and terminate outside the building at a location in compliance with code.
iii. Provide pressure gauges with gauge cocks on the upstream and downstream side of each regulator and a separate low pressure cut-off to aid in checking the gas pressure.

D. Tests
i. Gas piping shall be tested with air at 100 psig for four hours with no loss in pressure.

E. Gas supply
i. Coordinate the location of the gas meter with Northwest Natural Gas Company.
ii. Northwest Natural Gas Company has all known gas pipe lines documented.
iii. Install seismic gas shut-off at meter prior to entry into building.

6. BUILDING SYSTEM

A. Pressure
i. Piping within the building shall be sized and distributed at 6.5-7” water column, unless a higher pressure is required for the equipment.

B. Piping
i. All piping shall run above the slab, with branches connected to the top of mains. When necessary, due to structural conditions, piping may be installed in other locations with the permission of the local jurisdiction.

C. Equipment Connections
i. All connections to equipment shall terminate with a dirt tee and shut-off valve. Flexible connectors are not acceptable.

7. MANUFACTURERS

A. OSU maintains a stock of spare plumbing parts for most components on campus.

B. The following table lists preferred brand and manufacturers for plumbing components.

C. The brand of company name listed is to be used as the basis of design for that component. Provide a list of alternate manufacturers to the OSU Project Manager for review with the OSU FS Shops with the 100% design development documents. Provide a list of any changes or additions with the 95% construction document review.
<table>
<thead>
<tr>
<th>Domestic Water/Non-potable Water</th>
<th>Gas</th>
<th>Waste</th>
<th>Vent</th>
<th>Item</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hot X</td>
<td></td>
<td></td>
<td></td>
<td>Control valves</td>
<td>Honeywell, Johnson</td>
</tr>
<tr>
<td>Cold X</td>
<td></td>
<td></td>
<td></td>
<td>Cross connection devices (preferred)</td>
<td>FebcO</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Back-flow prevention devices</td>
<td></td>
</tr>
<tr>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
<td>Flexible shield couplings</td>
<td>Ferco</td>
</tr>
<tr>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td>Lab fixtures</td>
<td>J&amp;S, Chicago, Water Saver</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Pipe &amp; fittings, black steel</td>
<td>Domestically manufactured</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Pipe &amp; fittings, cast iron, no hub</td>
<td>Domestically manufactured</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Pipe &amp; fittings, PVC schedule 40</td>
<td>Domestically manufactured</td>
</tr>
<tr>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
<td>Pipe, type L/X copper</td>
<td>Domestically manufactured</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>MP-500 for 1-4 primers, Prim-Time units for larger quantities</td>
<td>ppm</td>
</tr>
<tr>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
<td>Valves, ball</td>
<td>Stockholm, Grinnel</td>
</tr>
<tr>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
<td>Valves, ball-PVC</td>
<td>Apollo, Nibco, Hammond</td>
</tr>
<tr>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
<td>Valves, brass ball</td>
<td>Omni-Spears</td>
</tr>
<tr>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td>Valves, flush</td>
<td>Sloan, Moen</td>
</tr>
<tr>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
<td>Valves, gate</td>
<td>Nibco</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Valves, pressure</td>
<td>Watts</td>
</tr>
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<td></td>
<td>X</td>
<td></td>
<td></td>
<td>Valves, pressure regulating</td>
<td>PRV Spence</td>
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<tr>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
<td>Valves, rising stem valve - none above 2 inches</td>
<td>Stockholm, Grinnel</td>
</tr>
<tr>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td>Steam to hot water heat exchanger</td>
<td>Patterson-Kelley</td>
</tr>
</tbody>
</table>

D. Refer to Section 22 40 00 for OSU approved plumbing fixture list
Section 22 40 00: Plumbing Fixtures

1. GENERAL
   A. Provide fixtures in accordance with the Construction Standards 01 10 02 Accessibility Best Practices for OSU and the 2010 Americans with Disabilities Act Standards for Accessible Design. Where applicable requirements are more stringent, those requirements shall be followed.

2. MATERIAL
   A. Interior faucets, hose bibs, and flush valves shall be chrome-plated brass.
   B. Fixtures shall be selected for the specific function. Where possible, water saving features should be employed, particularly in high use areas.
   C. Material shall be the best quality, easy to clean, with surfaces smooth and resistant to chipping, cracking, and discoloration.
   D. OSU allows limited types of plumbing fixtures to be able to provide sustainable maintenance. The table below lists the preferred brand and manufactures for plumbing fixtures. If there is compelling reasoning for alternate fixtures, the Design Professional shall provide a list of alternate plumbing fixtures to the OSU Project Manager for review with the responsible Facilities Maintenance Manager for approval. This process shall be done at the 100% design development stage. If this step is skipped, the Design Professional shall be responsible to use Brand/manufacturer’s below.

<table>
<thead>
<tr>
<th>Domestic Water/Non-potable Water</th>
<th>Gas</th>
<th>Item</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hot X</td>
<td>Cold X</td>
<td>Emergency shower &amp; eye wash</td>
<td>Guardian</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>Drinking fountains &amp; water coolers</td>
<td>Elkay</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>Lab Faucets</td>
<td>Moen</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>Lab Faucets</td>
<td>Chicago, Water Saver</td>
</tr>
<tr>
<td>X</td>
<td></td>
<td>Faucets</td>
<td>Moen</td>
</tr>
<tr>
<td>X</td>
<td></td>
<td>Hose bibs freeze-proof</td>
<td>JR Smith, Woodford</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>Lab fixtures</td>
<td>Chicago, Water Saver</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>Water closet-flush valve</td>
<td>Sloan, Moen</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>Water closet-floor mount</td>
<td>Kohler, American Standard</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>Urinal</td>
<td>Kohler, American Standard</td>
</tr>
</tbody>
</table>

E. Refer to Section 22 30 00 for approved plumbing equipment list.

F. Floor Drains
   i. Floor drains in mechanical rooms, laundries, promenades, terraces, and similar locations shall have perforated sediment bucket with integral auxiliary drainage rim so designed that grate cannot be set in place until bucket is in position.
   
   ii. Sterilizers and autoclaves shall have a fixed air gap between the equipment and the sewer.
iii. Every floor drain shall be equipped with an electronic trap primer to prevent the trap from drying out and to prevent sewer gas from entering the occupied space.

iv. Floor drains located above the ground floor shall be equipped with clamping collars and shall be flashed with 24" x 24", 6-lb. sheet lead.

v. A floor drain shall be provided to serve each emergency shower. Drain shall be located directly below shower head. Floor shall slope toward drain.

vi. Floor drains and floor sinks are generally cast iron with a polished bronze heel proof grating.

G. Water Closets

i. Toilets shall be floor mount, back outlet, vitreous china, elongated bowl, siphon jet action, 1 1/2 inches top spud. American Standard or Kohler are approved manufacturers. Fixtures shall be similar or equal to Kohler Anglesey. Sloan toilets are prohibited.

ii. Toilet seats shall be open front, no cover, and white with stainless steel check hinge similar to Church.

iii. Closet fittings and carrier shall be similar to JR Smith.

iv. Flush valves shall be Sloan or Moen and shall not exceed 1.6 gal. per flush. No electronic flush valves shall be installed.

v. Water closets in women's restrooms shall be equipped with dual-flush flushometers.

H. Urinals

i. Urinals shall be high efficiency wall hung, vitreous china, washout with 3.4-inch top spud and 2-inch outlet. Urinals shall be similar to American Standard Flowise. Flush valves shall be Moen or Sloan. No electronic flush valves shall be installed unless required by ADA.

ii. Carriers shall be complete with fixture bolts, bearing plate, adjustable extension, steel pipe uprights, cantilever foot bases and chrome plated trim. Carriers shall be JR Smith.

iii. The use of waterless urinals is only in stadiums and arenas. The use of waterless urinals is prohibited elsewhere.

I. Lavatory Sinks

i. Lavatory sink carriers shall be of the institutional type with support plate, bearing plate steel uprights and block bases for supporting lavatory fixture with concealed hangers. Carriers shall be similar to JR Smith 0700 series or similar.

ii. Lavatory sink supply and waste lines should enter the wall to allow for easier cleaning and better sanitation.

iii. Provide at least one hose bib on the hot and cold water supply under one lavatory sink in each restroom. Hose bib shall be keyed style. Each lavatory sink shall have wall mount cleanout.

iv. Lavatory faucets shall be single handle, meet ADA requirements, and be matching or similar to the Moen #9417. Moen, Delta, and American Standard are acceptable. Electronic faucets shall not be installed. If such faucets are used and only if approved with a Deviation Request, these faucets shall be the Moen CA 8301 with the AC option. No Batteries.
J. Showers
   i. Shower heads shall be self-cleaning and of the vandal-proof type solidly attached to shower stall. Use water saver type.
   ii. Shower rough-in valves shall be Moen 8372HD or similar Moen valve with integral ¼ turn stops and shall be thermostatically controlled.
   iii. Showers shall have dual flow controls, limiting water flow to two (2) gallons per minute, installed between the mixing valve and the shower head. Trim kits shall be Moen 8342EP15 or similar Moen product and shall be chrome plated.

K. Antifreeze Hose Bibs
   i. Antifreeze hose bibs are needed adjacent to all building entrances for the purpose of washing down walks and entrances.
   ii. Hose bibs shall be key type.

L. Service Sinks
   i. Service sinks shall be similar to Stonite Precast Terrazzo Mop Service Basins as manufactured by Stonite Products Company. Service basins shall be 24 inches square with three (3) inch wide and twelve (12) inch high shoulders and shall be cast as a single unit of terrazzo. The sides of the service basin installed against any wall shall be provided with stainless steel tiling flanges cast integral with the basin and extending two (2) inches above the shoulders. On exposed side the service basin shall be provided with integral cast stainless steel caps extending over the top of the shoulder and extending at least 1 1/2 inches down the sides. Provide three (3) inch drain connection with stainless steel strainer plates and traps. Install counter-flashing as required. Stainless steel sink basins allowed with pre-approval by Responsible Maintenance Manager.
   ii. Service sink fitting shall be equal to Chicago faucet No. 897 with bucket hook, wall brace, 3/4 inch threaded hose connection, vacuum breaker, and integral stops.
   iii. When pre-qualified with responsible Facilities Maintenance Manager via the OSU Project Manager, mechanical spaces/rooms shall install service sink and appropriate storage for any necessary mechanical-chemical additives required for mechanical systems in that space.
   iv. All service sinks shall have isolation valves on both hot and cold water lines. Where angle stops are used, angle stops shall be commercial grade ¼ turn style.

M. Roof Drains
   i. Roof drains shall be JR Smith.
   ii. Insulate drain body and all horizontal rain leaders.

N. Sinks
   i. 18 gauge, type 304 stainless steel (Kitchen, coffee bars, break areas, etc.)

O. All sinks shall have isolation valves on both hot and cold water lines. Where angle stops are used, angle stops shall be commercial grade ¼ turn style.
P. Drinking fountains

   i. Will be the "high-low" dual use type, one at standard height and one at ADA height. A minimum of one drinking fountain per floor should be lower "wheelchair" height and locate on the accessible route of travel. The lower drinking fountain should also have a bottle filler. Provide refrigerated fountains only where cold domestic water temperature at the point of service is 75 deg. F or higher. Refrigerated fountains should be installed on a timer or tied to building management systems to prevent running during unoccupied hours.

Q. Restrooms

   i. All locations, elevations, and correct size of bathroom accessories shall be shown on plans.

   ii. In addition to the required restrooms per applicable building code requirements, a single user (gender neutral) restroom shall be designed to meet the Universal Design Standards (Section 01 10 00, Design Requirements for OSU). There will be a minimum of one single stall restroom per building. If only one restroom is designed, then it shall be located on the first floor of the building.

   iii. Accommodations will include a changing table for infants.

   iv. All restrooms must meet at a minimum ADAAG 2010 guidelines and 01 10 02: Accessibility Best Practices for OSU.

   v. Wall-mounted partitions are preferred.

   vi. Ceramic or Seamless floor construction shall be required
Section 22 45 00: Emergency Plumbing Fixtures

1. REQUIREMENTS
   A. These criteria set OSU campus standards for emergency shower and eyewash equipment to comply with the regulations set forth in the most current applicable OAR.

2. EMERGENCY EYE WASH
   A. This equipment must meet the most current performance and installation requirements of the American National Standards Institute (ANSI).
   B. All campus laboratories that use substances described above must have at least one emergency eye or eye/face wash located within the laboratory and as close as possible to the hazard.
      i. Hand held drench hoses are not considered eyewash units. They may be used in addition to equipment, which is described as meeting the ANSI standard. In some cases, a sink mounted eyewash and a drench hose may be installed in lieu of a combination eyewash/safety shower.
      ii. Consult OSU EH&S for review and approval of this configuration.
   C. Approved emergency eye or eye/face wash units are Guardian G1805 (laboratory unit – install at sink), Guardian G1750PT (Barrier Free), Guardian GBF 1735DP (recessed), or equal. The approved units must be:
      i. Supplied by domestic water.
      ii. Readily visible and accessible to the laboratory or work site. The unit should be located as close to the hazard as possible and cannot be blocked by building structures, cabinets, supplies or equipment.
      iii. Regulated to provide a spray force of three to six gallons per minute at 30 psi.
      iv. Mounted such that the water nozzles are 33 inches to 45 inches from the floor level; height should comply with the current Americans with Disabilities Act (ADA) requirements.
      v. Mounted so that spray nozzles, when activated, are no more than eighteen (18) inches from the counter front when located above work counters or benches.
      vi. Provided with an activation device, such as stay open ball valve, that allows the user full movement of both hands after the valve is turned on.
      vii. Identified with a highly visible sign.
      viii. Drain will be plumbed to sanitary sewer.
      ix. No electrical outlets within six (6) feet unless GFI protected.
      x. Indoor units are not required to deliver tempered water. Units installed outdoors or in adverse climates may need to be tempered. The need for tempered water shall be reviewed and approved by OSU EH&S during the design phase.

3. EMERGENCY SHOWERS
   A. Emergency Showers must be a combination unit that meets the requirements of current ANSI standards. The unit must be installed and located so both the shower and eyewash can be used at the same time by one
person. Approved eyewash/emergency shower units are Guardian G1909 HFC (GBF1909 Barrier Free), Guardian GBF2150 (recessed). The approved units must be:

i. Supplied by domestic water.

ii. Readily visible and accessible to all occupants of the laboratory or work site. They cannot be blocked by building structures, cabinets, supplies or equipment.

iii. Adequately supplied with potable water to meet the requirements of each component. The shower must be able to deliver a minimum of 20 gallons per minute for a minimum of 15 minutes. The diameter of the water pattern of the shower measured 60 inches above the surface on which the user stands must be a minimum of 20 inches. The center of the spray pattern shall be located at least 16 inches from any obstruction.

iv. Supplied by a minimum iron pipe size of one inch.

v. Installed with a stay open ball valve.

vi. Installed so that the shower head is not less than 82 inches nor more than 96 inches from the surface on which the user stands.

vii. Identified with a highly visible sign.

viii. Eyewash component drain must be plumbed to sanitary sewer.

ix. Located so as not to pose an electrical shock hazard. No electrical outlets within six (6) feet unless GFI protected.

x. Indoor units are not required to deliver tempered water. Units installed outdoors or in adverse climates may need to be tempered. The need for tempered water shall be reviewed and approved by OSU EH&S during the design phase.

xi. A dedicated water shutoff valve shall be located within ten feet of the shower unit.

4. LOCATION OF EMERGENCY EYE WASH AND/ OR SHOWER

A. A combination eyewash/emergency shower may be located outside the laboratory area provided a proper hazard assessment has been performed and EH&S has approved of this alteration and an approved eyewash is located in the laboratory.

B. The combination unit must be located so that travel distance is no more than ten seconds with no obstructions and only one door to pass through to reach the unit. Note: Emergency eyewash or eye/face wash shall be plumbed to sanitary sewer or sink-mounted.

C. OSU EH&S will make final determination on selection of “equal” equipment to ensure the equipment meets current ANSI standards.
Section 22 60 00: Gas and Vacuum Systems for Laboratory and Healthcare Facilities

PART 1: GENERAL

1. GENERAL REQUIREMENTS

   A. Refer to Construction Standard 22 05 00 Common Work Results for Plumbing for more information and requirements.

   B. Compressed air, vacuum, gas, and deionized water valves and outlets at accessible work stations shall be located within the reach range of a person in a wheelchair. Locate valves and outlets no more than 24” from the leading edge of the counter

PART 2: SYSTEM

1. COMPRESSED AIR

   i. General Requirements

   ii. Verify with the OSU Project Manager the type and quality of compressed air required.

   iii. OSU uses two types of compressed air systems: clean lab air and building control air. Verify the type of air required with the OSU Project Manager.

   iv. All systems to have redundant features to provide continuity of service during maintenance and/or repair.

B. Lab Air System

   i. The compressed air system shall include the following:

      a. Air or water cooled one or two stage rotary screw or scroll type oil-free air compressor.

      b. An air dryer to match or exceed cfm of air compressor.

      c. An air receiver.

      d. A filtered intake to the compressor.

      e. Particulate filters.

      f. Filters, Air Driers, Regulators and Compressor air discharge piping shall be fitted with unions to facilitate replacement of equipment.

      g. Copper piping system cleaned for oxygen service.

      h. Preferred manufacturer: Rogers Machinery, Powerex.

   ii. Once through cooling water is not acceptable on water cooled units. Provide an integral heat exchanger and a cooling fan.

   iii. “Oil-free" compressors, which depend on various seals to keep oil out of the air, or those equipped with oil filters located after the compression chambers, may be acceptable. Consult with the OSU Project Manager. Provide a receiver with a by-pass upstream of the dryer.
iv. Air dryers are to be either refrigerated type or the desiccant heatless, reactivated dual tower type. Verify with the OSU Project Manager the desired dew point (Desiccant -40 deg. F. -100 deg. F., Refrigerated 36 deg. F -40 deg. F.) and select the appropriate dryer.

v. Install a “coalescing” filter upstream of the dryer and particulate filter downstream of the dryer. Use Type 304 stainless steel housings. Install these devices in series with the gauges and isolation valves.

vi. Provide a bypass with valves for all filters and dryers to allow for routine maintenance without interruption of service.

C. Building Control Air System

i. The compressed air system shall include the following:

   a. Air or water cooled one or two stage rotary screw type oil flooded air compressor, or reciprocating air compressor
   b. A refrigerated dryer
   c. An air receiver.
   d. A filtered intake to the compressor
   e. Particulate filters
   f. Coalescing filters
   g. Copper piping system
   h. Preferred manufacturer: Quincy Northwest.

ii. Size the air intake filter for 150% of the compressor flow rate.

iii. Install “coalescing” filter upstream of the dryer and particulate filter downstream of the dryer. Use Type 304 stainless steel housings. Install these in series with the gauges and isolation valves.

iv. Provide a bypass with valves for all filters and dryers to allow for routine maintenance without interruption of service.

D. Piping

i. Lab Air System

   a. ASTM 280 ACR Type L copper above grade, Type K below grade; wrought copper fittings, 15% silphos silver solder for OFA and Nitrogen. Piping must be installed while maintaining a continuous inert gas (argon or nitrogen) purge during the entire installation period.

   b. Identify all compressed air piping per general requirements.

   c. Cleaning of piping.

   d. The most important single requirement for the process gas piping systems is that they are suitable and capable of conveying a gas from the source to use point with no contamination.

      1) Order all pipe material, fittings, etc., to be cleaned by the manufacturer for “oxygen usage”, charged with nitrogen, and sealed at the ends prior to transportation.
2) Each pipe length and fitting is to be individually inspected on arrival at the job site for integrity of the sealed ends and for physical injury (such as bends or flat spots). Pipes with lost seals or physical damage are to be re-cleaned or rejected.

3) Acceptable pipes are to be stored in a clean, safe location.

4) Quantities of pipe cleaned at any one time shall not exceed that which can be installed within the same working days. No pipe may be installed if the plastic bags on the ends of the pipe are not “puffed up”, which indicates a loss of the N2 charge.

5) Pipes, valves and/or fittings which do not comply with the cleaning standards (i.e. which show contamination at specified stages of the cleaning process) must be rejected and removed from the site.

ii. Building Air System

   a. Type L copper above grade, Type K below grade; meeting ANSI 11.1, wrought copper fittings, brazed.

   b. Identify all compressed air piping per general requirements.

E. Valves

   i. Lab Air System

      a. All valves for the oil free air systems shall meet these specifications:

         1) Non-lubricated.

         2) Cleaned for “oxygen usage” at the factory.

         3) Packaged and sealed individually in heavy duty polyethylene bags with a nitrogen charge.

         4) Pressure rated for a minimum of 1.5 times working pressure.

         5) Inspected prior to installation by OSU Authorized Representative via the OSU Project Manager/Construction Manager.

         6) Have an extension at each end (except flanged valves).

   ii. Building Air System

      a. Ball valves shall have a three (3) piece design to permit servicing without cutting the pipeline.

      b. Check valves shall be spring loaded.

      c. Provide ball type shutoff valve and female connection on outlet of valve for connection by user. Verify with the OSU Project Manager exact requirements.

      d. Provide isolation valves at each floor, at each lab, and at each point of use.

2. LAB VACUUM SYSTEM
A. General Requirements
   i. Use direct drive hook and claw dry type unit.
   ii. System to include factory controls for unit staging.
   iii. System shall include an appropriate sized receiver.
   iv. System shall include a liquid trap with isolating valves and drain before the receiver.
   v. All systems to have redundant features to provide continuity of service during maintenance and/or repair.
   vi. Preferred manufacturer: Busch.
   vii. Lab vacuum pump exhaust shall be a minimum of 16 feet above the roof line.

B. Piping
   i. Type L copper above grade; Type K below grade; wrought copper fittings, soldered.
   ii. Use of schedule 80 PVC with solvent welded joints may be allowed in certain cases. Contact the OSU Project Manager for approval.

C. Valves
   i. Ball valves shall have a three (3) piece design to permit servicing without cutting the pipeline.
   ii. Provide a ball type shutoff valve and a threaded female connection on outlet of valve for connection by user. Verify with the OSU Project Manager exact requirements.

3. GAS SYSTEMS

A. General
   i. The quality of the specialty gas systems to be delivered should be suitable for the intended use.
   ii. The OSU Project Manager will provide a list of gasses required on the project and the piping materials to be used.
   iii. If extending an existing system the materials and cleanliness specifications shall match existing system. Only at the directive of the OSU Project Manager should variations from existing systems be made.
   iv. Medical gas system piping shall be designed and installed per NFPA 99.
   v. Install seismic gas shut-off at meter prior to entry into building.
   vi. Nitrogen generators are not allowed.

B. Piping
   i. Where gas systems will be carried in copper piping use the above requirements for lab air systems.
   ii. Where gas systems will be carried in stainless steel piping:
      a. Special cleaning requirements must be followed (see below for detailed description).
b. Acceptable materials for gas systems, unless requested otherwise are:
   
   1) Type 316 stainless steel tubing
   2) Valves
   3) All valves for the cleaned dry air and Nitrogen systems shall be:
      a) Non-lubricated
      b) Pressure rated for a minimum of 1.5 times working pressure
      c) Inspected prior to installation
      d) Have an extension at each end (except flanged valves)

c. Valves
   
   1) Ball valves shall have a swing-out center to permit servicing without cutting the pipe line.

C. Accessories and supports
   
   i. The body material of pipe line accessories and specialty valves, such as pressure regulating valves, flow monitoring devices, etc., must match the material of the piping system, and internal parts shall be compatible with the particular gas.

D. Cleaning of piping
   
   i. The most important single requirement for the gas piping systems is that they are suitable and capable of conveying a gas from the source to use point with no contamination.
      a. Order all pipe material, fittings, etc., to be cleaned by the manufacturer, charged with nitrogen, and sealed at the ends prior to transportation.
      b. Each pipe length and fitting is to be individually inspected on arrival at the job site for integrity of the sealed ends and for physical injury (such as bends or flat spots). Pipes with lost seals or physical damage are to be re-cleaned or rejected.
      c. Acceptable pipes are to be stored in a clean, safe location.
      d. Pipes, valves and/or fittings which do not comply with the cleaning standards (i.e. which show contamination at specified stages of the cleaning process) must be rejected and removed.

4. CHEMICAL SYSTEMS
   
   A. Acid resistant drainage piping, if required after a EH&S and FS hazard assessment, shall be FUSEAL for interior piping, and Duriron for exterior piping.
   B. Duriron exterior piping shall extend to the manhole outside the building.
   C. Chemical drains shall run independently of the building system to a point outside the building before connecting to the building sewer
5. REVERSE OSMOSIS DEIONIZED WATER SYSTEM

A. Consult with the OSU Project Manager and Facilities Services to select the type of reverse-osmosis (RO)/Deionized Water (DI) unit to be used.

B. Distribution piping:
   i. Will be Schedule 80 PVC piping or Polypropylene with no dead ends.
   ii. Will include a continually recirculating system through mixed bed bottles and a UV light.
   iii. Piping will be properly flushed, cleaned, and sanitized before being placed into service.

C. Provide isolation valves at each floor, at each lab, and at each point of use.

D. RO/DI system will be fully integrated and skid mounted.

E. System will include a spill containment tray larger than the skid, with leak detection.

F. System will be located on the ground floor or in a mechanical room with direct elevator access.

G. System will include pre and post filters for carbon bottles and mixed bed bottles.

H. Resistivity meters will be installed after RO elements and after lead and lag mixed bed bottles to measure water quality.

I. System will include isolation valves for all pumps and filters to allow replacement.

J. Differential pressure gauges will be installed across every filter housing.

K. System will include 3-way bypass for mixed bed bottles to allow zero down time during bottle exchange.

L. System will include quick disconnect fittings for carbon and mixed bed bottles to allow easy exchange.

M. RO/DI systems will be capable of producing 15 megaohm resistivity water.

N. Preferred company/supplier: Resys
Division 23: HVAC

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3. WATER SYSTEM REQUIREMENTS
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19. SECTION VALVES
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2. ROTATING EQUIPMENT
3. DUCT SEALING
4. DUCT PRESSURE TESTING
5. DUCTWORK CONFIGURATION
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7. DUCT LAYOUT
8. LABELING
9. VARIABLE AIR VOLUME (VAV) SYSTEMS

Section 23 60 00: Refrigerant Containing Equipment (RCE)
1. GENERAL REQUIREMENTS
2. SUPERVISION AND EXECUTION
Section 23 05 00: Common Work Results for HVAC

1. HEATING AND COOLING LOAD CALCULATIONS

   A. Heating and cooling design loads for the purpose of sizing HVAC systems shall be determined in accordance with one of the procedures described in the latest edition of the ASHRAE Handbook of Fundamentals or equivalent computation procedures. The engineer shall furnish copies of applicable HVAC design calculations for review, along with periodic progress drawings.

   B. Outdoor summer and winter design temperatures used in the building load calculations shall be as follows for the Corvallis campus:

      i. Summer Outdoor Design for Classroom Buildings: 96° F. db and 67° F. wb.
      ii. Summer Outdoor Design for Laboratory Buildings: 100° F. db and 67° F. wb.
      iv. Summer Outdoor Air Cooled Condenser Design ≤ 10 tons 95° F. db, ≥ 10 tons 105° F. db.
      v. Winter Outdoor Design: 17° F, Wind @ 15 mph.

   C. Indoor summer and winter design temperatures shall be guided by the following and verified with the OSU Project Manager (PM) who will confirm with the sustainability office.

      i. Office, classroom, and other non-lab spaces shall be guided by ASHRAE Standard 55 with the following as a starting point:
         a. Summer Indoor Design: 76° F. No humidification.
         b. Winter Design: 68° F. No humidification.
      ii. Lab spaces shall be guided by lab equipment and experiment temperature and humidity requirements, with the following as a starting point:
         a. Summer Indoor Design: 74° F.
         b. Winter Indoor Design: 70° F.
      iii. Summer/Winter Indoor Design for others rooms as directed by the PM.

2. BUILDING ENVELOPE REQUIREMENTS

   A. Design criteria listed below shall be used unless directed otherwise by the PM.

   B. The proposed type of building envelope construction shall be designed using thermal transmittance values (U value), which comply with the State energy Code requirement for thermal design.

   C. To prevent energy waste, all spaces with operable windows must have window-HVAC interlocks to prevent HVAC system operation with windows open.

   D. Equipment Loads

      i. General offices: 0.5 watts per sq.ft.
ii. Classrooms: 0.5 watts per sq.ft. or actual occupant load, with each occupant having a laptop computer, times 50%.

iii. Labs: based on actual equipment load plus 20%.

iv. Cafes, Restaurants, and any rooms with freezers, refrigerators, or other heat generating equipment should have stand alone or separate HVAC equipment and controls.

v. Copy rooms: based on actual equipment load.

vi. Computer rooms: based on actual equipment load plus 20%.

vii. Corridors, walkways lobbies, etc.: None.

viii. MDF rooms: based on actual equipment load.

ix. IDF rooms: based on actual equipment load.

x. The PM will provide equipment loads for specific spaces when applicable.

xi. When no specific data is available, use connected equipment electrical load (FLA) data with a 50% diversity factor.

E. Occupancy Loads


ii. Labs: Base on one person per lab station.

iii. Classrooms: Base on one person per seat.

F. Lighting Loads

i. Minimum lighting loads based on NEC Table 220.12.

ii. When a lighting designer is included as part of the project team base lighting loads on actual room by room lighting loads designed by lighting designer.

G. Minimum Outside Air Requirements

i. Minimum requirements based on latest edition of ASHRAE Standard 62.1 or the Mechanical Code.

H. Noise Criteria

i. Open office space: RC 30-40.


iv. Classrooms maximum: RC 35.


I. Provide for review a list of all pipe and duct systems with a brief justification of insulation and thickness, or no insulation if none is specified.
   i. Include all field insulated equipment on the list.

3. WATER SYSTEM REQUIREMENTS

   A. General
      i. Projects having total cooling requirements exceeding 50 tons of refrigeration should be designed around a central chilled system.
      ii. Hydronic systems design shall ensure that valves, control fittings and piping are of alloys which shall not deteriorate when subjected to the water treatment chemicals and are optimum for the piping and heat exchanger service. Provide a test port on discharge side of all pumps.
      iii. Locate mains and shutoff valves in hallways and corridors not in occupied rooms. Valves to be located within 18 inches of the main.
      iv. Consider routing main lines on the first floor to serve the first and second floors and mains located on the third floor to serve the third and fourth floors of the building.
      v. All hydronic systems shall be flushed of foreign materials, chemically cleaned, flushed, and filled with the proper chemically treated water before being put into service.
         a. Pre-Operational Cleaning of Closed Loop Hydronic Systems
            1) Add 2.5 gallons Chem-Aqua 61502 per 1,000 gallons system volume and 1 gallon Chem-Aqua 32115 per 1,000 gallons of system volume.
            2) Circulate 12-24 hours.
            3) Drain and thoroughly flush system.
         b. Pre-Operational Cleaning of Closed Loop Hydronic Systems
            1) Refill system.
            2) Add 1 gallon Chem-Aqua 32115 per 1,000 gallons system volume.
            3) Circulate 5-7 days.
            4) Drain and flush the system
         c. Pre-Operational Cleaning of Closed Loop Hydronic Systems
            1) Refill system.
            2) Add Chem-Aqua 51999 to obtain a residual value of 800-122 PPM Nitrite with a minimum of 5 PPM Tolytriazol.
      vi. All closed loop water systems will have centrifugal air separator, bladder type expansion tank and make-up water connection connected as close as practical to the suction side of the circulating pump. Water systems should have separate make up water connections or check valves to prevent backflow/crossflow between heating and cooling hydronic systems, no cross connections.
vii. Make-up water supply components will have isolation valves and union connections to allow removal for servicing. The make-up water supply will be connected on the circulating pump suction near the expansion tank connection. The make-up supply will include an isolation valve, a strainer, a water meter, adjustable pressure regulator, safety relief and outlet check valve and isolation valve in that order. A valved by-pass line shall be provided around the make-up water pressure regulator assembly for initial system filling and emergency use. Provide ball valves in lieu of gate valves for sizes 3-1/2” and smaller.

eviii. All closed loop water systems will include a Neptune DBF-5HP Chemical Feeder with isolation valves, bottom drain and inlet filter consisting of two (2) each Aqua Pure H1P748 or equivalent, connected in parallel across the circulating pump to allow continuous online partial flow filtering. Pressure gauges will be installed on each side of the filter housing and include a sampling port.

ix. All automatic vent devices must be provided with a manual isolation valve to allow replacement with system in operation. Devices with internal check valves are not sufficient to allow replacement with system in service.

x. When glycol feed tanks are provided the feed system pressure shall be digitally controlled and alarmed using Advantage controls 1.5 GPM control glycol feed system with a 55 gallon tank. City water to be plumbed to loop for non-automated manual makeup.

xi. Glycol freeze protected systems will contain a minimum of 30% glycol.

xii. All systems requiring glycol for freeze protection should be filled to a 30% glycol concentration using Protherm 720HD, Dowfrost HD or Intercool P-300. Glycol to be dyed red for identification.

xiii. Hydronic Loop Static Pressure Monitor: include at least one static pressure sensor monitoring point in each closed hydronic loop in a building, preferably near the Pressure Reducing Valve (PRV) for the makeup water of that loop. Provide threshold pressure alarm setpoints and include in BMS (alarm) points list specification.

4. WATER SYSTEM LEAKAGE PREVENTION

A. All chilled water coils mounted within ductwork will have internal provisions to collect and drain condensation to prevent condensate transfer and leakage from ductwork.

B. In addition to any internal drain collection features all chilled and hot water HVAC systems will be provided backup leakage prevention measures that will contain any water condensation or leakage from the HVAC coil and prevent system condensation or leakage from migration to lower levels.

C. HVAC unit housings are not permitted to be installed directly to slab or other flooring without a drain pan or waterproof membrane protective shield to collect condensation or leakage and prevent migration.

D. Metal drain pans or berms with durable waterproof membranes will be provided under each AHU housings or coil to collect leakage when the coil or end turns are perforated

E. Metal drain pans or berms will be alarmed to indicate leakage unless safe drainage is also provided.

F. All condensate drains will be directly routed to floor drains. Condensate is not allowed to be pumped to the drain. Condensate drains shall include appropriately sized P traps.

G. Water Leak Detection: At the discretion of OSU Facilities via OSU Project Manager, include monitoring of water presence in areas such as computer/serving rooms, lab spaces, etc. where hydronic (water) piping is present or located above, including floors above in multi-story buildings. A single monitored zone can
include an entire floor as deemed necessary for rapid response to potential flooding. Include in BMS (alarm) points list specification and coordinate connection to Public Safety annunciation system for personnel dispatch.

5. CHILLED WATER SYSTEMS

A. Chilled water system flows and temperatures will vary based upon load, programming, scheduled or seasonal outages.

B. New connections shall not be made to chilled water systems for the purpose of cooling process equipment or condensing units without the approval of the Facilities Services Energy Operations Manager.

C. The primary-secondary pumping system arrangements for variable flow are to be used whenever possible.

D. Multiple chillers are to be connected in parallel on the primary loop with each chiller served by a dedicated primary pump.

E. Primary pump redundancy, if required, shall be provided by cross-connection lines with manual isolation valves and a stand-by pump.

F. Secondary pumping redundancy shall be provided with a stand-by pump.

G. Provide variable flow pumping schemes for secondary chilled water distribution loops.

H. The primary loop piping to each chiller shall be provided with a flow measurement device such as a Venturi meter or Annubar unit, pressure gauges, industrial quality thermometers and thermowells and “Pete’s Plug” test points. Similar instrumentation shall be installed on secondary supply piping circuits.

I. All chilled water coils will be provided duct drip pans internal to the ducting to collect and drain condensation.

J. Design chilled water systems using schedule 40 black steel pipe on larger sizes and type L copper for smaller sizes.

K. Fittings can be either, soldered, welded, flanged, threaded, or Victaulic type connectors depending on the pipe size.

L. Chilled water piping systems
   i. Pressure drop: 4 ft. w.c. per 100 ft.
   ii. Maximum velocity
      a. Mains (equipment rooms): 10 ft. per sec.
      b. Mains and branches (other areas): 5 ft. per sec

M. Chilled water system design temperature
   i. Chilled water: 10 - 20°F. Temperature difference depending on manufacturer.

N. Chilled Beam systems are to be a 4-pipe configuration (if application is being used for Heating and Cooling). Heating water and chilled are never to be mixed as single beams.

6. HEATING WATER SYSTEM

A. Two types of piping and equipment arrangements shall be used.
i. A one heat exchanger system shall have a pair of pumps connected in parallel, each sized for full load and located downstream of the heat exchanger. One pump shall be a spare and they both shall pump into the primary loop.

ii. If two heat exchangers are used, they shall be piped in parallel and connected to a common suction header connecting the pumps.

B. Size single heat exchanger systems for the load. Size multiple heat exchanger systems so that each heat exchanger is sized for 100% of the load.

C. The primary loop piping to each heat exchanger shall be provided with a flow measurement device such as a Venturi meter or Annubar unit, pressure gauges, industrial quality thermometers and thermowells and “Pete’s Plug” test points. Similar instrumentation shall be installed on secondary supply piping circuits.

D. Hot Water System Design

i. Design heating water systems using schedule 40 black steel pipe on larger sizes and type L copper for smaller sizes as approved.

ii. Fittings can be either, soldered, welded, flanged, threaded, or depending on pipe size.

iii. Hot water piping systems

iv. Pressure drop: 4 ft. w.c. per 100 ft.

v. Maximum velocity
   a. Mains (equipment rooms): 10 ft. per second
   b. Mains and branches (other areas): 5 ft. per second

vi. Hot water system design temperature
   a. Heat Exchangers: 40 - 60°F. temperature difference
   b. Main coils: 20°F. temperature difference
   c. Re-heat / fan coils: 10°F. temperature difference
   d. Systems shall be based on heating water temperatures of approximately 125°F to maximize future flexibility for heat pumps, heat recovery chillers and other high efficiency heating sources.

E. Heat recovery coils shall not be used in any exhaust system connected to fume hoods without approval by Facilities through OSU Project Manager.

7. CONDENSER WATER SYSTEM

A. Condenser water systems shall be designed with a pump and cooling tower for each chiller or with multiple (at least two) pumps located to discharge to a common pipe manifold with piping redistributed to each chiller. The designed system shall to minimize life cycle costs to the maximum extent practical while emphasizing energy efficiency.

B. Tower systems designs shall consider the following criteria:

   i. Design temperatures for Outdoor and Condensing Water systems as specified in these standards.
   ii. Water filtration.
iii. Water treatment.

iv. Basin sweep system if appropriate.

v. Open circuit versus closed circuit cooling towers.

vi. Sound and noise with respect to surroundings.

vii. Energy consumption.

viii. Capacity control utilizing variable frequency drives. Consider valves to proportionally control the water flow through a by-pass line to the tower basin when chillers are to be utilized and condenser water temperatures could be below 65 deg. F.

ix. Vibration isolation, including upper limit stops.

x. Location of pumps and piping to ensure flooded suction on the pumps to prevent possible cavitation.

xi. Basin and make-up water heaters.

xii. Fire resistance of the tower components.

xiii. Control of the tower water flow through the chillers as they are cycled on and off.

xiv. Electric heaters or steam coils in the basin, for freeze protection.

xv. Insulate and heat trace exposed cooling tower condenser piping.

xvi. Hose bib at location of tower for cleaning in future.

C. Condenser Water System Design

i. Design condenser water systems using schedule 40 black steel pipe.

ii. Fittings can be either welded, flanged, threaded, or Victaulic type connectors depending on pipe size.

iii. Provide a minimum of 20% extra tower capacity (BTUH, Flow, CFM) for future growth.

iv. Cooling tower piping systems
   a. Pressure drop: 4 ft. w.c. per 100 ft.
   b. Maximum velocity
      1) Mains equipment rooms: 10 ft. per sec.

v. Condenser water design temperatures
   a. Design dry bulb: 97° F.
   b. Design wet bulb: 73° F.
   c. Entering water temperature: 95°F.
   d. Leaving water temperature: 80°F.

8. SNOW AND ICE MELT

A. Use of snow and ice melt products to be confirmed with Facilities via OSU PM/CM.
9. DIRECT EXPANSION REFRIGERANT

A. Systems May Be:
   i. Single package for single zone applications.
   ii. Single package for multi-zone application.
   iii. Split system air-cooled condenser/evaporator for cooling air or water.
   iv. Split system water-cooled condenser/evaporator for cooling air or water.

B. Systems shall be used where the life cycle is cost effective and reviewed on a case by case basis. If the system exceeds 50 tons, air cooled chillers may be considered for single unit with one per air handler for air handlers up to 400 tons. One air cooled chiller for multiple air handlers up to 50 tons each. Obtain approval from Facilities Services via the PM prior to designing the system incorporating such features.

C. Direct Expansion Refrigerant System
   i. Design refrigerant systems using type L copper.
   ii. Fittings to be copper to match piping, and brazed using a nitrogen purge.
   iii. Size is based on manufacturer’s recommendations.

D. Decommissioned refrigerant containing equipment shall display a weather resistant label clearly noting the removal of all hazardous materials, e.g. refrigerant, coolant, used oil, or any other hazardous material removed from unit.

10. LABELING AND IDENTIFICATION

A. Color Coding of Pipe and Duct Labeling
B. Identification of Concealed Valves and Equipment

i. Affix a color coded “dot” to walls or ceilings wherever valves or other equipment are concealed. The colors shall be as follows:

<table>
<thead>
<tr>
<th>Classification</th>
<th>Color of Field</th>
<th>Color of Letters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire Protection</td>
<td>Red</td>
<td></td>
</tr>
<tr>
<td>Domestic/Non Potable CW</td>
<td>Green</td>
<td></td>
</tr>
<tr>
<td>Domestic/Non Potable HW</td>
<td>Yellow</td>
<td></td>
</tr>
<tr>
<td>HVAC Valving &amp; equipment</td>
<td>Yellow</td>
<td></td>
</tr>
<tr>
<td>HVAC Fire, Smoke, or Combination Fire/smoke dampers</td>
<td>Yellow</td>
<td></td>
</tr>
<tr>
<td>Plumbing Cleanouts</td>
<td>Black</td>
<td></td>
</tr>
<tr>
<td>Lab piping</td>
<td>Purple</td>
<td></td>
</tr>
</tbody>
</table>

C. Identification of Equipment, Pipes, and Ducts

i. All plumbing, heating, air conditioning, piping, automatic temperature control equipment (excluding thermostats and relays), and distribution systems shall be labeled. Electrical switches and starters for mechanical equipment shall also be labeled.

ii. Equipment labels shall be black face plastic laminate with white engraved letters 3/16-inch high or larger, and shall be attached securely. Larger equipment should be engraved letters ¾-inch high or larger.

iii. Equipment nameplates shall include the following information at a minimum:

b. Capacity specified at designed operating conditions.

c. Actual capacity as balanced at site operating conditions.

d. Area or zone served.

e. All new installations of evaporator coil housing and condenser units shall have tags that states who installed the unit, a warranty contact phone number and warranty date, start to finish.

11. PIPING

A. All valves within the building, regardless of size and location, shall have brass or stainless steel tags at least 1" by 3" or two inch diameter in size and 0.051 inches thick. Lettering on the tag shall be engraved or stamped at least 3/16 inch high and match the valve numbers shown on the plans.

B. Valve tags shall be connected to valve stems by steel rings and include the following minimum information:

   i. Plan Identification
   
   ii. Normal Position
   
   iii. Duty
   
   iv. Area Served
   
   v. Valve Type

C. Heating Water Valves, Steam Valves, and all Valves located in the secondary (low pressure) side of HTW Heat Exchangers shall include the Manufacturer, Size, Grade, and Pressure-Temperature service rating.

D. Valve Tag Directory: Include tag number, location, exposed or concealed, service, valve size, valve manufacturer, valve model number, tag material, and normal operating position of valve. Include valve tag directory in the Operation and Maintenance Manuals and framed under glass on wall of mechanical room.

E. All piping systems shall be properly identified with labels and signs indicating direction of flow and fluid. Identification shall be specified to have identification as outlined in the ASME (ANSI) Standard and current NFPA requirements. Provide a list of each system being installed with the appropriate name and label colors in the specifications.

F. Comply with OSPSC Section 1003(r) regarding identification of non-potable piping systems.

G. All accessible piping shall be color coded and identified with wording and arrows every 20 feet on straight runs, at each riser, at each junction, at each access door, adjacent to all valves and, flanges, on both sides of floor and wall penetrations and where required to easily identify the medium transported.

H. Provide a trace wire for locating and identifying underground piping systems in the future.

I. Provide marker tape one foot above the top of underground piping over the entire length of the pipe.

12. AIR SYSTEM REQUIREMENTS

A. General

   i. This section’s purpose is to establish standards of quality and utility for the mechanical components. The engineer’s task is to utilize equipment that provides the best value and lowest lifecycle cost while conforming to these standards.
ii. The quality of items not covered in these standards shall be of the same general level and be subject to the same tests of value as those that are included.

iii. Select items made by established manufacturers who have demonstrated the capability to provide replacement parts and service as may be required. The quality of the manufacturer’s local representation is very important.

iv. Analyze manufacturers’ designs for inherent maintenance qualities, as well as adequate access doors, fasteners, and other accessories, which will facilitate maintenance.

13. EQUIPMENT ACCESS AND LOCATION

A. Ease of operation, maintenance and repair, and safety of personnel are primary considerations for the design and installation of all items. Design for a minimum of 4 feet of clearance all around major items such as boilers, chillers, pumps, air handlers and fans unless the manufacturer’s recommendations or code requirements are greater.

B. No equipment shall be installed in locations that will prevent future removal without major disruptions to the building or its contents. All equipment selected shall be designed for and provided with access doors and other accessories to address the requirements of this section. Connecting systems such as ductwork, piping, and electrical conduit shall be located so they do not obstruct access to the equipment service points.

C. Provisions shall be made to allow easy access for hoisting heavy or cumbersome equipment onto elevated mechanical spaces.

D. Critical wear components such as bearings, fan shafts, couplings, and belts shall be easily replaceable. Frequent service items shall be convenient; for example, easy access to filters and extended lubrication fitting.

E. Equipment shall be designed so access doors, panels, guards, and similar items can be removed and replaced without special tools, so they are sturdy enough not to sustain damage under normal use and care.

F. Provisions shall be made to provide a penthouse enclosure for rooftop equipment, when deemed suitable by the OSU Project Manager.

14. SOUND AND VIBRATION

A. Consider all appropriate sources of concern including radiated energy, energy transmitted through connecting items such as supports and electrical conduit, and energy transmitted through ducts, pipes and the fluids carried in them.

B. Select equipment and specify isolators and attenuators to eliminate undesirable sound and vibration levels. Obtain approval for the design criteria from the OSU Project Manager. If the design criteria is not established by an acoustical consultant use the following specifications:

i. Vibration: Eliminate vibration which will be detrimental to the structure, its contents, or the activities taking place within the structure, or which would be annoying to the occupants.

ii. Sound: The operating systems should conform to the recommendations listed in the latest edition of the ASHRAE Handbook.

iii. Documentation: Provide documentation, for all office, conference room, classrooms, labs, and mechanical equipment areas showing actual sound levels at the project’s close-out.
15. SEISMIC REQUIREMENTS
   A. HVAC systems, equipment, and parts shall meet or exceed current applicable requirements for seismic resistance specified by codes, regulations, or agencies having jurisdiction.

16. VARIABLE SPEED/FREQUENCY DRIVES
   A. Drives and motors shall be specified to be provided by the same vendor to provide single source responsibility.
   B. Shaft to frame voltage difference shall be specified to be 3 volts or less to reduce the potential of bearing pitting to a minimum.
   C. Shaft grounding or bearing isolation shall be provided as directed from the OSU Project Manager.
   D. See Electrical: Section 26 00 00 for additional requirements.

17. BELT DRIVES
   A. Specify multi-belt, adjustable speed drives rated at 150 percent of motor horsepower for constant speed motors which are 15 horsepower and smaller.
   B. Specify fixed pitch drives rated at 150 percent of motor horsepower for constant speed motors larger than 15 horsepower.
   C. Adjustable pitch drives shall operate at or near the midpoint range of adjustment when the equipment is balanced to the specified performance.
   D. Belt drives shall have fully enclosed guards. Outdoor guards shall be of solid metal construction; indoor guards shall be of expanded metal set in angle iron frames. Guards shall be constructed in two pieces to allow for belt and sheave adjustment without disturbing the guard supports. Specify 4" diameter tachometer holes with pivoted cover plates at each shaft. Guards shall comply with applicable codes.

18. ELECTRIC MOTORS
   A. Electric motors shall have sufficient starting torque to start and drive the equipment load to which they are connected. Motors shall be of the premium-efficiency type conforming to the latest State Energy Code requirements.
   B. Provide insulated motor bearings or shaft grounding on motors connected to variable frequency drives.
   C. Motor enclosures shall be:
      i. Drip-proof for general use.
      ii. Totally enclosed, fan-cooled (TEFC) for wet or exterior use.
      iii. Totally enclosed, air over (TEAO) for cooling towers.
   D. Motor voltages shall be:
      i. 1/2 HP or less: 120V, 1 phase.
      ii. ¾ HP or greater: 460V, 3 phase.
   E. See Electrical Section 26 00 00 for additional requirements.
19. BEARINGS
   A. Bearings shall be selected for 400,000 hours or better or L-10 life expectancy.

20. WEATHER PROTECTION
   A. Products installed exposed to the weather, moisture, or other potentially damaging conditions shall have their joints effectively sealed to prevent intrusion of moisture or other unwanted substances. Consider the use of heater in control panels and other items that could experience internal condensation. Tops of cabinets and equipment enclosures shall be designed to prevent puddling of liquids.

21. EQUIPMENT SELECTIONS
   A. Select the type of equipment best suited for the specified project requirements considering performance, flexibility, noise and vibration level, quality of construction, cost of ownership, and energy consumption.

22. UNIVERSITY PREFERRED HVAC EQUIPMENT WITH STOCKED PARTS

<table>
<thead>
<tr>
<th>Air Compressors</th>
<th>Quincy</th>
<th>PRV’s</th>
<th>Spence - Type ED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bearings</td>
<td>Fafnir</td>
<td>R.O.s</td>
<td>Culligan</td>
</tr>
<tr>
<td>BFP</td>
<td>Febco</td>
<td>Radiator Thermostat Valve Controls</td>
<td>Danfoss, Tunstall</td>
</tr>
<tr>
<td>Condensate Pumps, Tanks, Pressure Power Pumps</td>
<td>Paco, Spirax-Sarco, Sterling</td>
<td>Refrigeration Compressors</td>
<td>Copeland</td>
</tr>
<tr>
<td>Couplings</td>
<td>Lovejoy</td>
<td>Utility Set and Skycap Fans</td>
<td>Pace</td>
</tr>
<tr>
<td>Motors, Pumps</td>
<td>industrial Grade</td>
<td>Comp. Air Filters</td>
<td>Finite Filters</td>
</tr>
</tbody>
</table>

23. MEDIA ACCESS CONTROL ADDRESS
   A. Specify that the media access control (MAC) Address (Hardware address that uniquely identified the device node) for equipment (chillers, boilers, VFD’s etc.) that needs an Ethernet connection, is clearly written on the inside of the equipment control panel at the time the equipment ships from the factory.

24. AIR AND WATER BALANCING
   A. Systems testing, adjusting, and balancing is the process of checking and adjusting all the building environmental systems to produce the design objectives. It includes:
      i. The balance of air distribution
      ii. Adjustment of system to provide design quantities
      iii. Electrical measurement
      iv. Verification of performance of all equipment and automatic controls
      v. Air Balancers must be registered engineers in the State of Oregon and have at least 3 years of testing, adjusting, and balancing experience similar to that required for OSU’s project. The Balancing contractor and project supervisor shall be NEBB or AABC Certified.
vi. NEBB: National Environmental Balancing Bureau

vii. AABC: Associated Air Balance Council

viii. Mark equipment settings, including damper control positions, valve indicators, fan speed control levers, and similar controls and devices, to show their final settings. Mark with paint or other suitable, permanent identification materials.

25. PIPING MATERIALS

A. Note 1: Steel grooved and fittings allowed on heating water systems in exposed areas only. Maximum of 180 degree F. water temperature.

<table>
<thead>
<tr>
<th>Chilled Water</th>
<th>Heating Water</th>
<th>Condenser Water</th>
<th>Steam</th>
<th>Condensate</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td>ASTM A53 Schedule 40 black steel with ANSI B16.1 maleable iron fittings; ANSI B16.9 steel bevelweld fittings.</td>
</tr>
<tr>
<td>X</td>
<td>Certain locations; See note 1</td>
<td>X</td>
<td></td>
<td></td>
<td>Steel grooved end fittings; Victaulic or Guston-Bacon full flow using victaulic 07 or Guston-Bacon #105 gasket for 500 psi service.</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td>ASTM B88 Type L copper above ground with ANSI B16.22 wrought copper fittings with 95%-5% tin-antimony solder joints.</td>
</tr>
</tbody>
</table>

X See Section 23 22 16.

26. MANUFACTURERS

A. Piping Air

<table>
<thead>
<tr>
<th>Chilled Water</th>
<th>Heating Water</th>
<th>Steam</th>
<th>Item</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Control Valves</td>
<td>Honeywell, Johnson, or Belimo</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Thermostatic Control Valves and Stats</td>
<td>Danfoss, Turnstall</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td></td>
<td>Trap</td>
<td>Armstrong 800, Turnstall</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td></td>
<td>Trap (floats &amp; thermostats)</td>
<td>Hoffman</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Rising stem valves</td>
<td>Stockham/Grinnell</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Valves, ball</td>
<td>Apollo</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Valves, brass ball</td>
<td>Gem</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Valves, gate</td>
<td>Nibco, RP&amp;C</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Valves, pressure</td>
<td>Watts</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Valves, rising stem valve</td>
<td>Stockham/Grinnell</td>
</tr>
</tbody>
</table>
B. Air Handling Equipment
   i. Fans - general: Barry Blower, Twin City, Greenheck, Peerless, Cook.
   ii. Fans – Fume Hoods: Plasticare
   iii. Central Station Air Handling Units: Hunt Air, LogicAir, Haakon.
   iv. Package Rooftop Air Handlers: Carrier, Trane, Daikin, York, AAon.
   v. Other manufacturers approved by Facilities through OSU Project Manager.
C. Chilled Water Equipment
   i. Chillers: Carrier, Daikin, and Trane.
   ii. Pumps: Bell & Gossett, TACO, PACO, and Grundfoss.
   iii. Inline pumps Bell & Gossett Series 60 or 80.
   iv. Other manufacturers approved by Facilities through OSU Project Manager.
D. Heat Recovery Chillers
   i. Require ease of service access on modular units.
   ii. Manufacturers to be approved by Facilities through OSU Project Manager.
E. Cooling tower: Baltimore Air Coil, Evapco. Provide a sewer deduction meter for cooling tower make-up water.
   Meter specifications found in Section 33 09 00 – Instrumentation and Control for Utilities.
F. Heating Water Equipment
   i. Steam to hot water heat exchangers: Taco, Bell & Gossett, Hubbell
   ii. Domestic and Industrial Steam to Hot Water heat Exchangers: Hubbell, Patterson-Kelley
   iii. Direct buried steam and condensate piping: to be approved by Facilities Services. See Division 33 63 13.
   iv. Condensate Pumps: Steam Powered Condensate Return Pumps (Liquid Mover) are preferred if steam is available. See 23 22 16 for details on Condensate Return Pumps.
   v. Water Treatment: Chem Aqua.
   vi. Steam meter information is found in section 33 09 00 – Instrumentation and Control for Utilities.

27. FUEL BURNING EQUIPMENT – PARTICULATE EMISSIONS
A. Particulate matter emissions from any fuel burning equipment installed, constructed, or modified after June 1, 1970 must not exceed 0.1 grains per standard cubic foot, corrected to 12% CO2 or 50% excess air. *Fuel Burning Equipment* means a device that burns a solid, liquid, or gaseous fuel, the principal purpose of which is to produce heat or power by indirect heat transfer. Particulate emissions for backup emergency generators is < 0.1 grain/ft3 (for new sources) or < 0.2 grains/ft3 (for existing sources).
Section 23 07 00: HVAC Insulation

1. REQUIREMENTS
   A. Provide for review a list of all pipe and duct systems with a brief justification of insulation and thickness, or of no insulation if none is specified.
   B. Include all field insulated equipment on the list.
   C. As a minimum, insulation thickness to meet the requirements of the State Energy Code.

2. MATERIALS
   A. The insulation and jacketing shall be resistant to moisture and mold and shall be resistant to damage or deterioration under the service intended. Materials shall meet the smoke and flame spread ratings required by the governing codes.
   B. Closed cell plastic insulation is preferred on refrigerant piping and cold equipment.

3. EXPOSURE
   A. Surfaces, which will operate within 10 degrees F. of the ambient dew point, shall have a vapor barrier over the insulation.
   B. Surfaces better than 90 degrees F. shall be insulated as required to protect personnel and/or conserve energy.
   C. Insulation exposed to weather or to physical damage shall have suitable protection.
   D. Aluminum jackets secured with aluminum bands on 12” centers with longitudinal seams lapped and turned down shall be installed on all piping exposed to weather. Provide similar protection at all valves, fittings, and flanges.

4. SERVICE
   A. Insulation shall be installed such that service and maintenance points such as valve handles, access doors, pressure and temperature fittings, lubrication fittings, and strainers remain accessible without disturbing the insulation.
   B. Vapor barrier jackets shall be sealed at locations to prevent the intrusion of moisture.

5. PIPING
   A. Use factory made PVC covers at fittings, flanges, and all other irregular shapes for which they are available.
   B. Specify structurally rigid insulation sections at all hangers and supports to prevent damage to the insulation and jackets.
   C. Size hangers and supports to go outside the insulation.
   D. Provide steam traps 1” and over with snap on insulation.

6. DUCTWORK
   A. Provide a vapor seal design at strap or rod hangers and a thermal conduction barrier at trapeze hangers and supports.
B. Require extra erosion protection at the upstream edge of duct lining sections such as a sheet metal flashing.

C. Internally lined ductwork
   i. Internally lined ductwork shall be avoided, except when used for sound attenuation or when used in areas where external insulation is subject to damage (such as mechanical rooms).
   ii. Where internal insulation is used provide Mylar facing to allow cleaning.
   iii. Provide perforated liner over internal insulation inside mechanical units.

D. Access will be provided at elbows, turning vanes, and locations where debris collects.

E. Other sound isolation is anticipated when the insulation is external.

F. Use a maximum of six feet of flexible ductwork on diffuser and grille run outs.

7. EQUIPMENT
   A. Coordinate insulation and equipment specifications to be sure that the required insulation is field applied if equipment is not factory insulated.
   B. Equipment such as chilled water pumps or heat exchangers which must be completely insulated shall be provided with boxed insulation which is designed and marked so it can be removed and replaced without destroying the utility and appearance, except for repairs needed on the jacket.
   C. Chilled equipment insulation must not have voids, pockets, or air space that can allow condensation to form.
Section 23 09 00: Instrumentation and Control for HVAC

1. REQUIREMENTS

A. Design

i. Throughout this section, manufacturers/installers are referred to as the “Contractor”.

ii. Currently approved manufacturers/installers:

a. Siemens Building Technologies Inc.

b. Alerton

c. Automated Logic Corp. (ALC)

d. Other manufacturers may be added to the approved vendor list by demonstrating compliance with BACnet Protocol Implementation Conformance (PIC) and BACnet Testing Lab Listing (BTL). The demonstration must occur prior to the schematic design portion of the project.

iii. The Building Automation Systems (BAS) shall be a distributed digital network (DDC) and compatible with existing Oregon State University (OSU, hereafter) Campus network devices. Full compatibility is defined as a seamless ability to operate on the segment(s) of the network provided and defined by OSU without causing any adverse reactions or significant reduction in communication integrity of other device sharing the OSU network.

iv. BACnet device instances are unique addresses defined in the BACnet standard. It is imperative that contractors do not assign duplicate instances on the same BACnet network. For this reason, OSU instance numbering guideline is defined and must be adhered to by all the Contractors:

<table>
<thead>
<tr>
<th>OSU BACnet Device Instance Selection Guideline: by Building</th>
</tr>
</thead>
<tbody>
<tr>
<td>xxx000 to xxx999</td>
</tr>
<tr>
<td>xx000</td>
</tr>
<tr>
<td>xxx001 ~ xxx010</td>
</tr>
<tr>
<td>xxx011 ~ xxx099</td>
</tr>
<tr>
<td>xxx100 ~ xxx999</td>
</tr>
</tbody>
</table>

Note: with the increasing use of Ethernet for communication of terminal equipment, the “BACnet/IP” instance numbers can extend in the “MSTP” device instance range.

v. Installation of systems are to be performed by the most-local branch office or dealer and/or their approved installation vendor.

B. Documentation: in addition to print media, provide electronic print files (PDF preferred) of entire control submittal as outlined below in a non-volatile memory format:

i. Provide all control submittals including specification Sections:
a. 23 10 00 – BUILDING AUTOMATION SYSTEMS

b. 23 09 30 FIELD INSTALLED COMPONENTS

c. 23 09 50 through 23 09 53 – AUTOMATIC CONTROLS SEQUENCE OF OPERATIONS.

ii. Submittals prior to starting work: Submittal requirements are per OSU Division 1 Specifications, the Contract Documents, and the Construction Contract.

iii. Each submitted piece of literature and drawings shall clearly reference the pertinent specification or drawing.

iv. Hardware: Provide a complete bill of materials (BOM) of building automation control system hardware indicating quantity, manufacturer, model number, and technical data. Technical data shall include performance curves, product specifications sheets, and installation/maintenance instructions.

v. Network Communication Diagrams: Provide schematic diagram showing all BAS panels, communications cabling, and termination points. Identify power requirements and power source for each BAS panel. Identify equipment each BAS panel is controlling. Show termination numbers.

vi. Provide floor plans indicating locations of all BAS hardware.

vii. Provide source programming files and a printed programming manual for each BAS controller furnished in its latest revision (electronic PDF format is preferred over hardcopy print media).

viii. Controlled Systems: Provide an instrumentation list for each controlled system including all controlled system elements in table format. Tables to show element name, type of device, manufacturer, model number, and product data sheet number.

ix. Provide a schematic diagram of each controlled system. Include control points labeled with appropriate point names. Graphically show the location of all control elements.

x. Provide a schematic wiring diagram for each controlled system. Label all elements. Label all terminals.

xi. Provide a mounting, wiring, and routing plan-view drawing. Layout to account for HVAC, electrical, and other system design and layout requirements.

xii. Provide a complete description of the function of each controlled system including sequence of operation.

xiii. Provide a points list for each system controller including both input and output (I/O) points. Note point designations, point function, controlled device associated with the I/O point, location of the I/O device, and point alarm requirements.

xiv. Project record drawings will be as-built versions of the shop drawings, including color installation layout floor plans with the installers’ hand drawn notes (scanned in color PDF format is preferred).

xv. For each control panel layout, one print copy shall be included and mounted in a protective plastic sleeve inside each panel.

2. BUILDING AUTOMATION SERVER AND OPERATING SYSTEM

A. Each of the existing approved control systems has a primary virtual server accessible by OSU Facilities System Administrator and Staff. These are the primary servers for each of the different control systems on campus. Each system is configured to perform all the data gathering and processing functions,
communication with peripherals, and application packages. The control program provides for all operational needs, without requiring any program changes.

B. Each new building shall come with additional user licensing, as required by the system. Licensing will allow for remote monitoring and manipulating of all of the controls in the building and be able to access the systems in other buildings. Front-end graphics and user interface is to be a web based system, preferably in HTML5 format.

C. Contractor shall provide all communication media, connectors, repeaters, hubs, and routers necessary for sub-campus network communications. IP “dumb” Ethernet switches are not permitted on the OSU Campus network. Dedicated drops must be requested and installed by OSU staff to each control panel.

D. The Contractor shall provide all necessary field tools, software applications, testing cables and equipment necessary to interface control devices to make configuration changes in the field, such as programming, database manipulation, IP addresses and BACnet settings.

3. BUILDING CONTROL SYSTEM

A. The building control system shall operate under the control of one or more microprocessors/microcomputers with peripheral hardware and software configured to perform the following functions.

B. The system shall be a modular family of programs, peripherals, and application packages designed specifically for building management, including energy management, HVAC control and monitoring, and controlled access. The system shall be capable of interfacing with the existing primary virtual server shall allow for future expansion of both input/output points and processing/control functions and operating stations. Specifically, it shall be easy to add components, including memory, peripherals, field devices, and software, to the system to expand the size of the scope of automation.

i. Provide a minimum of ten percent (10%) spare point capacity of each type and functionality (e.g. HOA) of point (input/output/universal) at each control cabinet and point expansion location.

ii. Each input and output point will be dedicated to functionality of a single end device or switched input. Multiplexing points is not permitted, except for special controller interoperability as noted below.

C. All materials and equipment used shall be standard components, regularly manufactured for this system and shall not be custom designed especially for this project. All systems and components shall have been thoroughly tested and proven in actual use.

D. The BAS shall include full support for its compatibility with the system. In addition, the BAS shall use the latest product line offered by the BAS manufacturer.

4. REMOTE INPUT/OUTPUT DEVICES

A. Sensors included as part of this system shall meet the following installation requirements. Note: Intended use of room may require tighter controls.

B. Accuracy

i. Temperature:

   a. Space: +/- 0.75°F accuracy.
   b. Outside Air: +/- 1.0°F accuracy.
c. Ducted Air: +/- 1.0°F accuracy.
d. Chilled Water: +/- 0.75°F accuracy.
e. Heating Water: +/- 2°F accuracy.

ii. Relative humidity: five percent (5%) of full-scale accuracy.

iii. Energy: kWh and kW demand range suitable for site, one percent (1%) of full-scale accuracy.

iv. Pressure: range suitable for application, two percent (2%) of full scale accuracy.

v. Pressure switches: adjustable settings, two percent (2%) of full scale accuracy.

vi. Water Flow: five percent (5%) of full-scale accuracy.

vii. Carbon Dioxide: +/- 50ppm

C. Each new or retrofit building must have at least one dry bulb Outside Air Temperature sensor. Sensors located outdoors shall have suitable weather shields to provide protection from wind, rain, solar effects and radiation from nearby buildings.

D. Water temperature sensors shall be immersion-type. All transducers shall be industrial-grade quality.

E. All equipment will be provided with local manual overrides Hand-Off-Auto (H.O.A.) control and shall remain able to be manually overridden (Hand or Off position), but shall be set in the automatic position after all acceptance testing is approved. Provide labelled, accessible, and visible HOA in control panel at each air handling unit, exhaust fan, or pump start/stop function except where an MCC HOA is provided. Override(s) should be obvious of their current command state.

F. All controlled relays shall have LED indicator of active status.

5. SOFTWARE: GENERAL

A. The system shall be a user-programmable direct digital control system, utilizing P.I.D. (proportional-integral-derivative) algorithms for the control of all modulating equipment.

i. P.I. (D-derivative removed) is an acceptable alternative means of modulating control.

ii. All PI (or PID) tuning parameters must be made available to OSU Building Control personnel for future operator adjustment (tuning) after project completion. If “Adaptive”, “Auto”, or “Self” type tuning sequences are used, these sequences must be selectable (enable/disable) by OSU operators via the graphical controls interface. This applies to all custom programmed central plant type equipment controls. Terminal units may be excluded.

B. The system shall support multiple users performing multiple tasks. System changes (add points, modify programs, etc.) shall be able to be performed while the system is on-line. Alarms shall be able to be printed while system changes are being made.

C. The software shall include diagnostics to isolate component failures and verify system operation.

D. User interface graphics and programming tools are to match the most current version on the system’s primary virtual server. If the graphics and programming tools are a version that is no longer supported, the contractor is responsible for updating the system’s primary virtual server, existing graphics, and programming tools to the latest version.
6. OPERATOR INTERFACE AND ACCESS

A. Graphical Software: Graphics are to be a web based system compatible with commercially available web browsers. HTML5 based systems are preferred.

B. The software shall provide, as a minimum, the following functionality:
   i. Graphical viewing and control of environment.
   ii. Scheduling and override of building operations.
   iii. Collection and analysis of historical data.
   iv. Definition and construction of dynamic color graphics.
   v. Editing, programming, storage and downloading of controller database.

C. Provide functionality to allow for any analog or digital point value or status to be displayed as an individual dynamic display window for use as a convenient control and diagnostic tool. The display window shall include the following information as a minimum:
   i. Point name.
   ii. Point description.
   iii. Set point.
   iv. Current value.
   v. Range of values.
   vi. High and low limit set points.
   vii. BACnet priority array and override status.

D. All values shall be displayed in both text and symbolic form, such as an analog bar, gauge or other standard measurement device or ON/ACTIVE, OFF/INACTIVE status and graphic indicator.

E. Provide the capability to control any point from a dynamic graphic display.

F. Provide a graphical spreadsheet-type format for simplification of time-of-day scheduling and overrides of building operations. Provide the following spreadsheet graphic types as a minimum:
   i. Weekly schedules shall be provided for each building zone or piece of equipment with a specific occupancy schedule.
   ii. Zone schedules shall be provided for each building zone as previously described.
   iii. Monthly calendars for a 24-month period shall be provided to allow for simplified scheduling of holidays and special days in advance. Holidays and special days shall be user-selected with the pointing device and shall automatically reschedule equipment operation as previously defined on the weekly schedules.

G. Provide trending capabilities that allow the user to easily monitor and preserve records of system activity over an extended period of time. Any system point may be trended automatically at time-based intervals or changes of value, both of which shall be user-definable. Trend data may be stored on hard disk for future diagnostics and reporting.
i. Trend data report graphics shall be provided to allow the user to view all trend point data. Provide functionality to allow any trended data to be transferred easily to an off-the-shelf spreadsheet package such as Microsoft Excel.

ii. A collection schedule function shall be provided to automatically collect trend data without impacting performance of the system.

iii. Setup individual trending logs that record usage data every fifteen (15) minutes for the building electrical, steam, natural gas, condensate, domestic water, chilled and heating water flow, inlet and outlet temperatures and BTU. See Section 33 09 00 for metering requirements.

iv. Provide additional functionality that allows the user to view trended data on trend graph displays: Displays shall be actual plots of both static and real-time dynamic point data.

H. A full screen, forms based point editor and programming function shall allow for point additions, deletions, changes, program modification and creation and point and program storage. This program shall be similar to a word-processing format such that full documentation of program changes may be available. This program shall provide the user with the capability to insert full English narratives to describe the control program. Search, insert, find, cut and paste functions shall allow for quick program modifications.

I. Provide a general purpose editable graphics package which shall allow the user to quickly and easily define or construct color graphic displays.

J. Provide context-sensitive help menus to provide instruction appropriate with the operation and applications currently being performed.

K. Multiple user security levels shall be provided to allow for various degrees of system access and control.

L. The user interface shall be provided with a key element display that records individual user activity such as logons, logoffs, TOD overrides, point overrides, alarms and alarm acknowledgments.

M. Key element reports may be filtered by operator name and may be run for a user-defined time interval.

N. System shall display up to 3 graphic screens at once for comparison and monitoring of system status.

O. Provide a method for operator to easily move between graphic displays (navigation).

P. Graphics Library. Furnish a complete library of standard HVAC equipment graphics including chillers, boilers, air handlers, terminal units, fan coils, unit ventilators, etc. Library to also include standard symbols for other equipment including fans, pumps, coils, valves, piping, dampers, and ductwork. Library provided in file format directly compatible with graphics package.

7. GRAPHICAL INTERFACE

A. Provide a graphics oriented user interface software. Updates to graphics for existing buildings are required for all projects that change HVAC systems (other than like-for-like change outs) or the zones those systems serve. Examples of this type of change includes, but not limited to, adding or removing walls, relocating or adding space temperature (or other) sensors, and changed in ducting distribution, etc.

B. Prior to commencing control work on all new projects (including new buildings, renovations, and additions), the contractor will provide hierarchy of graphics and displays showing intended color scheme, animations, navigation buttons and graphical links, allowing OSU FS personnel ample opportunity to review, comment and contractor to revise prior to final turnover.
C. All graphics should be intuitive to navigate, monitor, operate, and shall accurately depict building HVAC systems and floorplans. Graphical pages need to include:

i. Top navigation level page with links to all equipment and systems (summary pages). Also include “summary” of “any” alarm point for each system on the top page for easy identification and troubleshooting.

ii. Summary pages include multiple building systems and show fan and/or pump statuses, damper & valve positions, heating & cooling statuses, control temperatures, color indicators showing summary thermal, override, and alarm/fault statuses in a tabular format.

iii. System graphic. Each unique system will have its own graphic with labels and live data clearly showing temperatures, pressures, set points, thermal, alarm, and status animations. Zone level graphics shall have a custom graphic that shows all HVAC equipment influencing zone airflow, temperature, pressure and humidity control.

iv. Setup and configuration pages. These have detail settings of each system allowing configuration and operation based on the engineered specifications. These shall be categorized based on sections in the specification sequence of operations. Security levels shall lock out access to these critical pages from unauthorized personnel.

v. Manual overrides: access and visible status of overridden points shall be clearly displayed on main and separate manual override pages.

vi. Polling information from terminal units associated with a central plant (AHU, chiller, boiler, etc.) used for resetting control parameters shall be accessible and intuitive in how the information affects the main system.

vii. Balancer (TAB) system access: accommodation for TAB contractor to adjust flow multipliers and set points.

viii. Floorplan graphics shall show zone temperatures, humidity, and CO2 (where applicable) locating the relative location of the sensor(s) for each zone to the overall floor layout. Each zone will be labeled with its room number and unit designation - and regardless of scale of the project, shall be updated to accurately reflect floorplan and HVAC equipment changes resulting from the project. Color-code separate areas on the floorplan showing boundaries the central plant equipment servers.

ix. Duct static pressure sensors, building pressure sensors, outdoor air and humidity sensors, and other building level sensors should be accurately shown on floorplan graphics to indicate their location if they need to be serviced by facility staff.

x. Terminal and zone units associated to central plant equipment shall be grouped as such on summary pages to easily delineate without operator referring to mechanical drawings.

xi. DDC alarm points should be red color and easily identified at-a-glance.

xii. Panel locations to be shown on control systems graphics pages.

8. SUMMARIES AND LOGS

A. The system shall be provided with a log function. This function shall provide the system operator with a means of requesting a single point, all points in a given system, or all points in the building.

B. The system shall have the capability of generating the following reports as a minimum:
i. Program Summary: Upon operator request, the system shall output a programmed start/stop, time summary. This summary shall contain all points, their associated programmed start/stop times and the respective days of week.

ii. Limit Summary: An Analog Limit and Differential Summary shall be provided that details the high and low limits and limit differentials for all analog points, or all analog points within a unique building system.

iii. System Log: A System Log shall be provided which contains the point status of all points specified by operator input.

iv. Trend Logs: Trend Logs shall provide a means of producing a hard copy printout of points selected by the operator on a periodic time basis to form a trend log. The operator shall have the ability to add or delete points and select the reporting time interval.

v. Alarm Summary: Upon operator request, an Alarm Summary report shall be printed and contain alarms for a user specified period, any previous open alarms and acknowledgement of alarms.

vi. Override Summary: Upon operator request, an Override Summary report shall be printed and contain point and equipment overrides for a user specified period.

9. ENERGY CONSERVATION APPLICATION PROGRAMS

A. Scheduled Start/Stop: The scheduled start/stop program consists of starting and stopping equipment based on the time of day and day of week.

B. Optimized Start/Stop: The scheduled start/stop program described is defined by automatically adjusting the equipment start time in accordance with building thermal mass, space temperature and outside air temperature. In the scheduled start/stop program, the HVAC system is restarted prior to occupancy to cool down or heat up the space on a fixed schedule independent of outside air and space conditions.

C. Building Warmup/Cooldown: Building Warmup mode shall operate with 100% return air. Building Cooldown shall utilize airside economizing if outside air conditions are optimal, otherwise mechanical cooling shall operate with 100% return air.

D. Night Purge: A night purge mode is required when it is part of the mechanical design. It shall operate with 100% outside air and no mechanical cooling.

E. Economizer Control: Where applicable, air handlers use outside air to reduce the building’s cooling requirements when the dry bulb temperature of the outside air is less than that of the return air. When this condition exists, the economizer control is used as the first stage of cooling prior to enabling mechanical cooling. Note: for our climate, enthalpy control is not typically needed or desired. If this is a requirement of the Energy Code, then we should have a switchover point that, if RH sensor fails, we can switch to Dry Bulb control until repaired.

F. Chilled Water Reset: The chilled water temperature shall be reset based on downstream equipment that uses heating water. The program will poll downstream equipment heating demands and reset the hot water temperature down when one or more (adjustable) heating demands are below 80% (adjustable) and reset up when one or more (adjustable) heating demands are above 95% (adjustable). The user interface shall allow downstream equipment to be included or excluded in the polling.

G. Heating Water Reset: The heating water temperature shall be reset based on downstream equipment that uses heating water. The program will poll downstream equipment heating demands and reset the hot water
temperature down when one or more (adjustable) heating demands are below 80% (adjustable) and reset up when one or more (adjustable) heating demands are above 95% (adjustable). The user interface shall allow downstream equipment to be included or excluded in the polling.

H. Supply Air Reset: For air handler, the supply air temperature will reset based on downstream terminal unit cooling needs. The program will poll terminal unit cooling demands and reset the supply air temperature up when one or more (adjustable) cooling demands are below 80% (adjustable) and reset up when one more (adjustable) cooling demands are above 95% (adjustable). The user interface shall allow terminal units to be included or excluded in the polling.

   i. When humidity control is required, the program shall prevent the cooling coil discharge temperature from being set upward when the maximum allowable humidity is reached.

   ii. On applicable air handling units, supply air temperatures shall be set to a fixed setpoint as appropriate during morning startup to minimize heat-up or cool-down periods prior to scheduled occupancy.

I. Terminal units shall use a state of the art variable air volume system with direct digital control. Terminal unit sequencing to be based on ASHRAE Guideline 36. Constant volume terminal units shall only be used for specialty lab environments and requires approval from the Project Review team and directed by the Project Manager.

J. Each enclosed space designed for continuous occupancy (i.e. classroom, lab, etc.) will be served by at least one separate VAV device, and will have its own temperature sensor.

10. MONITORING AND ALARMS

A. The system shall automatically and continuously monitor and record the values of all inputs points, and the status of all controlled equipment. In the event of the following conditions, an alarm message is to be generated and displayed at the operator’s terminal.

B. The alarm display shall include a description of the alarm condition and its source. An alarm condition shall be displayed until the operator acknowledges it. The operator ID shall be recorded by the operator who acknowledges the alarm.

C. Alarms should be generated for the following scenarios:

   i. A binary output point does not match its command. (eg. Running WITHOUT start command or not running WITH start command.)

   ii. An analog point value is outside its high and low limits.

   iii. A field device failure, as sensed by a binary input point.

   iv. A piece of equipment shut down because of a safety switch such as low temperature detection, fire/smoke alarm, or high duct pressure.

D. Air Handler Low Temperature Detection (Freeze Projection) and Static Pressure Switch Devices

   i. These devices that are used to protect mechanical air handling equipment shall reset automatically (no physical pushbutton reset) when its preset alarm condition has cleared.

   ii. The BMS shall disable the unit, register, and latch (or hold) this alarm condition for an adjustable delay period of no less than 2 minutes, after which the alarm is released allowing the unit to restart. If the alarm condition reoccurs within a 24 hour period, the above sequence of “restart attempts” will be
executed two additional times (adjustable), after which the alarm point is latched and the unit remains off until an operator investigates the cause and manually clears the alarm at the BMS interface.

iii. If the unit remains free of these alarms for 24 hours, the alarm “restart attempts” counter is reset back to zero.

E. Manual override of controlled equipment shall be distinguished from normal operation on the BMS interface via a different text color or highlighted text. The user shall be able to generate an Override Summary report of overridden equipment and points for a user-specified time period via the BMS interface.

11. INSTALLATION, WIRING, and LABELING

A. All equipment shall be installed by skilled electricians and mechanics, who are properly trained and qualified for this work, and who shall be in accordance with governing codes.

B. All wiring between the automation system and sensors and control devices including any power wiring of devices and necessary conduit shall be provided.

C. Plenum cable jacket to be color coded and factory printed for easy identification. Use color coded cable and wire throughout.

D. Field Labeling

i. All wiring and tubing shall be labeled end to end with point address and point descriptor using mechanically printed permanent label.

ii. Label all pull boxes and junction boxes with permanent marker.

iii. Overhead ceiling t-bar grid shall be labelled designating terminal equipment and system sensing devices not visible from the finished interior.

iv. All major mechanical equipment, control cabinets and end devices (room temperature, humidity, and CO2 sensors, AHU sensing and switching/relay devices) shall be clearly and permanently labelled matching engineering equipment schedules and control system submittals. Handheld machine printed, adhesive backed print tape is acceptable for end device labels (wall sensors, t-bar grid, unit sensors, etc.). Major equipment and panels must be tagged with a polymeric or metallic plate with high-contrast legible characters, secure with high quality adhesive or rivets.

v. All plug-in, removable components, or component removable covers shall be labeled so that removal of component or cover does not remove label.

vi. Label all pneumatic tubing at each end within 2 inches of termination with a descriptive identifier.

E. Sensors located outdoors shall have suitable weather shields to provide protection from wind, rain, solar effects and radiation from nearby buildings.

F. Transient protection of system power supplies, data communication lines, digital hardware and controllers shall be provided. This protection shall consist of surge arresters which shall provide a low impedance ground path for surge voltages and lightning.

G. Equipment shall have a power ground.

H. Communications and instrumentation systems shall have a separate single point ground in addition to the power ground.
I. Communication and data lines shall have electrical shielding.

J. Install Control wiring as follows:
   i. Mechanical Rooms: In conduit
   ii. Exposed in building spaces: In conduit
   iii. Concealed in building walls and hard ceilings: In conduit
   iv. Concealed in T-bar ceilings: Plenum rated cable supported every five (5) feet with j-hooks.
   v. Run all wiring and conduit parallel to building lines.
   vi. Terminate all conduit with end protectors.
   vii. Provide strain reliefs where plenum cable enters junction boxes, pull boxes, and cabinets.
   viii. All wiring shall be installed as continuous lengths with no splices permitted between termination points.

K. No test tees and cap on VAV air flow poly tubing from flow-cross in VAV terminal units.

12. SUPERVISION AND CHECKOUT
   A. This process shall be conducted by factory-training engineers and technicians directly employed by the contractor. OSU will review the controls shop drawings concurrently with the Design Professional’s review.

13. ACCEPTANCE TESTING
   A. An acceptance test in the presence of the commissioning agent and or the engineer shall be performed. This test shall include, but not be limited to:
      i. Complete verification of transmission media operation.
      ii. Cross-check and document each sensor and control point acceptance.
      iii. Final calibration of the sensor.
      iv. Verification of failure mode operation.
      v. Verification of program loading/unloading capability.
      vi. When the system performance is deemed in accordance with these specifications, it shall be accepted and placed under warranty.
      vii. All trends created for the sole purpose of commissioning will be removed at the end of the commissioning process. Any trends created by the commissioning agent that serve other purposes than just commissioning may remain but a complete list of those trends will be provided to the OSU FS Building Controls shop upon completion of commissioning.

14. TRAINING
   A. The contractor shall provide full instruction to the Owner’s designated representatives in these procedures during the start-up and test period and again three months after completion of project. The second training will include one vendor service technician of the specific system installed. These instructions are to be conducted onsite in a hands-on manner when the system is fully operational during normal working hours.
B. Training on the functional operation of the system shall include:
   i. Operation of equipment.
   ii. Programming and Sequence of Operations.
   iii. Diagnostics, including the configuration and management of trends.
   iv. Failure recovery procedures.
   v. Alarm formats.
   vi. Maintenance and calibration.
   vii. Trouble shooting, diagnostics, and repair instructions.
   viii. Trending logs – how to set up, how to use, how to delete.

15. INSTRUMENT AIR COMPRESSOR
   
   A. The duplex air compressor must be sized to operate no more than 33% of the time. The unit must be sized to operate at a low piston speed and low temperature to minimize oil vaporization and carryover. Provide an automatic lead/lag selection.

   B. The receiver must be ASME labeled with a pressure gauge, a relief valve, and an automatic drain. The size to require no more than ten (10) starts per hour of an individual compressor.

   C. Provide a refrigerated dryer to assure a 39 °F dew point.

   D. Air piping:
      i. Exposed: hard drawn copper or single tube polyethylene in a protective raceway, or multi tube polyethylene with vinyl jacket.
      ii. Concealed above ceiling: single tube polyethylene in a protective raceway, or multi tube polyethylene with vinyl jacket.
      iii. Buried: hard or soft drawn copper tubing or polyethylene tubing in a metal conduit.

16. CONTROL POWER
   
   A. Provide a duplex outlet at each building’s automation system panel.

   B. Each outlet must be on a dedicated circuit feed from the life safety power system.

   C. Feed all global controllers, critical air handling unit controllers, chillers and boiler controllers, from the Life Safety Power System.

17. FIRE ALARM INTERFACE
   
   A. When required, interface the building automation system to the fire alarm system. The fire alarm system will report a ‘General Alarm’ condition to the BAS. The BAS will facilitate additional HVAC system shut down sequences required as a result of fan shut down and smoke damper closer operations performed by the fire alarm system.

18. CRITICAL SYSTEM AND BUILDING CONTROL SEQUENCES
A. All new buildings that use substantial outside ventilation, conditioning, or lab air shall have a differential pressure monitoring point referenced between outside atmospheric pressure and main entrance(s). The differential pressure setpoints will be set to annunciate an alarm when the pressure exceeds a high or low-pressure threshold to indicate a critical malfunction of the HVAC air handling system(s).

B. To mitigate significant building envelope damage, lab facilities that exhaust substantial volumes of air and supply equivalent fresh outside air, such as for fume hoods, must interlock operation of supply and exhaust fan system controllers via hardware input/output connections rather than relying solely on Ethernet or serial communication.

19. Contractor as-built documentation to include (but not limited to) installer notes, communication layout, and end-of-line (EOL) terminations and resistors.
Section 23 11 00: Facility Fuel Piping

1. GENERAL
   A. Newly designed or remodeled/re-designed fuel systems shall be designed in conformance with all applicable state and local plumbing and mechanical code.

   B. Instructions to Design Professionals
      i. Design shall show all existing and/or new fuel systems. New designs shall overlay all other mechanical systems to avoid the potential for design conflicts.
      ii. Refer to Division 22 05 00, Common Work Results for Plumbing, for additional guidance.
      iii. Coordinate the location of the gas meter with Owner’s Authorized Representative and Northwest Natural Gas Company (NWNG), via the OSU Project Manager/Construction Manager. Coordinate meter placement with all exterior existing/new Work. Verify size and capacity of NWNG’s distribution system at point of connection.

2. MATERIALS
   A. Piping
      i. Pipe above grade shall be:
         a. Threaded or welded Schedule 40 standard weight seamless black steel where located inside a building
         b. The pipe above grade, when exposed, shall be painted with paint suitable for corrosion protection. Refer to Section 09 90 00 Painting & Coating.
      ii. Pipe below grade shall be:
         a. Shall be the same as above ground pipe fittings except the fittings shall be mill wrapped and pipe shall be vinyl coated type.

   B. Fittings
      ii. Below Grade Steel Pipe Fittings: Shall be the same as above ground pipe fittings except the fittings shall be mill wrapped and/or vinyl coated type.
      iii. Pipe Joints: TFE pipe thread sealant or Teflon tape. Apply to male threads only.

   C. Valves
      i. Provide valves at each capped stub out for future extension, and at each piece of equipment. Valve shall be plugged with brass plug until it is ready for use.
      ii. Request the local utility company to provide a valve upstream of the gas meter.
D. Regulator

i. Provide a gas pressure regulator with a built-in internal relief and low-pressure cut-off, or for large demands, a gas pressure regulator with an internal relief and separate low-pressure cut-off.

ii. Vents shall be provided from each pressure regulator. Vents shall run independent and terminate outside the building at a location in compliance with code.

iii. Provide pressure gauges with gauge cocks on the upstream and downstream side of each regulator and a separate low pressure cut-off to aid in checking the gas pressure.
Section 23 20 00: HVAC Piping, Pumps, Chillers, and Cooling Towers

1. CHILLERS

A. Provide chiller packages with centrifugal compressors, or screw compressors, and water cooled condensers.

B. Redundancy must be supplied for all critical loads.

C. Include equipment KW/Ton and APLV values in a selection criteria.

D. Basic Equipment Requirements

i. The equipment shall be furnished as a complete factory assembled package, including hermetically sealed compressor, variable speed drive and motor, evaporator, condenser, lubrication and purge systems, capacity controls, instrumentation and control panel, power and control wiring, refrigerant piping and full refrigerant charges.

ii. The control package on the chiller must be capable of controlling chilled and condenser water pumps, the cooling tower, and interface to the building automation system via the BACnet or LON control protocols.

iii. Chiller room ventilation is required in accordance with the Uniform Mechanical Code and ASHRAE 15. Include refrigerant sensors, control systems, only required for HCFL or HFC refrigerants and air handling equipment in any existing chiller rooms to be upgraded to bring them in full compliance with current codes.

iv. The equipment shall be rated in conformance with the latest ARI Standard 550-88 and shall conform to the latest ANSI/ASHRAE 15 Safety Code.

v. The condenser and evaporator shall also conform to the ANSI B9.1 Safety Code for mechanical refrigeration and to the ASME Code for Unfired Pressure Vessels where applicable.

vi. Electrical components and assemblies shall bear the UL or ETL label, where applicable, and electrical requirements, including control requirements, must be coordinated with available utilities.

vii. The starter may be unit mounted or free standing, but shall be designed specifically for the characteristics of the chiller and shall be furnished with the chiller by the chiller manufacturer.

viii. The temperature control system shall be provided with interface devices and a terminal block to allow remote adjustment of the chilled water temperature set point.

ix. Include provisions for gantry and/or other heavy lifting apparatus for maintenance and repairs.

E. Performance requirements

i. Equipment selection, including evaporator and condenser size and configuration, shall be based on the chilled water system requirements. Coordinate the choice of chillers and system requirements to provide the optimum selection of equipment vs. flow rates, temperatures and temperature changes.

ii. Provide computerized analyses from the manufacturer for at least three different selections. Data should include part load performance in kW/ton based on ARI 550 test conditions, including condenser water relief in 10% increments from 10% to 100% of machine capacity. Base selections on 0.0005 fouling factors for both the evaporator and condenser.
2. COOLING TOWERS

A. Specify that cooling towers shall not be filled until chemical treatment is operational and that only treated water shall be used in the system.

B. Isolate the cooling tower from all pipe flushing and cleaning operations.

C. Use only induced draft cross flow cooling towers located on the roof of the building. Forced draft cooling towers and cooling towers located at grade are not acceptable to OSU.

D. Towers shall be constructed of non-combustible materials.

E. Cooling towers to be selected for maximum efficiency at the selected operation point and are to be sized for an additional 20% capacity.

F. Equalizer connections between basins shall be specified on multiple open evaporative tower applications. Equalizer connections and piping between tower basins shall be separate from any other piping systems. Evaluate the impact of sound upon surroundings.

G. Cooling towers shall meet the following minimum criteria:

i. The towers shall be factory assembled, induced draft, cross flow type with a vertical air discharge. Counterflow type may be acceptable in some applications and requires approval by Facilities through OSU Project Manager on a case by case basis.

ii. The basin and casing up to the top of the fill shall be constructed of 304 stainless steel.

iii. The casing above the fill shall be constructed entirely from fiber reinforced plastic or stainless steel panels supported by a fiber reinforced plastic or stainless steel angle and channel framework; all finished inside and out with zinc achromatized aluminum.

iv. The basin shall have a connecting weir for equalization of water level and a by-pass connection. A brass, float-operated make-up valve shall be provided complete with a large diameter plastic float, arranged for easy adjustment. The float valve is to be sized for the worst possible conditions of basin fill rate.

v. Basins shall be provided with provisions for a winter bypass to the sump when the system is expected to operate during winter conditions.

vi. Basins must have a bottom outlet with a strainer and an anti-cavitation device. Do not select a side outlet configuration.

vii. Inlet louvers shall be of fiberglass or galvanized steel construction, and equipped with inlet screens.

viii. The fill material shall be PVC and have a flame spread rating of 5 per ASTM Standard E84-77A and shall be impervious to rot, decay, fungus, or biological attack.

ix. Drift eliminators shall be constructed of PVC and shall limit drift to less than 0.2 percent of the total water circulated.

x. Fans shall be a fixed pitch, heavy duty, cast aluminum, multi-blade type, protected by a fan guard and each driven though a gear box or power belt reducer by a TEAO (totally enclosed, air over), 1800 RPM, motor, ball bearing type designed specifically for cooling tower service. The motor shall be the high-power factor and high-energy efficient type and have non-fused disconnects located at the motor.
motor shall be furnished with special moisture protection windings, shafts, and bearings. The fan and shaft shall be supported by re-lubricatable ball bearings with special moisture seals, slingers, and housings designed to prevent moisture accumulation. Provide a vibration cut-out switch.

xi. Access doors shall be provided on both sides of the tower for access to eliminators and the plenum section. Safety railing and a ladder shall be furnished with a tower unit requiring a fan and drive service above the fan deck, and shall meet OSHA requirements. Units capable of being serviced from within the unit shall be provided with an internal galvanized steel catwalk for service access. Safety railing, ladder and catwalk meeting OSHA requirements shall be provided around entire unit for any unit with a basin height over 4 feet above roof deck.

xii. Lubrication points are to be provided with appropriate lubrication fittings.

xiii. Furnish electric immersion heaters factory installed to prevent freeze-up conditions. Include factory installed thermostats and controllers.

xiv. Furnish vibration isolator rails for vibration control. Consult with the sound consultant for requirements.

3. PUMPS

   A. Specify single stage centrifugal pumps for water service.

   B. Horizontal, base mounted, end suction pumps with a common forged or cast, steel base frame (not welded), are preferred for applications up to 1,000 GPM.

   C. Horizontal or vertical split case pumps with a common steel base are preferred for applications larger than 1,000 GPM.

   D. Select the pump motor horsepower for non-overloading conditions.

   E. Small circulation pumps must be a maintenance free type.

   F. Pipe mounted pumps must have a cast iron volute.

   G. Shafts shall be aligned on site after installation.

   H. Pumps shall include pressure differential gauges on inlet and outlet with isolation valves.

   I. Pumps shall include we well temperature gauges with isolation valves.

   J. Basic equipment requirements

      i. All water service pumps shall be of bronze fitted cast iron with mechanical seals of the carbon-ceramic type.

      ii. Impellers shall be bronze, enclosed, statically and dynamically balanced, and fitted to the shaft with a key and locked in place. Motors and impellers shall be easily removed without disassembling the piping.

      iii. Specify 1,750 RPM motors. Avoid using 3,500 RPM motors. Motors shall be the premium-efficiency type. Pumps, coupling, and motors shall be factory installed.

      iv. The pump shaft shall be fitted with a bronze sleeve and the bearing frame assembly shall be fitted with re-greaseable ball bearings.
v. The end suction or split case pump and the motor shall be connected with a flexible coupler fitted with an OSHA approved coupling guard. The pump housing shall have gauge and drain trappings.

4. PUMP SUCTION DIFFUSERS
   A. Suction diffusers should be considered for all chilled and hot water system pumps with capacities up to 2,500 GPM and installed to maintain minimum pump flow requirements at all times.
   B. Basic equipment requirements
      i. The unit shall consist of an angle type body with inlet vanes and a combination diffuser-strainer-orifice cylinder with 3/16” diameters openings for pump protection.
      ii. The orifice cylinder shall be equipped with a disposable fine mesh strainer which shall be removed after system start-up.
   C. A permanent magnet shall be located within the flow stream and shall be removable for cleaning.
   D. The unit shall be provided with an adjustable support foot to carry the weight of the suction piping.

5. EXPANSION TANKS
   A. Pressurized diaphragm type, pre-charged with air to the initial fill pressure of the system shall be located on the return side of closed loop systems. The tank shall be ASME stamped and certified for 125 psi and 240 deg. F. Furnish horizontal tanks with saddles and vertical tanks with base mounts.

6. STRAINERS
   A. Specify strainers in all hot water, chilled water, steam, and condenser water systems. Provide manual blow-down valves for strainers in sizes 1 1/4” and larger. Provide Y-type strainers at water supply piping to all chilled water and hot water coils, upstream of all components except the last isolation valve. Size the mesh for service. Provide valving, and allow space to remove and clean the strainer basket or mesh.
   B. Use Y-type strainers for up to 8” diameter. For larger sizes, use basket-type strainers.

7. WATER FLOW MEASURING STATIONS
   A. Use a pitot tube or Venturi type and specify stations complete with a portable readout meter. Locate the meter in the piping at a point where proper upstream and downstream distances are observed so that accurate readings can be obtained. Differential pressure taps for the meter readout shall be located on the horizontal centerline of horizontal pipes.
   B. Specify stations with shut-off valves and quick disconnects for the portable meter.
   C. Water flow measuring stations shall be non-impeller type.

8. AIR SEPARATORS
   A. Specify air separators in all hot and cold water closed loop systems.
   B. Air separators shall be the centrifugal type complete with removable strainers, drains and support legs or brackets.
   C. Provide an automatic air vent with separator assemblies.
D. Air separators shall be at the high point of the system.

9. TEST PORTS

A. Specify a "Petes Plug" to be installed in piping at the inlet and outlet of all water coils, heat exchangers, chillers, pumps, and at all ports of water coil temperature control valves.

10. WATER TREATMENT

A. Water treatment systems shall be provided for all open circulated systems requiring a continuous supply of make-up water. The chemical treatment system shall be automatic in operation and shall continuously monitor and control pH, conductivity, and the corrosive tendency of the recirculated water. Chemicals shall come in a solid concentrated form and be specifically formulated for the water on the OSU campus.

B. All closed loop chilled water and hot water circulating systems shall be provided with chemical feeders across the appropriate pumps.

C. Specify system components to be furnished by a single supplier. Components shall include, but not be limited to, the following:
   i. A pre-wired control and instrumentation panel mounted in a NEMA 12 enclosure with a key-lock door with a window.
   ii. A water meter for monitoring make-up water quantity.
   iii. An automatic bleed valve.
   iv. Sensor assemblies.
   v. Chemical feed pumps (positive displacement type).
   vi. Corporation stop and injection assemblies.
   vii. Chemical feeding tubing.
   viii. Solid concentrated chemical.

D. Acceptable manufacturers: Chem Aqua, or an equal.

11. PIPING

A. The piping systems shall be designed in accordance with the guidelines established by the latest edition of the ASHRAE Fundamentals Handbook.

12. QUALITY ASSURANCE

A. Welders must be certified in accordance with the American Welding Society Standard Qualification Procedures.

B. Refrigerant piping installers must be certified under Oregon Mechanical Specialty Code Chapter 11.

C. A factory trained representative of special items or systems must provide field instruction to the installers.

13. ROUTING

A. The piping shall be routed as directly as possible and sloped for venting and draining. Where possible, use routing to accommodate thermal expansion requirements. Locate pipes, valves, and accessories to be readily
observable and accessible for modification, maintenance, or repair, except when concealed in finished areas.

14. LAYOUT

A. Piping runs, manifolds, and connections to equipment should be arranged so the operation and function of the systems and their components are easily understood.

15. CONNECTIONS TO EQUIPMENT

A. Arrange pipe, valves and accessories for ease of operation and maintenance. Every item of equipment and every assembly such as pressure reducing stations and flow control/measuring stations shall be provided with isolation valves; a balancing valve equipped with a memory stop may be used as the downstream valve if appropriate. By-pass loops with balancing valves shall be provided where it is desirable to keep the system in operation during shutdown.

B. Flexible connections shall be provided at equipment to allow for minor misalignment. Vibration elimination connections shall be provided where required. Rigid pipe supports shall be provided on the "outboard" side of flexible connections and vibration eliminators. Avoid strain on equipment.

C. Provide clear access to all heat exchanger bundles of chillers, boilers, heat exchangers and coils for cleaning, removal or replacing individual tubes. Route connecting piping to clear access space or provide flanged connections to allow minimal removal of piping to gain clear access. In general, the clear access shall be provided at one end only of the heat exchanger bundle.

16. THERMAL EXPANSION

A. Where it is not possible to accommodate expansion and contraction by the general routing of the pipe, expansion devices must be used.

i. Take special care in providing for adequate expansion.

ii. Proper pipe guides are imperative at expansion loops and devices.

B. Locate properly designed anchors that control the way expansion occurs to ensure the effectiveness of routing devices and to prevent undesired movement at connections to equipment, where pipes are close to structure, etc.

17. VENTING AND DRAINING

A. Piping shall be pitched to allow for proper automatic venting of all system high points and manual or automatic draining of all system low points. Use eccentric reducers as required. Provide manual shut-off valves for maintenance of automatic devices.

B. Extend the vent or drain piping, if required, to allow installation of valves and assemblies at convenient service locations. Extend vent discharge piping to a safe location; extend drain discharge piping to a floor drain or other appropriate location such as the condensate return system for steam traps.

C. Provide vacuum relief’s at coils, heat exchangers, and other heat transfer devices as required.

18. HANGERS AND SUPPORTS

A. Specify hangers and supports with special considerations for vertical piping and connections to equipment. Use vibration eliminating hangers for piping near pumps, fan coil units, and other dynamic equipment for vibration-sensitive applications.
B. Provide seismic restraints to meet local codes. Use SMACNA Guide restraints where applicable. Attachments to the building structure must be adequate and shall be detailed and/or specified.

C. Pipe, valves, and accessories "in-board" of flexible connections at vibration isolated equipment must be supported from the equipment inertia base or otherwise isolated with the equipment without putting undesirable stress on the equipment.

19. SECTION VALVES

A. In addition to local connections to equipment, provide piping systems with isolating valves to facilitate maintenance and minimize the extent of the system that must be shut down for repairs, modifications, or expansion. In general, provide an isolation valve, ball, gate or butterfly, at all pipe header connections to eliminate total system drainage during future piping modifications.

B. The valve pressure rating must be a minimum of 1.5 times the working pressure of the system served.

20. MATERIALS

A. Pipe valve fittings and accessories shall be of good quality. To ensure quality, specify piping by ASTM, AWWA, or other appropriate standard; specify ASME ratings for valves and list brand names as a standard; specify fittings by ANSI or another appropriate standard.

B. All materials must meet applicable codes. Where standards may not be sufficient to ensure the quality desired, specify a brand name as a means of establishing the quality level. Whatever method is used, be specific. Include pipe joint materials and methods in the specifications.

21. CLEANING AND TESTING

A. After installation, all systems shall be properly cleaned by flushing with an appropriate liquid or gas before installation of valves and final connections to the equipment. After flushing, closed heated and cooled water systems shall be cleaned by circulating a solution of trisodium phosphate or a similar agent before the final flush and fill. Untreated water and all cleaning and water treatment chemicals shall be approved by EH&S by going through the OSU Project Manager.

B. Isolate the cooling tower from all piping flushing and cleaning operations to prevent untreated water from entering the basin.

C. Before their final acceptance all strainers, drip legs, and similar items shall be thoroughly cleaned.

D. All tests must be observed by OSU’s Project Manager. In general, test systems at 1-1/2 times the highest system operating pressure for 24 hours.

E. Any tank for chemicals which may enter the sewage system will be located so it can be easily charged and serviced.

F. Refrigerant piping to be purged with dry N2 during brazing, and pressure tested using dry N2.

22. DIRECT BURIED PIPING

A. Refer to Section 33 63 13 – Underground Steam and Condensate Distribution Piping

23. DUCTWORK

A. Refer to Section 23 30 00 – HVAC Air Distribution
Section 23 22 16: Steam and Condensate Piping Specialties

1. RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, Standard General and Supplemental General Conditions, Division 1 Specification Sections, and other applicable Specification Sections including the Related Sections listed below, apply to this Section.

2. SCOPE OF WORK
   A. Furnish and install piping, fittings, and specialties for the following systems
      i. Low pressure steam and condensate systems (nominal 0-15 psig).
      ii. Medium pressure steam and condensate systems (nominal 60-75 psig).

3. PRODUCTS
   A. Pipe
      i. All steam and steam condensate piping shall be DOMESTIC and comply with ANSI Standard B31.1- Power Piping.
   B. Steam Pipe in Buildings
      i. For piping 2-inches and smaller
         a. Pipe: Black Steel, SCH 40 (welded), Sch 80 (threaded), ASTM A53, Seamless, Grade B
         b. Fittings: Sch 40 malleable is accepted. Cast iron and 3000# forged are also accepted.
         c. Joints: Threaded
         d. Note: 2-inches and smaller is to be WELDED in shafts or inaccessible spaces.
      ii. For piping 2 ½- inches and larger
         a. Pipe: Black Steel, SCH 40 (all welded), ASTM A53, Seamless, Grade B
         b. Fittings: Welded, Flanged
   C. Steam Condensate Piping in Buildings
      i. For piping 2-inches and smaller
         a. Pipe: Black Steel, Sch 80, ASTM A53, Seamless, Grade B
         b. Fittings: No Sch 40 malleable fittings. Minimum 150# cast iron fittings. 3000# forge fittings recommended.
         c. Joints: Threaded
         d. Note: 2-inches and smaller is to be WELDED in shafts or inaccessible spaces.
      ii. For piping 2 ½- inches and larger
         a. Pipe: Black Steel, SCH 80 (all welded), ASTM A53, Seamless, Grade B


D. Float and Thermostatic Traps:
   i. Cast iron body, bolted cap, renewable, stainless steel internal components, balanced pressure thermostatic air vent. Internal parts shall be accessible without disturbing piping.
   ii. Capable of discharging condensate, air and other non-condensable gasses corresponding with design pressure.
   iii. Manufacturers: Turnstall, Spira-Sarco, Watson McDaniel, Armstrong
   iv. Refer to xx for trap piping detail.

E. Inverted Bucket Traps
   i. ASTM A 278, Class 30 cast iron body and cap, pressure rated for 250 psig, 450 degrees F; stainless steel head and seat, stainless steel valve retainer, lever, guide pin assembly, brass or stainless steel bucket.
   ii. Manufacturers: Turnstall, Spira-Sarco, Watson McDaniel, Armstrong
   iii. Refer to xx for trap piping detail.

F. Strainers
   i. Strainers for steam service shall be the “Y” type. Note that all strainers upstream of a steam trap are considered to be in the steam service, not the steam condensate service.
   ii. Provide a screen blowdown valve for each strainer. The valve shall be the full size of the blow-off cap. Provide a shut-off valve. Provide nipple with cap downstream of the valve. Select the length of the nipple connecting the blow-off valve to the strainer basket connection so that the blow-off valve is clear of insulation.
   iii. Install steam strainer horizontally on their side with screen chamber at the 3 or 9 o’clock position. Install strainers vertically only when required and when the direction of flow is down.
   iv. Strainers shall be installed in steam and steam condensate systems ahead of control valves, traps, pumps, regulating valves, and elsewhere as shown on drawings.
   v. Body may be bronze for 1-inch and ¾-inch. 1-inch and larger shall be cast steel, or cast iron. Shall have a minimum pressure rating of 125 psig.
   vi. Screen material shall be stainless steel, with openings of 1/32-inches (0.031) for 2-inches and smaller; and 3/64-inches (0.047) for piping 2 ½-inches and larger.
   vii. Manufacturers: Mueller, Watts, Keckley

G. Check Valves
   i. 2-inches and smaller: Class 125 horizontal swing check valve, cast bronze body and cover, screwed ends, bronze seat and disc, screwed cover, integral seat, boday and cover material to conform to ASTM B 61 or B 62. The valve shall conform to MSS SP-80, Class 150-B62, Type 3.
ii. 2 ½-inches and larger: Class 150 steel horizontal swing check valve, flanged ends, bolted flanged cover and renewable seat ring. Body material shall conform to ASTM A 216 Grade WCB or A105. Disc or disc seating face and the seat ring shall be 13-percent chromium steel. Face to face dimension shall conform to ASME B16.10. Flange shall be faced and drilled to ASME B16.5. Working pressure and temperature rating shall comply with ASME B16.34 (Standard Class).

iii. Manufacturers: Mueller, Watts, Keckley

H. Condensate Flash Tank

i. Provide condensate flash tank of size and openings as shown on drawings. Tank shall be ASME constructed and stamped for 125 psig.

ii. Manufacturers: Cemline, Spirax-Sarco, Bell & Gossett, Armstrong

I. Vacuum Breakers

i. Brass body, stainless steel retainer tube, ball and spring, rated for 365 degrees F, 300 psig.

ii. Manufacturers: Macon Controls, Spirax-Sarco, Bell & Gossett

J. Drip Pan Elbows

i. Cast iron construction, ASTM A126, Class B, rated for 250 psig, 450 degrees F.

ii. Manufacturers: Spence, Spirax-Sarco, Bell & Gossett

K. Gate Valve

i. Class 800, forged steel body, bolted bonnet, rising stem, seal-welded seat rings, OS & Y, stainless steel hard facing seating surfaces, rated for 1000-degrees F.

ii. 2-inches and smaller shall be threaded. Larger than 2-inches shall be flanged.

iii. No brass or bronze valves shall be installed on steam or seam condensate systems.

iv. Manufacturers: Velan, Crane, Bonney Forge, Chicago

L. Safety Relief Valves

i. Follow local jurisdiction.

M. Pressure Reducing Valves

i. Pressure reducing valves shall be single seated, flanged, cast iron body, stainless steel diaphragm, Seco metal disc, stainless steel stem, and carbon steel main spring. Valves shall be normally closed type and designed for dead end service. Steam velocity through the valve shall be limited to 7000 fpm.

ii. Provide muffling orifice required to limit sound level to 85 dba, 3 feet from the valve.

iii. Manufacturer: Spence.

N. Condensate Return

i. Steam Powered Condensate Return Unit (Liquid Mover) – PREFERRED if steam to operate is available.
a. **Description:** Factory-fabricated, packaged, steam powered unit of capacity indicated. Unit shall use steam pressure to move condensate to the next condensate receiver downstream. Include receiver and accessories suitable for operation with specified conditions. Receiver shall be able to receive and flash high pressure condensate.

b. **Configuration:** Floor-mounted. For each location, provide two units so that one serves as a back-up. For a lead-lag type configuration, provide all external piping to allow isolation of one unit to keep the other unit in service.

c. **Package:** Size of body is dictated by the capacity of the unit. Body shall be steel, shall be provided with ASME Sec VIII Code stamp, and the external shall be painted. The package shall include all necessary items for complete operation including steam inlet control valve, float valve of chromium or stainless steel, and check valves for inlet, outlet, and vent. All of these items shall be steel or stainless steel. Include water-level gauge with isolation valves and one loose pressure gauge and dial thermometer for Contractor installation on common discharge header downstream of all isolation valves. Include drain plug. Float and steam inlet and vent valves shall be accessible through a flanged connection on top of the unit.

d. **Performance:** Each liquid mover shall be provided with the following design values:

   1) Fluid: Condensate
   2) Temp (deg F.): 212 or above
   3) Design Flow (GPM): Per the design.
   4) Pump Head (PSIG): Per the design. Ensure that the pump can satisfy the static lift requirements back to the next condensate receiver it is pumping to.
   5) Note that the flow and head ability of the equipment are highly dependent on available motive pressure (steam). Designers must verify conditions with the manufacturer before specifying.

ii. **Electric Powered Pump Condensate Return Package:**

   a. **Description:** Factory-fabricated, package, electric-drive pump units of capacity indicated. Include receiver, pumps, float switches, controls, control panel, and accessories suitable for operation with specified conditions. Receiver shall be able to receive and flash high pressure condensate.

   b. **Inlet valves:** Shall be provided for each pump, pre-assembled.

   c. **Inlet Strainer:** Provide basket style strainers for each pump.

   d. **Pressure Gauge:** Provide at discharge of each pump.

   e. **Manufacturers:** Spirax-Sarco, Paco, Sterling

4. **EXECUTION**

   A. **Piping Installation:**

   i. **Branch connections from horizontal steam, steam condensate, and gaseous system mains shall be taken off the top, up at a 45 degree angle or off the side.**

   ii. **Branch piping shall have valves at the branch connection points.**
iii. Pitch of piping to vary to prevent flashing in steam and steam condensate systems.

iv. Refer to Standard 22 05 00 for more piping installation guidelines.

B. Trap Installation Detail:

C. Steam Condensate Return Installation Requirements:

i. Steam powered condensate return units (also known as liquid movers, or pressure power pumps) are PREFERRED in any application where adequate steam pressure is available.

ii. Condensate return units shall be located in all building mechanical rooms and at all low points in the system where pressure in a dedicated return line cannot push the condensate back to a condensate receiver.

iii. Ensure that the vent of a condensate receiver goes to atmosphere and to a safe location where if discharging will not cause harm or damage to property. Do not pipe the vent into the mechanical room (a blown trap could cause major humidity and temperature issues).

iv. Note that all condensate receivers for electric powered systems have overflow pipes. Ensure that there is a floor drain or sump pump that is rated for the temperature that could come out of an overflowing condensate receiver. Ensure that the vent line for the condensate receiver is sized accurately and that the overflow line is piped correctly so that the overflow line does not act like a vent and cause humidity and high temperature to go into the mechanical room. The overflow piping shall be combined with the receiver drain.

v. Overflow: Pipe end shall be located near the bottom of the receiver with water loop to prevent overflow from acting as a vent. Provide separate vacuum breaker piping external to the tank to prevent the overflow line to act as a siphon.

vi. The designer shall ensure that condensate receivers are not over pressurized, especially by the pressure from the flash steam. Typical receiver packages that are not the steam powered type are not rated pressure vessels. A flash tank may be required upstream of the receiver package depending on the design and the flash tank must have a safety relief valve with a set pressure to protect the vessel. The electronic powered pump package is specified to have the condensate pumps rated for 250 degrees F service. If this does not occur, a flash tank must be installed on condensate return lines ahead of the condensate receiver to reduce the condensate temperature to a specified pumping temperature of 200
degrees F. Some steam powered packages require steam to be flashed upstream of the unit so provide one where required.

vii. All condensate return pumps and liquid movers shall have spring loaded check valves at the discharge.

viii. Plumbing Specialty Code 810.1 states that no water discharging from a steam system into a plumbing drainage system shall be over 140 degrees. When installing steam condensate return systems there shall be a ¾” domestic or industrial cold water line hard piped with an air gap to the drain that receives the discharge from the condensate receivers (liquid movers or electric). There shall be a manual ball valve (normally closed) no more than 6-feet above the floor that can be opened to temper condensate going down drain if receivers fail.

ix. If sump pumps are installed to receive discharge from these systems at any point these pumps shall be rated for the possible temperatures they could receive. All discharge piping from pumps shall be metal to a point temperatures are under 140 degrees F.
Section 23 30 00: HVAC Air Distribution

1. DUCT DESIGN

   A. Duct Sizing Criteria

      i. Air Systems

         a. Volume dampers shall be provided in all supply air branch ducts and at all supply air outlets. Volume dampers shall not be placed upstream of VAV terminal units. Supply air duct systems shall be designed with care and considerations to minimize the overall system pressure drop.

         b. Low Pressure Supply Return or General Exhaust

            1) Maximum pressure drop: 0.10 inches w.c. per 100 ft.

            2) Maximum velocity:
               a) Supply Diffuser run out: 500 fpm.
               b) Return or exhaust grille run out: 600 fpm.
               c) Branch duct above ceiling: 1750 fpm.
               d) Mains in mechanical rooms or shafts: 2,000 fpm.
               e) Exposed mains: 1,450 fpm.

         c. Medium Pressure Supply

            a) Maximum pressure drop: 0.35 inches w.c. per 100 ft.

            b) Maximum velocity:

            c) Branch to terminal unit: 2,200 fpm.

            d) Round branch above ceiling: 3,000 fpm.

            e) Rectangular branch above ceiling: 1,750 fpm.

            f) Round main in mechanical rooms or shafts (above 35,000 CFM): 3500 fpm.

            g) Rectangular main in mechanical rooms or shafts: 2,500 fpm.

            h) Exposed round mains: 2,600 fpm.

            i) Exposed rectangular mains: 1,450 fpm.

      B. Kitchen Exhaust

         i. Ductwork and exhaust systems (serving Type I or Type II kitchen hoods) shall be designed and constructed per NFPA requirements.

         ii. Ductwork serving a Type I hood will be constructed from stainless steel, pitched back to the hood with condensate drains, fire sprinklers, access doors at changes in direction, and separate from any other exhaust systems.
iii. Dishwasher exhaust will be constructed from aluminum or stainless steel.

iv. Hood exhaust fans shall be approved specifically for this application and shall meet the requirements of the local authorities having jurisdiction and NFPA.

v. Locate supply and exhaust grills away from exhaust hoods to prevent air being discharged from affecting hood performance.

vi. Provide makeup air systems, per State Energy Code.

vii. Minimum velocity for duct design: 1,500 fpm.

viii. Maximum velocity for duct design: 2,500 fpm.

C. Lab Exhaust Duct Design

i. Ductwork for lab exhaust systems will be 316 stainless steel.

ii. Ductwork for fume hood exhaust systems shall be welded 316 stainless steel duct, pitched back to the hood.

iii. VAV lab exhaust systems are preferred for new construction where there are multiple exhaust hoods in a building. See Variable Air Volume (VAV) Systems in this standard.

iv. Locate supply and exhaust grilles away from fume hoods to prevent air being discharged from affecting hood performance.

v. Hood stacks will terminate a minimum of sixteen (16) feet above the standing surface at the point where service personnel will stand to work on the equipment or perform other tasks.

vi. Stacks located on sections of buildings within fifty feet of taller section of the building will be constructed as if they were on the taller section (i.e., sixteen feet above the standing surface of the taller section).

vii. Other physical arrangements may be suitable with equipment that is designed for outside dilution air, high discharge velocities, and higher effective stack height. Such systems will be reviewed and approved on a case-by-case basis by EH&S. In no case will physical stacks terminate LESS than seven (7) feet above the standing surface.

viii. Maximum pressure drop: 0.35 inches w.c. per 100 ft.

ix. Recirculation of any laboratory exhaust is prohibited.

x. Heat recovery systems in lab exhaust air will NOT utilize filter media. Another design must be used.

xi. Duct velocity

   a. Mains - maximum 2500 fpm

   b. Branches – maximum 1500 fpm

   c. Minimum stack exit velocity 3,000 fpm

2. ROTATING EQUIPMENT

A. Do not locate rotating equipment above hard ceilings
3. **DUCT SEALING**
   A. Seal all low and medium pressure metal supply exhaust and return ductwork, per SMACNA Class A standards using either adhesive, gaskets, or tape systems.

4. **DUCT PRESSURE TESTING**
   A. Test all ductwork slated to operate at ≥ 4 inches water gauge.
   B. Randomly test three sections of medium and three sections of low pressure ductwork slated to operate at ≤ 4 inches water gauge.

5. **DUCTWORK CONFIGURATION**
   A. Utilize spiral round duct wherever possible for low velocity.
   B. Utilize rectangular where round duct will not fit.
   C. For medium velocity, mains and branches utilize flat oval ducts where round ducts will not fit.
   D. Utilize rectangular ductwork where flat oval sizes are not available for supply ducts.
   E. For return and exhaust ducts utilize round where possible and rectangular otherwise.

6. **ZONING**
   A. Provide exterior zones around the perimeter of the building and interior zones for the remainder of the area.
   B. Perimeter zones to be a maximum of 15 foot deep.
   C. Corner rooms having two different exposures shall be made a separate zone if practical.
   D. Meeting and conference rooms shall be made separate zones.
   E. Other specific zoning requirements will be provided by the PM.
   F. Terminal Unit Area of Coverage:
      i. Maximum exterior zone size: 1,000 sq. ft.
      ii. Maximum interior zone size: 1,800 sq. ft.

7. **DUCT LAYOUT**
   A. Indicate the desired layout on the Construction Drawings using double lines to delineate ducts to scale; use standard symbols.
      i. Show items such as dampers, lining, turning vanes, extractors, splitters, air flow measuring stations, and other features required for good control of air.
      ii. Indicate round ductwork where possible.
      iii. If rectangular ductwork is used, specify radius turns where possible.
   B. Keep the duct aspect ratio at 3 to 1 or less where possible, but not over 5 to 1 unless approved by the OSU Project Manager. Arrange the layout to avoid items that pass through ductwork unless absolutely necessary. When penetrations occur, specify an airfoil section around them.
C. Coordinate the location of ducts with other building features such as columns, ceilings, conduit, piping and lighting fixtures. Position ductwork to allow for the removal of, or access to, filters, terminal box coils or controls, lighting fixtures, fire dampers and other similar items.

D. Ductwork design: To design the system, consider noise, pressure drop, the type of system, the type of duct material, vibration, drumming, fire and smoke control, and any other factors that may affect sizing.

E. Hangers and supports
   i. The type and size of hangers and support shall follow ASHRAE and/or SMACNA recommendations. Seismic restraints where applicable shall be designed, specified and detailed as recommended in SMACNA’s "Guidelines for Seismic Restraints in Mechanical Systems". Spring or other resilient supports shall be used in hangers where sensitivity to vibration is a problem. Coordinate with the other design disciplines when specifying or designing the duct support and hanger locations.

F. Dampers
   i. Manual and automatic opposed blade volume control dampers, back draft dampers, inlet vanes, and fire and smoke dampers shall be shown in duct layouts where required. Provide adequate room around shafts for fire/smoke damper sleeves.
   ii. Where possible, select 100 percent free area fire and smoke dampers that have their entire assemblies approved by the Underwriters' Laboratories and any governmental agencies having jurisdiction.
   iii. After completion of the duct layout, review the design for proper arrangement and for adequacy of the volume dampers to ensure ease of initial balancing and of rebalancing to accommodate future modifications.
   iv. Knife or gate dampers shall be provided at each constant volume fume hood for balancing purposes.
   v. T.A. Morrison & Co. Inc. (Tamco) Dampers: preferred equipment for new and replacement dampers on campus.
   vi. Backdraft Dampers (aka. Barometric or Gravity Dampers: use non-power-controlled dampers as much as possible and applicable for fan section isolation, especially:
       a. Fan wall fans (one-each damper section per fan outlet).
       b. Redundant supply and exhaust fan systems (for isolation during repair, maintenance, and filter replacements).

G. Cleaning
   i. Specify that duct systems are to be wiped down, vacuumed, or blown clean with compressed air before installation, and that all ductwork is sealed with plastic after cleaning and during assembly to keep ducts clean. All ductwork shall be shipped sealed to the job site and kept sealed until construction is complete. Store ductwork out of the weather at all times.
   ii. The return duct system shall be kept sealed at all times during construction to keep it clean. If heat is required in the building prior to finish of construction 100% outside air shall be used.
   iii. Require the contractor to provide and install a new, complete set of clean filters shortly before final acceptance.
iv. Fans shall be operated with construction filters installed, at full air volume for 24 to 48 hours after installation.

H. Special requirements
   i. Supply and return ductwork
      a. Use galvanized sheet metal spiral round, rectangular, and flat oval ductwork, in that order, unless special conditions dictate use of other materials. Use pressure and/or velocity criteria to select gauge thickness according to the ASHRAE Guide or SMACNA.

   ii. Exhaust ductwork
      a. Ducts must convey ambient temperature or heating exhaust, smoke and grease from kitchen hoods, moisture, abrasives, and other exhaust air streams that are not acids or caustics. Use the following materials for these exhausts:
      b. Specify the gauge for galvanized sheet metal as recommended in the ASHRAE Guide or SMACNA. Ductwork for kitchen exhausts and abrasives shall have material thickness as recommended in the references.
      d. Dish Washing Exhaust: Use 304 stainless steel material for moisture latent air streams. Pitch ductwork to dish washing hood or to duct mounted drains.
      e. See Section 11 53 13 for Laboratory Fume Hood ductwork requirements

8. LABELING
   A. All accessible ductwork shall be color coded and identified with wording and arrows every 20 feet on straight runs, at each riser, at each junction, at each access door, adjacent to all valves and, flanges, on both sides of floor and wall penetrations and where required to easily identify the medium transported.
   B. Smoke dampers shall be permanently identified on the exterior by a label with letters ½ inch in height reading: Fire Damper, Smoke Damper, or Fire/Smoke Damper, as appropriate. The label will be constructed from same material as equipment nameplates.
   C. Terminal Units: Mark all terminal units with a permanent marking system so that the markings can be easily read from the most likely viewing position (i.e., catwalk, through the ceiling below, etc.).

9. VARIABLE AIR VOLUME (VAV) SYSTEMS
   A. VAV systems shall be used for general office and circulation areas including lobbies, cafeterias, and meeting rooms, unless otherwise approved by the Project Review team and directed by the PM.
      i. VAV air handling systems must be capable of stable operation over a wide air quantity range. The selection and arrangement of terminal units shall minimize modification required to accommodate changing tenant configurations.
      ii. Terminal units shall also be capable of stable operation over a wide control range.
      iii. VAV terminal units serving perimeter zones shall be provided with hot water heating coils.
iv. Supply and return fans serving VAV systems shall be provided with a variable frequency drive to varying the air volume in response to system pressure.

v. Minimum ventilation rates should adhere to ASHRAE 62.1. VAV terminal unit control should follow ASHRAE Guideline 36.

vi. Recirculation of any laboratory exhaust is prohibited when using a VAV system for lab hood exhaust.

B. Recirculated air systems equipped with an economizer cycle shall be capable of supplying 0-100% outside air.

C. Air economizer systems shall be used whenever practical. Dry bulb temperature controlled economizers are preferred over enthalpy controlled.

D. Reheat VAV must include a discharge air temperature sensor.

E. For conditions under which economizer systems are not required and shall not be used, reference ASHRAE/IES Standards 90.1.

F. Constant volume systems shall only be used for specialty lab areas requiring constant air flow and areas with constant exhaust requirements. Constant volume systems need to be approved by the Project Review team and directed by the Project Manager.

G. Insulation – refer to Section 23 07 00 – HVAC Insulation
Section 23 60 00: Refrigerant Containing Equipment (RCE)

1. GENERAL REQUIREMENTS

A. This section applies to the management of refrigerant containing equipment during new construction, demolition, renovation, or preventative maintenance activities.

   i. This section pertains to the material and installation requirements for direct expansion, air- and water-source heat pump systems utilizing variable refrigerant flow (VRF) as a means of refrigerant control and distribution. Various manufacturers use the terminology of variable refrigerant volume to describe their system. Use of the term VRF in this standard shall refer to all variable flow refrigerant designs and Mini VRF for 1 to 1 and smaller standalone ductless systems with side discharge condensers.

   ii. This section covers applications in buildings that are used for new construction, renovations (whole or partial) and supplemental uses such as IT/data rooms. Designer shall review all potential applications for VRF systems with Facilities Services and the OSU project manager. Where available, traditional HVAC systems utilizing campus central plant utilities such as chilled water, steam, or heating water are preferred over standalone VRF and heat pump systems.

   iii. This section covers air- and water-source heat pump systems, as well as cooling-only systems. Water source VRF may be part of a geothermal (ground source) system for that application. Use of campus chilled water, or steam, as a heat source, or sink, may be considered for the design but only in coordination with and after written approval from Facilities Services through the OSU project manager.

   iv. This section implements refrigerant-based systems as a heating alternative to both fossil fuel and electric resistance heating. The engineer of record (EOR) shall avoid planning and specifying electric resistance heat as a means of convenience.

B. Whenever possible, attempt to utilize equipment that contains Hydro fluorocarbon (HFC) type refrigerants (non-ozone depleting type refrigerants). Equipment that utilizes either Class I or Class II refrigerants should be avoided when feasible.

   i. Class I refrigerants include the (CFCs), R-11, R12, R13, R-13B1, R113, R114, R115, R-500, R502 or R503.

   ii. Class II refrigerants include the Hydro chlorofluorocarbons (HCFCs), R-21, R-22, R-23, R-31, R-121, R-122, R-123, R-124, R-141b, R-142b, R-401a, R401b, R-401c, R-402a, R-402b, R-403b, R-406a, R-408a, R-409a, R-411a, R-414a, R-414b, FRIGC FR-12, Free Zone, GHG-HP, Freeze 12, GHG-X5, G2018C, or NARM-502.

B. When refrigerant containing equipment is removed, dispose of equipment and refrigerants in accordance with EPA Guidelines. OSU Facilities Services requests to have first right of refusal for capturing the refrigerant for other campus equipment.

2. SUPERVISION AND EXECUTION

A. Individuals performing work or apprentices’ supervisor must possess EPA certification of appropriate EPA level.

B. Contractor must inform OSU Facilities Services when non-portable equipment is demolished or moved.

C. Contractor shall submit a record of the quantity of refrigerant and oils recovered, and equipment disposed to the OSU Facilities Services Refrigeration Supervisor.
3. GENERAL DESIGN REQUIREMENTS

A. System Design

i. Variable refrigerant flow (VRF) systems shall be a variable capacity, direct expansion (DX) field selectable heat pump, heat recovery, or cooling-only engineered system, unified within a single cabinet. The outdoor condensing unit shall consist of one or more frames connected though a common two (2)-pipe heat pump, or three (3)-pipe heat recovery refrigerant piping network, and control communication wiring. Each system shall have single or multiple inverter compressor(s).

   a. Basic heat pump systems where the entire system is indexed to either heating or cooling operation are generally limited to process cooling applications or single zone occupied areas.

   b. Heat recovery systems are generally applied to occupied areas where zone conditions vary. Additionally, heat recovery systems shall be capable of simultaneous heating and cooling of individual zones.

   ii. Each system shall be connected to multiple indoor terminal units (ducted or mixed combinations) through a common refrigerant piping network with integrated system controls and communication network. Each indoor unit shall be capable of being controlled individually for small zones or as a group for larger zones.

B. Design

i. The Design Professional/engineer shall consider/include the following items for the design.

   a. Branch controller locations need to be placed in areas where acoustic disturbance is not a potential issue for concern.

   b. Include smart changeover (optimized) functionality for cooling/heating switchover type systems.

   c. When configuring a system design layout, group like spaces together that operate on similar schedules and combine them with a single outdoor unit. Also consider maximizing the heat recovery capability of the system, for VRF heat recovery applications, grouping zones that are likely to be in different modes at the same time to maximize the heat recovery potential of the system and, thus, achieving energy savings.

   v. Consider resiliency when laying out the VRF system and how zones are grouped together onto branch boxes and outdoor units. Consider how the failure of any single outdoor unit or branch box will impact the use of the building.

   vi. VRF systems that are dependent on an uninterruptible power source to protect equipment from memory loss during a power failure shall not be considered for design installation. Systems shall automatically resume operation upon restoration of power at previous modes and setpoints.

   vii. Space thermostats for VRF system control needs are to be sourced by the same VRF manufacturer for proper functionality. Central VRF controllers need to have full BACnet capability to communicate with campus through the building management system. Consider including an independent building automation system temperature sensor within each zone that is served by a VRF unit for redundant temperature monitoring, or to control other heating or cooling systems, within the zone such as perimeter radiation.

   viii. Designers comply with the latest ASHRAE 15 and ASHRAE 34 requirements when laying out system pipe routing and consider open/closed plenum spaces to meet standard requirements for refrigerant
concentrations in the event of a leak. Designers shall submit refrigerant volume calculations to OSU for each system that demonstrate compliance with ASHRAE 15 and ASHRAE 34.

ix. All air-source VRF systems shall include a low ambient kit that includes wind baffles, where required, to meet the design ambient condition of 17°F or below, wind at 15 MPH.

x. Where used as the primary heating source, VRF systems shall provide full design heating capacity at 17°F outdoor ambient without the use of supplementary electric resistance heating. Designers shall base compressor unit selection(s) on the greatest load, cooling versus heating. Consider the application of augmented heating output type units for these installations.

xi. Designers shall evaluate each system for a defrost cycle and determine the impact the operation and frequency of this cycle will have on maintaining space temperature while the compressor is in the defrost mode.

xii. Designers shall include the ventilation air conditions (or supply from a ventilation unit if one will be utilized) and flow rates in their load calculations for sizing and selecting the indoor units. Selections and capacities shall be determined by actual entering air conditions rather than by nominal entering air conditions matching current OSU standards in Sec. 23 05 00, #1-C & D.

a. Energy recovery ventilators (ERV) are preferred over heat recovery ventilators for exchange of sensible and latent heat energy.

b. Higher outdoor air flow rates can be connected to indoor units if pretreated with a ventilation unit such as an ERV or a dedicated outdoor air supply (DOAS) ventilation system. However, designers must follow the VRF manufacturer guidelines for recommended mixed air temperatures entering the indoor unit coil and not exceed them in heating or cooling mode. In particular, VRF indoor units do not handle high incoming air humidity well in cooling mode.

c. Designers can consider supplying outdoor air from a ventilation unit at neutral conditions directly to room(s) in lieu of ducting air to the indoor units. This should also be considered for high occupancy spaces.

xiii. Designers shall coordinate the proposed location of outdoor units with the project architect or OSU project manager for approved locations. Outdoor units may be located on grade, rooftop, indoor, or sidewall depending on the building and application. All proposed locations shall conform to the manufacturer’s requirements for clearance on all four sides and overhead. Stacking units, or the creation of “farms,” are acceptable within the manufacturer’s limitations.

xiv. Locating on the sidewalls shall be limited to renovation or supplemental applications only with approval from the project architect or OSU project manager. Designers shall consider provisions for service access for high sidewall installations.

xv. Mounting of outdoor units indoors must be in conformance with manufacturer’s requirements for ducted discharge and air intake configurations and static pressure limits. Provisions for gravity drainage of defrost water shall be included in enclosure.

xvi. Water source systems shall review the requirement for a propylene glycol solution of adequate concentration to prevent freezing.

xvii. VRF components shall be provided with a 10-year material warranty for compressors and mechanical parts.
Minimum energy efficiency (SEER and COP) shall be as mandated by the current energy code requirements unless the project has higher goals for sustainable design achievement.

Designers shall work with the manufacturer, or its representative, to create the system architecture and generate a system flow diagram that incorporates the unit piping sizes and distribution lengths. This diagram shall be included as part of the construction documents bid package. Designers shall select major component sizes and configurations that are available across all approved VRF manufacturers so that if an alternate approved VRF manufacturer is submitted, changes to the overall system configuration will be minimal.

Designers shall work with the manufacturer, or its representative, to create the system architecture and generate a system flow diagram that incorporates the unit piping sizes and distribution lengths. This diagram shall be included as part of the construction documents bid package. Designers shall select major component sizes and configurations that are available across all approved VRF manufacturers so that if an alternate approved VRF manufacturer is submitted, changes to the overall system configuration will be minimal.

Review control designs for compliance with owner’s project requirements and basis of design, controllability with respect to actual equipment installed.

The design documents shall include a detailed piping and instrumentation diagram drawing with a control point list, and sequence of operation for each system and subsystem.

The control point list shall clearly provide direction to the equipment vendor and mechanical and control contractor, which points shall be uploaded to the BMS.

4. CONSTRUCTION. The Contract/Design Professional/Engineer shall consider/include the following items for construction.

A. Contractors must have a minimum of 10 documented and successful installations of VRF systems with any of the acceptable manufacturers listed in the next section, and system sizes similar to the current project installation scale.

B. Contractors must be certified to install VRF systems and must be certified with the specific manufacturer that is being installed as part of a project. Documentation of experience and certification is provided as part of the submittal process.

C. A manufacturer representative shall attend a preconstruction meeting and shall also verify that the training certifications provided by the contractor are in order. Construction managers shall submit list of contractors who have been trained and certified within a designated geographical range to service and replace systems installed.

D. Contractors shall provide a basis of design bid as specified and with specified products. If the contractor wishes to propose alternate products to the basis of designed products, they shall provide a separate and complete bid detailing the proposed alternate products. The alternate shall clearly identify the impact to the scope of work for each trade. Any product proposed as an alternate shall have been offered, as a VRF product, in the United States for a minimum of five (5) years.

E. Refrigerant piping used to connect VRF system components shall be type L-ACR hard temper copper, ASTM B-280, B-819. Piping shall be shipped to jobsite with nitrogen charge and capped ends until ready for installation. Use with long radius wrought copper refrigeration fittings with brazed connections. Annealed copper tubing (soft temper) may be substituted in retrofit applications that are approved in advance by Facilities Services through OSU Project Manager.

F. Refrigerant piping shall be insulated with preformed flexible elastomeric, type E-1, in accordance with OSU’s design standard, 23 07 00 HVAC Insulation. Exposed (outdoor) insulation shall be covered with a type B PVC jacket.

G. Upon job completion, Contractors will provide the owner with a copy of an approved submittal, including mobile service and diagnostic software (VRF system service diagnostics), project mechanical and control...
drawings, a summary of total line set length and sizes, all as-built piping drawings with device controls addressing map and guide, operations and maintenance instructions, complete start up sheet, troubleshooting guides, startup and system configuration reports, the final total refrigerant charge of each system (including differentiating between factory charge and any added refrigerant amount), evacuation micron level and hold time and any service and engineering manuals in PDF format. Additionally, Contractors will provide any specialized repair tools needed for system maintenance and arrange for off site manufacturer training for up to two OSU refrigeration technicians (OSU to provide travel related expenses).

5. MINIMUM PRODUCT REQUIREMENTS

A. All equipment and components shall be new, and the manufacturer’s current model.

B. All parts and components shall be readily available in the United States of America.

C. Acceptable Manufacturers:
   i. Mitsubishi Electric
   ii. Daikin
   iii. Fujitsu

D. VRF, Condensing Unit, Heat Pump Sections (Outdoor Section)
   i. The outdoor section shall be factory packaged with compressor(s), reversing valve(s), air- or water-source heat exchange components, refrigerant charging provisions, and controls. All components shall be factory mounted on a structural steel frame, concrete pad or manufactured pad on case by case basis.
   ii. Large capacity units shall be modular in design to allow multiple units to be connected in parallel to satisfy the design load.
   iii. Outdoor style units shall utilize air coils for heat transfer with fans configured for a draw-through operation. Coils shall be constructed of all aluminum or composite aluminum fin and copper tube. Air coils shall be coated with a hard anodized protection from corrosion for coastal installations. Where outdoor units are installed on grade, provide coil protection grilles.
   iv. Fan(s) for outdoor units shall be a shaped propellor type designed for reduced noise. Fan speed shall be variable through an onboard controller for capacity control and reduced energy consumption.
   v. Indoor style units shall utilize a brazed plate heat exchanger for heat transfer.

E. Indoor Terminal Units
   i. Indoor unit types shall be coordinated with the building architecture for the specific application. Unit types, including wall or ceiling hung, ceiling cassette, console, concealed ducted, and floor standing ducted may be used in any combination the manufacturer allows.
   ii. Indoor units generally follow the configuration of fan coil units and include a refrigerant coil, blower, condensate drain pan, and controls.
   iii. Units designed for installation in the space served include means for air distribution with supply and intake grilles. Casings for these units are constructed of high-impact plastic on a steel frame.
iv. Units designed for concealed and ducted applications shall have galvanized steel casings with coated insulation lining.

v. Concealed units installed above a ceiling shall have a supplemental drip pan installed below the unit with leak detection monitored by the building automation system.

vi. Ducted units shall have the external static pressure calculated to operate within the unit’s fan capacity. The fan motor size and speed shall be selected as applicable.
   a. Specify standard filter sizes readily available without special order (i.e. 14x20, 14x25, 16x20, 16x25, etc.)

vii. Gravity condensate drainage is the preferred system and shall be designed wherever possible. The use of integral condensate lift pumps can be considered to facilitate condensate drainage where gravity drainage is impractical due to unit locations. Where unavailable due to unit style, external condensate pumps are an option. Condensate pumps may be used to lift condensate to overhead gravity system(s) or discharge directly to drain. Condensate shall be discharged indirectly to the storm waste connection(s) in the plumbing system.

viii. Some terminal units (i.e., cassette types) shall be able to accept a ventilation air connection. Only terminal units designed for ventilation air shall be connected. Concealed units can be equipped with intake plenums for ventilation air connections.

F. Branch Control and Distribution Boxes

i. Various manufacturers utilize refrigerant distribution and control boxes to meter refrigerant to the indoor units from the outdoor units. This is especially true for heat recovery type installations. These boxes shall be located in mechanical rooms or in readily accessible locations for service access. Selection of the boxes shall be part of the manufacturer’s engineering process and project support. Capacity and quantity of ports shall be coordinated with the load. Its branch controller shall have labels indicating which terminal devices are connected to it.

ii. All branch controllers shall have isolation valves for each refrigerant circuit, both on the suction and liquid lines.

G. Controls

i. Control packages shall be scaled in size with the project. Small systems used for supplemental applications are required to be connected via a MSTP device, such as a Procon card, and have the ability for a BACnet MSTP. For larger system installations, units may connect to and be integrated with the building automation system (BAS) via BACnet IP (JCI Metasy, ALC, Tridium or Siemens as applicable).

ii. The VRF manufacturer shall prepare a customer interface wiring diagram with all the required conductor numbers, insulation types, and wire gauges as part of their engineering support for the project. This drawing shall be included in the construction documents bid package.

iii. The VRF system controller and space thermostats within each space shall include the following features and interface with the building BAS.
   a. Acceptance of indoor unit on/off command from the BAS, and ability to lock out these functions from the user at the thermostat.
b. Acceptance of occupied/unoccupied command from the BAS, and ability to lock out these functions from the user at the thermostat.

c. Acceptance of operating mode (heating, cooling, dehumidify) command from the BMS and ability to lock out these functions from the user at the thermostat.

d. Dual setpoints (heating and cooling) in occupied, unoccupied, and standby. Standby setpoints will be in use when the BMS is commanded by the VRF and occupancy sensor in the space reads unoccupied.

e. Push button temporary override. A button on the thermostat when the space BAS is scheduled to be unoccupied. This will provide occupied setpoints for up to 120 minutes.

f. Limit of $2^\circ\text{F}$ plus or minus adjustment from the setpoint. Gives users the ability to change occupied heating setpoints from 68°F to between 66°F and 70°F and cooling setpoints from 75°F to between 73°F and 77°F.

g. Have all points available for BACnet view on the BAS and occupied/unoccupied setpoints as well as occupied command set to read and write.

iv. Submit proposed VRF thermostat types for each space type within the building to OSU for review.
Division 25: Integrated Automation

Section 25 30 00: Integrated Automation Instrumentation and Terminal Devices

1. REFERENCE – MOVED to 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC
Section 25 30 00: Integrated Automation Instrumentation and Terminal Devices

1. REFERENCE - MOVED to 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC
Division 26: Electrical

Section 26 00 00: Electrical

1. REQUIREMENTS FOR DESIGN
2. REQUIREMENTS
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5. WIRING DEVICES
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26. PRODUCT SPECIFICATION
27. LIGHT LEVELS GENERAL
28. INTERIOR LIGHTING
29. EXTERIOR LIGHTING
30. LIGHTING CONTROLS
31. WINDOW OPERATORS
32. CONTROLLED RECEPTACLES
Section 26 00 00: Electrical

1. REQUIREMENTS FOR DESIGN

A. Design with maintenance and repair as a priority, including working elevations, working clearances, replacement costs and operating costs. Additionally, be aware of the proposed OSU/Pacific Power process for reviewing electrical system designs and the sets of criteria required to recommend approval for new buildings or building specific improvements. Both OSU staff and Pacific Power propose using this tool (reference flow chart below) to properly evaluate future projects on a case-by-case basis. All design, engineering, and installation shall be done by licensed & bonded Contractors or Design Professionals.

B. The OSU/Pacific Power Future Project Evaluation Flowchart illustrates the proposed design review process and the set of criteria required to recommend each of the designs below for new buildings or building specific improvements projects moving forward. Both Pacific Power and OSU staff propose using this tool to properly evaluate future projects on a case-by-case basis.

C. Potential outcomes for the OSU/Pacific Power evaluation have been identified; however, a recommendation approach should not be inferred from the order presented.

i. Above Grade Outdoor 20kV Design: This electrical design includes individual building transformers being located outside in above ground containment. This design will be reserved for new buildings and building upgrades and expansions where a 20kV conversion is both feasible and cost-effective.

ii. Above Grade Outdoor 4kV Design: This electrical design includes the relocation of existing building transformers or switchgear outside into above grade enclosures. This design will be reserved for existing building upgrades or expansion projects where an upgrade to 20kV is not cost-effective or necessary, an outdoor design is feasible, and an indoor expansion or retrofit is either cost-prohibitive or not feasible.

iii. Below Grade Outdoor 4kV Design: This electrical design includes the relocation of existing building transformers outside into below grade infrastructure. This design will be reserved for existing building upgrades or expansion projects where an upgrade to 20kV is not cost-effective or necessary, an outdoor design is feasible, space for above grade enclosures is not feasible, and an indoor expansion or retrofit is either cost-prohibitive or not feasible.

iv. Indoor 4kV Upgrade and Retrofit: This electrical design includes the upgrade and retrofit of existing indoor facilities to accommodate new or improved indoor 4kV transformers. This design will be reserved for existing building upgrades or expansion projects where an upgrade to 20kV is not cost-effective or necessary, an outdoor design is not feasible and an indoor expansion or retrofit is both possible and cost-effective.
v. The warranty on all electrical installations begins at the date of substantial completion. The general contractor is responsible for the warranty for both labor and material. If there is no general contractor, the electrical contractor is responsible for the labor and material. The electrical contractor is responsible for code compliance from the beginning of the project to the end of the warranty. Acceptance of a design by a representative of OSU does not release the Design Professionals from the requirement that the design meet all applicable codes. The Design Professionals shall remain responsible for the design to the end of the warranty period.

2. REQUIREMENTS

A. Equipment and Installation Guidelines

i. During the initial planning, consult with OSU FS Electric Shop, regarding the choice of primary service voltage to be used, its location, and the capacity available.

ii. Contractor(s) and Design Professional(s) are responsible for addressing all the design review comments to the satisfaction of OSU Project Manager and stakeholder who provided the review comment(s).

B. Safety

i. The design shall meet requirements of all appropriate codes, standards and guidelines, including, but not limited to, the following codes and regulations: State and local, UL, NEC, NESC, NFPA, OESC, NEMA, NECA, ASHRAE, ISESNA, IEEE, ANSI, ADA, IBC, and OSHA. It is also important that all the equipment, devices and installations supplied and installed in all University’s Facilities meet high level of safety requirements. It shall also be known that the equipment, devices, and installation that fail to meet these requirements will not be accepted.
C. Short Circuit Study, ARC Flash Study and Overcurrent Protection Study: For all new building transformers or new buildings with electrical services where electrical work is being performed a short circuit study, an arc flash study and an overcurrent protection (coordination) study shall be provided.

i. The starting point of each study will be one overcurrent protective device “upstream” of the starting point of the scope of work of the project and terminating at the farthest point “downstream” affected by the “upstream” changes.

ii. Each study shall include the elementary diagram of the circuit being analyzed.

iii. The short circuit study shall depict the available fault currents at critical points in the distribution system. The study shall indicate the fault rating of the equipment being analyzed and designated with a “pass”/“fail” marking. Where available currents exceed the short circuit ratings of the equipment, the equipment shall be revised to a component with a higher short circuit withstand rating.

iv. The arc flash study shall be performed in accordance with NEC, NFPA and OSHA safety standards. Available fault currents shall be shown on the elementary diagram at critical points in the distribution system. The PPE level shall be provided at all switchboards, panels, disconnect switches, starters and similar electrical components with arc flash labels provided. OSU’s goal is to have, and the Design Professional should design, a system such that no more than PPE Class 1 is required for maintenance of any electrical equipment with the exception that in main electrical rooms, PPE Class 2 is acceptable.

v. Categories of PPE as described in NFPA 70E are:

<table>
<thead>
<tr>
<th>Category</th>
<th>Cal/cm²</th>
<th>Clothing</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.2</td>
<td>Untreated Cotton</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>Flame retardant (FR) shirt and FR pants</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
<td>Cotton underwear FR shirt and FR pants</td>
</tr>
<tr>
<td>3</td>
<td>25</td>
<td>Cotton underwear FR shirt, FR pants and FR coveralls</td>
</tr>
<tr>
<td>4</td>
<td>40</td>
<td>Cotton underwear FR shirt, FR pants and double layer switching coat and pants</td>
</tr>
</tbody>
</table>

vi. The coordination study shall be provided to assure both overcurrent and short circuit selective coordination provides an orderly shutdown and minimizes extent of outages.

vii. These studies shall be part of the design services.

D. Equipment belonging to other University Departments shall not be installed in Facilities mechanical or electrical rooms, unless permission is given by OSU FS Director in writing.

E. PROHIBITED MATERIALS AND CONSTRUCTION PRACTICES:

i. Extra flexible non-labeled conduit or non UL listed conduit.

ii. Plastic conduit for interior electrical use, except that PVC conduit may be used for power circuits below basement concrete floors in corrosive environments, and for ground wires in any location, or with approval from the OSU FS Electrical Shop. The transition from PVC to steel shall be made below the floor.
iii. Aluminum wiring/bussing shall not be used.
   a. Use of aluminum plated bus and aluminum wound transformers is prohibited.

iv. Use of incompatible Materials: Aluminum fittings and boxes shall not be used with steel conduit. All materials in a raceway system shall be compatible.

v. Use of wire ties to support conduit or raceway.

vi. Use of wood strips and wood screws to support lighting fixtures.

vii. Direct burial electrical cable.

viii. Electrical ducts crossing above gas piping.

ix. Ducts within ten (10) feet of a buried steam line in any direction. If it becomes necessary to cross a steam line, acceptable insulation of the crossing must be approved by the OSU FS Electric Shop.

x. Hard insulated wire connectors, which have Bakelite, are prohibited.

xi. Armored or metallic BX cable. (AC, MC, or BX)

xii. Nonmetallic sheathed cable.

xiii. Flat conductor cable type FCC, under carpet, etc.

xiv. Powder metal die cast connectors, fittings, and couplings.

xv. Locating equipment that requires access or ventilation less than four (4) feet from a wall, fence, or other screening material including, but not limited to, electrical equipment that permits or requires cooling; access for maintenance or cleaning; connection; and main distribution panels and equipment.

xvi. Bottom fed switches, breakers, or fuses.

xvii. Switches in which the blades pivot on the top.

xviii. Switches, breakers, etc. that require greater than 75 pounds of force on the operating handle.

xix. Irrigation controllers on shared circuits. See OSU Construction Standard 32 80 00 for more guidance on irrigation.

xx. Use of cable tray with medium voltage conductors.

xxi. Use of busway other than as permitted in “Busways” of this Division.

xxii. Use of busway, for panel risers, without a means of disconnect. Individual disconnect is required for each panel.

xxiii. Drilling or tapping of existing bussing in panel boards, switchboards, and motor control center. All spare spaces/motor buckets will have bus-ties installed.

xxiv. Troffers: Use of radiant ceiling panels.

xxv. Lamps not listed by an approved testing lab.

xxvi. Lamps (light engines, ballasts, drivers) provided by only one (1) manufacturer.

xxvii. Luminaires that require proprietary lamps.
Inverter Ballasts. (See emergency/standby systems)

Entrance to an Electrical Closet from a location other than a common use space such as a hallway, exterior door, or mechanical room.

Electrical panels or equipment that requires periodic maintenance located in offices, classrooms, ‘escort only’ spaces, or bathrooms.

Use of a bushing without a lock nut.

Use of communication cable tray to support power and lighting circuits/raceway.

More than two (2) offices on a single circuit. Multiple circuits are allowed for a single office as needed.

15A wiring devices unless required by the NEC or specific equipment.

Use of gray wire on 208Y/120 volt systems. Use of white wire on 480Y/277 volt systems.

Metal conduit covers supported by a threaded body for outdoor use in corrosive environments.

Piercing, push-in, or WACL type splices or connections (except for fixture wiring).

Recessed luminaires that require ballast/driver access through a 10-inch or less opening in a non-removable/non-accessible ceiling.

Sharing motor circuits with power receptacles.

Installation of light fixtures in a classroom, atrium, stairwell, or high bay that requires construction of scaffolding for service and maintenance; or installations without also providing the proper means for service and maintenance of said lights. Project must have approval of the OSU FS Electrical Shop for all high bay lighting above 12 feet from floor.

Panel enclosures that have stamped knock-outs.

Flexible conduit of any type used in interior partitions or in walls as a substitute for EMT, IMC, or rigid steel conduit.

Surface non-metallic raceways.

Battery backup ballasts in hard lid ceilings.

Self-luminous exit signs containing radioactive material unless specifically approved by Environmental Health & Safety (EH&S).

Fixtures that require use of proprietary lamps and ballasts and do not allow use of lamps or ballasts from other manufacturers.

3. ELECTRICAL MATERIALS AND METHODS

A. All materials shall be listed by an approved testing lab.

4. WIRE, CABLE, AND BUSWAY

A. Material:
   i. Copper conductors of 98 percent conductivity shall be used.
B. Secondary Conductors:

i. Color Coding
   a. Color coding for 480/277V and 208Y/120V shall be as follows:
   b. Label neutral at termination in panels with circuit number.

ii. Solid and Stranded Wire:
   a. No. 14 AWG and smaller may be solid.
   b. No. 12 and larger shall be stranded.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Voltage (208Y/120)</th>
<th>Voltage (480Y/277)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutral</td>
<td>White*</td>
<td>Gray*</td>
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<tr>
<td>A</td>
<td>Black</td>
<td>Brown</td>
</tr>
<tr>
<td>B</td>
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<td>Orange</td>
</tr>
<tr>
<td>C</td>
<td>Blue</td>
<td>Yellow</td>
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<td>Green</td>
</tr>
<tr>
<td>Ground</td>
<td>Green with Yellow Stripe</td>
<td>Green with Yellow Stripe</td>
</tr>
<tr>
<td>Isolated</td>
<td>Green with Yellow Stripe</td>
<td>Green with Yellow Stripe</td>
</tr>
</tbody>
</table>

*Each with identifiable color stripe

iii. Minimum Size for Lighting and Power Branch Circuits: No. 12 AWG.
   a. Use No. 14 AWG stranded for control wiring and auxiliary system circuits.

iv. Field installed cords to portable equipment shall be Hard Service Cord.

v. Circuit wiring through luminaire channels shall be 600-volt, 90 degrees C insulation. Fixture must be approved for through wiring.

vi. General Use Insulation: NEC, 600-volt type THHN/THWN or XHHW.

vii. Splices in No. 10 and smaller wire shall be made with threaded-on plastic or nylon insulated wire nuts. Piercing connectors, except butt connectors are prohibited. Joints in No. 8 and larger conductors shall be made with pre-insulated mechanical lugs.

viii. Any cable, including signal, communication, and low-voltage wiring, pulled in a raceway on grade or below shall be rated for wet locations.

5. WIRING DEVICES

A. Design

i. All wiring devices provided shall be 20A specification grade. New building devices will be ivory, white, or brown with stainless steel plates for standard and ground fault interrupter use. Generator backed devices shall be red with red cover plate. For existing building, designs shall match the existing color scheme that is prevalent throughout building.

ii. Placement of receptacles in University classrooms shall be coordinated with University Media department for locations and minimums of new technology for learning.
a. In standard size classrooms (49 students or less), provide one (1) double duplex receptacle at the front of the classroom centered under the chalkboard or marker board. Provide two (2) additional receptacles at the front of the room spaced half way between corners and double duplex receptacles. Back of the rooms to be provided with one (1) single duplex receptacle at the center of the wall. Remaining walls to be provided with two (2) duplex receptacles on each wall equally spaced.

b. In classrooms with 50 students or more provide two (2) duplex receptacles for the front wall, centered between the corners and one (1) double duplex receptacle at the center of the wall. Provide two (2) duplex receptacles equally spaced on all remaining walls.

c. Corridors shall be provided with duplex receptacles 35 ft. on center and a maximum of 10 ft. from each end of the corridor. These receptacles shall have separate circuits from the room circuits. In hallways and corridors adjacent receptacles shall be on alternate circuits.

d. Lecture halls shall be provided with one (1) double duplex receptacle centered on front wall and two (2) additional double duplex receptacles equally spaced between center double duplex and corners. Provide additional receptacles throughout for cleaning. These receptacles shall be a maximum of 25 ft. on center. If lecture hall is provided with a lab bench, then provide bench with one (1) double duplex for every 8 ft. of bench (on each side of the bench).

e. Computer labs shall be provided with at least two (2) general purpose receptacles equally spaced per wall in addition to all receptacles for computers.

f. Mechanical room shall be provided with at least four (4) duplex receptacles (one per wall) and additional duplex receptacles where walls are 25 ft. or longer. At least one (1) receptacle shall be fed from the standby panel and identified as such, and at least one (1) 30 amp receptacle will be available for a portable air compressor.

g. Projector and electronic display boards’ power shall be surge protected.

iii. Switches:

a. Switches provided for all uses shall be 20A specification grade. Color scheme shall match receptacles.

b. Switches provided at roof hatches or where provided outside of rooms they are serving shall be provided with pilot lights.

c. Wireless switches shall not be used.

iv. Cover Plates:

a. Generally cover plates for flush-mounted standard devices shall be stainless steel for interior use in new buildings. Where work is being performed in existing buildings, cover plates shall match the majority of the existing devices. In residential buildings covers shall be unbreakable nylon.

b. Cover plates for exterior use shall be a type which allows NEMA 3R rating to remain while in use. Where exterior device could be exposed to vandalism, provide locking type cover plates.

c. Cover plates shall be identified as to source (panel and circuit number).

6. HANGERS AND SUPPORTS
A. Requirements

i. Materials for Straps and Hangers: Heavy-duty malleable iron or steel. For installation in locations above grade that are subject to moisture penetration, specify corrosion-resisting steel. Perforated straps are not acceptable.

ii. Independent Support Systems: Required for all installations.
   a. Surface outlet boxes, to which fixtures are attached, and pull boxes shall be fastened to the structure independent of the conduit system supports.
   b. Conduits above suspended ceiling shall not be supported by a ceiling suspension system.

iii. Coordination with General Construction: The Design Professional shall include the following (or similar) statements in specifications for suspended lay-in ceilings:
   a. Surface mounted lighting fixtures shall be supported from the structure above independent of any ceiling system by use of an approved method.
   b. Flush or recessed fixtures in ceilings of the suspended lay-in type shall be installed so that the long dimension of the fixture is supported on the main support member of the ceiling system. Provide at least two (2) galvanized steel safety hanger wires or safety chains, attached from the fixture housing to the structure independent of the ceiling system. Wire or chain shall withstand a 3-foot, 50-pound drop test. In addition, the Luminaire Support Requirements of NEC shall be strictly followed. Manufacturer supplied grid clips must be utilized and installed per manufacturer instructions.
   c. Suspended ceilings in new construction shall have a minimum of 10 inches clearance below the lowest building structure, duct, and equipment.

7. RACEWAYS

A. Requirements

i. Interior Raceway and Fittings: Minimum conduit size for power and lighting circuits shall be 3/4-inch for home-runs. Minimum conduit sized for control wiring shall be ½-inch.
   a. Feeder/service conduits shall be sized for full load amperage rating of equipment supplied.

ii. Exterior Conduit and Fittings: Rigid galvanized threaded UL labeled conduit shall be specified where subjected to physical damage.
   a. Threaded couplings shall be used with rigid conduit and IMC.
   b. IMC may be used in place of rigid galvanized where permitted by code.
   c. EMT may be used where allowed by code.
   d. Feeder conduits shall be sized for full load amperage rating of equipment supplied.

iii. Steel Electric Metallic Tubing (EMT) UL labeled conduit may be used in interior partitions, above ceilings, and for surface application, except in corrosive and hazardous locations, where PVC coated rigid galvanized conduit is required to be used.
   a. Insulating bushings and insulated throat fittings shall be used throughout EMT installation.
b. Rain tight compression fittings shall be used outdoors. Set screw type fittings may only be used indoors.

iv. Plastic jacketed rigid galvanized steel conduit shall be used in corrosive atmosphere.

v. Flexible conduit shall be minimum size ½ inch. flexible conduit used for lighting fixture connections shall be minimum size of ½-inch unless part of a manufactured luminaire assembly. Maximum length shall be 6'-0". Flexible conduit of any type shall not be used in interior partitions or in walls as a substitute for EMT, IMC or rigid steel conduit. A ground wire shall be pulled in all flexible conduits. All flexible conduits shall be supported per NEC. Distance between supports as allowed per NEC.

a. Liquid tight flexible metal conduit shall be used on flexible conduit applications exposed to outdoor or moist locations.

b. Liquid tight flexible metal conduit shall be used in raised floor computer room applications.

vi. Rigid galvanized steel conduit shall be used outdoors, above grade, in damp locations where subject to physical damage.

vii. Conduit installed through a building wall shall have internal and external seals. Specify link seal or equivalent.

viii. Grounding: Conduit crossing building expansion joints shall have expansion provision with grounding continuity.

8. BUSWAYS

A. Requirements

i. The Design Professional may use feeder Busways in lieu of conduit and wire where approved by the OSU FS Electric Shop.

ii. Plug-in bus shall be used in shops where the load density provides an economic advantage over panels and shall not extend into more than one (1) space. Plug-in bus shall be copper. Busway shall be used to serve one (1) room or usable space. It is prohibited for busway to penetrate a fire rated wall.

iii. Indoor busway (if used) shall be water resistant per current ANSI/IEEE Standards.

iv. If use of busway is approved by special permission for a project, Contractor shall provide 10 percent of spare busway and 10 percent of total spare switches used. This includes when busway is installed in shop areas or specially approved conditions.

9. SURFACE RACEWAYS

A. Requirements

i. Surface raceway shall not be used in new construction except as approved by the OSU FS Electrical Shop in writing (via Design & Construction Standards Deviation Request Form).

a. If used on surface, proper fittings are to be used to feed the raceway. Any raceway mounted over flush mounted J-box shall have an opening not less than the opening of J-box.

ii. Surface metallic raceway with associated couplings, boxes, and fittings shall be mounted to the surface of the structure for the installation of electrical conductors and, when approved, may be used in the following locations:
a. In dry locations.

b. In Class I, Division 2 Hazardous (classified) locations and as permitted by National Electric Code (NEC).

iii. Surface non-metallic raceway shall not be used.

iv. Fittings and Boxes:

a. Raceway shall have manufacturer’s finish standard prime coating suitable for field painting.

b. The acceptable manufacturer for surface raceways shall include:

1) The Wiremold Co. Wiremold by Legrand US

c. All junction boxes, pull boxes, and conduit bodies above suspended ceilings shall be accessible by step ladder or lift, without dismantling the ceiling.

10. UNDERGROUND RACEWAYS

A. Requirements

i. All underground cables of any classification shall be installed in raceway systems. All the raceways for medium/high voltage shall be 6 inches in size and all others for street lighting and other applications shall be sized in accordance with the projected electrical load growth in the vicinity. Underground raceway systems for medium/high voltage systems shall be encased in concrete. Provide a red marker tape 18 inches above the conduits indicating “Danger Buried Conduits”.

11. SECONDARY ELECTRICAL DISTRIBUTION

A. Requirements

i. Magnetic Interference and Mitigation

a. Magnetic interference can pose major problems in the design and operation of electrical and electronic equipment, instruments, control systems, data processing equipment, and communication networks. This equipment frequently indicates aberrations whose sources may not be readily recognized, but which are due to magnetic interference. In general, such interference is classified as internal and external.

1) Internal interference, created by operation of components within the system itself, can usually be eliminated or nullified by shielding the individual components and confirming the magnetic force they create.

2) External interference is frequently caused by nearby or adjacent equipment such as transformers, medium voltage busway, or switching equipment, which generate magnetic “spikes” affecting apparatus which is not physically attached to the source of interference.

b. Special Protective and Preventive Materials: In addition to developing a basic protection design in preventing the penetration of magnetic interference, when it is required by this Standard to Design and specify EMF mitigation plans or strategies that will prevent and solve the magnetic interference problems, the expectation of this standard is to reduce EMF to below one (1) milligauss, even in the most complex field environment.
c. Special EMF Shielding Material: There are two means of EMF shielding that may be used to achieve effective prevention of magnetic interference or eliminate the existing problems.

1) In fields of low intensity, use CO-NETIC AA perfection sheet because of its high initial permeability and corresponding high attenuation characteristics. In fields with high intensity, use NETIC S3-6 sheet because of its high magnetic saturation characteristics. CO-NETIC AA Perfection Annealed Sheet are available in standard gauge .014” through .062” thick, in flat sheet sizes up to 30” x 59” or full sheet of .015” thick and 36” by 120”.

2) Installation: For wall or floor coverings, Design Professional shall specify that sheets shall be butted at seams, all seams flush and tight.

3) Fasteners: NETIC/CO-NETIC AA sheets shall be mounted to walls by non-magnetic fasteners to penetrate the shielding sheets. Hole in the NETIC/CONETIC AA alloy sheets for fasteners shall be drilled with standard metal drills (cobalt steel drill bits). Special fastening application (masonry, concrete, etc.) shall be consistent with EMF shield manufacturer’s recommended attachment procedures and EMU Building Design Standard requirements.

4) Seams: All seams between sheets to be covered by CO-NETIC AA foil, 0.01-inches thick by 4-inches wide, with factory supplied PST backing. Apply foil centered over the sheet seams and press down tightly.

5) Finishing: The CO-NETIC AA metal has a natural shiny, silver colored finish and will not rust. Gypsum wall board (dry wall) or approved other materials shall be applied over the CO-NETIC AA sheets after seams are covered. No magnetic fasteners are to penetrate the CO-NETIC AA sheets.

6) Installation: All medium voltage transformers and switch gear including motor control centers that are adjacent to or under offices, computer centers/rooms, or locations that will have the use of Sensitive Electronic Equipment (SEE) shall be shielded with ferromagnetic material.

7) Use a minimum 10 gauge ferrous steel sheet metal on the side(s) of walls where said offices or rooms are situated to prevent moving charges that produce Electric Magnetic Field (EMF) penetration that in turn destroys or distorts sensitive electronic equipment.

8) In order to have an effective shielding, the 10 gauge sheet metal shielding shall be overlapped at a minimum of 4-inches at every joint.

d. The Design Professional shall contact the University EH&S Office via the OSU Project Manager for details, if there should be any questions.

ii. Transformers (Under 600 Volts)

a. General purpose distributing transformers shall be single phase and three phase dry type, which are generally used with primaries feeding secondary distribution circuits. They shall be designed for the voltage of 120, 208, 240, 480, and 600 with ratings ranging from 500VA to 5000KVA and frequency of 60 Hz.

b. The transformers shall be designed for continuous operation at the rated KVA for 24 hours a day, 365 days a year operation with a nominal life expectancy and greater overload capabilities in accordance with the latest ANSI-C57. The temperature rise of these energy efficient transformers shall be 80 degrees C and shall be insulated with a UL recognized 220 degree C insulation system. Transformers shall have K factor rating as recommended by current ANSI/IEEE standards, where
required (i.e. computer center, lab, etc.). It shall have a 30 percent overload capability. Because of
the growth of computer labs in all buildings and use of wireless computers throughout the
University campus, all general purpose transformers in renovations and new construction shall be
K-rated transformers.

c. Transformers shall be designed for a low coil watt loss.

d. Coil and Core Assemblies:

1) Transformer cores shall be constructed with high grade, non-aging, grain-oriented silicon steel
   with high magnetic permeability, low hysteresis, and eddy current loses.

2) Transformer coils shall be wound of electrical grade copper and continuous wound
   construction. The neutral conductor shall be rated to carry 200 percent normal phase current,
   when required.

3) Enclosure shall be ventilated, heavy gauge sheet steel, primed and finished in gray baked
   enamel. The core and coil assembly of the transformers shall be impregnated with non-
   hygroscopic, thermosetting varnish, and cured to minimize hot spots and seal out moisture.
   The core of the transformer shall be grounded to the enclosure.

4) Transformer sound levels shall be designed in accordance with ANSI/NEMA recommended
   levels.

e. Provide minimum clearance working space of four (4) feet around transformers operating at 600
   volts, nominal or less to permit ready and safe operation adjustment, repair, and maintenance.

f. Transformers greater than 25 KVA shall not be mounted on or near walls adjacent to an office,
   computer room, or laboratory unless the wall is magnetically shielded.

g. Proper ventilation and cooling shall be provided at locations where transformers are installed to
   prevent the temperature in the room to rise above 75 degrees F.

h. Transformers shall be placed on a housekeeping pad no less than 4 inches thick.

i. Transformers shall not be suspended from structures above.

j. There shall be provisions made for replacing transformers with appropriate access (door openings
   and elevator areas).

k. Primary and secondary conductors and raceways shall be sized for the full rating of the transformer
   to the first piece of distribution equipment.

12. LOW VOLTAGE SWITCHGEAR SERVICE ENTRANCE

   A. Requirements

   i. Protective Devices: Main breakers and feeder breakers or switches shall be equipped with ground fault
      protection as required by applicable codes. In critical applications provide coordinated ground fault
      protection on feeder breakers. Provide settings and coordination information with the service manuals.
      (Must provide documentation that system coordination has been achieved.)

      a. All circuit breakers with solid state trip units shall comply with the following standards:

2) ANSI/IEEE – Withstand capability of relay systems to radiated electromagnetic interference from transceivers.

b. The maximum operating force required to open or close a switch or breaker shall not be greater than 75 pounds on the operating handle.

c. Vacuum breakers or vacuum switches may be used with the approval of the OSU FS Electric Shop in writing (via Design & Construction Standards Deviation Request form).

1) All switches shall be top or horizontal fed to the breakers.

d. Indicator lamps shall be LED or transformer type utilizing low voltage lamps.

e. Shall be placed on a housekeeping pad no less than 4 inches thick.

ii. Building service shall be connected for clockwise rotation from the utility power.

13. METERING (See Division 33 09 00, Instrumentation and Control for Utilities)

A. Functionality Requirements

i. Metering System: A system consisting of a building main meter, and submeters to meet Oregon Energy Efficiency Specialty Code (OEESC). All meters need a display.

a. Approved and acceptable building main meter: revenue grade power meters with bi-directional monitoring feature designed for renewable energy applications, allowing measurement of power imported from the utility grid as well as power exported from the renewable energy source, with Modbus RTU communication – to be approved by OSU Sustainability Office.

b. Approved and acceptable building submeters: revenue grade power meters with Modbus RTU communication.

c. Each individual KWH meter specified must have communications capability.

d. If complete meter setup cannot be done from the front panel, any required software, cables, and keys shall be provided to the OSU FS Electric Shop.

e. The height shall be five feet (5'-0'') from the finished floor to the center of the meter.

f. Provide four (4) current transformers and circuit monitor that indicate true RMS current for phase and neutral.

g. The monitor shall provide the following information:

1) Voltage: phase to neutral and phase-to-phase ABC.

2) Amps: present reading and 15-minute maximum demand ABCN

3) Kilowatt maximum demand based on 15-minute intervals.

4) Power factor, kilo VAR, kilo VAR, hour KVA.

ii. A 6-pole GE PK-2 panel-mounted test switch installed flush on switchgear for portable test metering by OSU FS Maintenance Personnel. Specify that three (3) left poles be factory wired to the phase current transformer secondary’s; wire the right hand pole No. 6 to the phase to neutral potential source. Current transformer poles shall have shorting auxiliary contacts.
a. If the meter used for KWHR reading does not have a meter serial number on the front of the display, then an engraved name plate shall be installed below the meter with the meter serial number engraved on it.

b. Avoid metering schemes that are only capable of measuring partial loads connected to the distribution system or electrical apparatus being monitored. Specify that the current transformers and the meter shall be installed to measure electrical load from the distribution system including fire pumps. The fire pumps shall be connected ahead of the main overcurrent protective device.

14. SERVICE DISCONNECT

A. Requirements

i. Fuses may be used in primary voltage services and motor controls.

a. UL classification fuses shall be used as required for time delay and current limitation requirements of the application.

b. Fuses for feeders and branch circuits up to 600 ampere shall be UL Class RK1 or RK5 with 200,000 AIC.

c. Fuses for secondary service mains and feeders over 600 ampere shall be UL Class L with 200,000 AIC.

d. Spare Fuses: Specify that a spare fuse complement be stored on existing metal shelves, metal mounting boards, or in a cabinet in the electrical switchgear room and that a typewritten and framed bill of material is mounted nearby. There shall be no combustibles stored or kept near transformers. If there is no existing storage or additional storage space is required, the Contractor shall provide a cabinet equal to Bussman SFC.

1) Spare fuse complement shall include a minimum of three (3) or 10 percent of the total (whichever number is greater) spare fuses of each class, ampere, and voltage rating installed, including primary fuses and control circuit fuses in switchgear and any equipment.

2) The above spare fuse requirements shall apply to all fuses, not limited to only the service disconnect.

15. GROUNDING SYSTEM

A. Requirements

i. Drawings and Specifications: Drawings shall show ground systems, protective conduit sizes, and relative locations. Specifications and drawings shall include detailed requirements of the grounding system. A reference only to the National Electrical Code, without elaboration, has proven to be insufficient. Specifying requirements only by referencing the code is prohibited. It is required that the Design Professional shall specify all requirements applicable, instead of referring only to National Electrical Code. This includes specifying the size and requirement of all grounding electrode conductors used for connecting to all code required grounding electrodes. It also includes sizing all equipment grounding conductors routed with the phase conductors. All sensitive electronic equipment (computer rooms, etc.) shall have single point grounding system originating at the service entrance ground.

ii. Transformer Grounds: as required by NEC for services.
iii. Equipment Grounds: A wire equipment ground shall be installed within the branch circuit conduit and be grounded to the cabinet of the panel board to an uninsulated ground bus. The neutral bar of the panel shall not be used for equipment grounds.

   a. Equipment grounds and the identified neutral shall not be electrically interconnected on the building side of the service ground.

iv. Convenience Outlets: Specify that a wired ground be provided for continuity of ground path from the device-grounding pole. Provide ground fault interrupter outlets in wet conditions and where required by NEC and other related codes.

16. DISTRIBUTION

A. Requirements

   i. Design: If feasible and when unit substations are provided, the secondary main breaker shall be made a part of the building distribution switchgear or switchboard. In no case shall the switchgear or switchboard or panel board be directly attached to the transformer. A minimum 12-inch transition section with solid barrier is required to reduce the transfer of transformer heat to the secondary section. Reduction of heat transfer may be accomplished with secondary throat or ventilated transition section.

      a. When double-ended substations are provided with tiebreakers, the tiebreaker shall be key interlocked with the main secondary disconnecting means requiring the spare key to parallel sections.

   ii. Equipment: Metal-enclosed switchgear or distribution boards shall be used in buildings or OSU Facilities at 600V and below for service entrance power, lighting distribution, and as the secondary sections of unit substations. Main service disconnecting, 1200 amp and larger, devices shall be individually mounted and clearly labeled. Feeder devices in the main switchboard or switchgear shall be individually mounted. Feeder devices in distribution panel boards shall be group mounted. The following components shall be specified as required:

      a. Service protectors
      b. Molded case circuit breakers
      c. Fusible switches
      d. Motor starters
      e. Low voltage AC power circuit breaker (generally limited to main or tie position)
      f. Bolted pressure switches
      g. Transfer devices or switches
      h. Instrumentation, metering, and relaying

         1) Type of Molded Case Circuit Breakers: These devices are available in the following general types:

            a) Thermal magnetic dash pot
            b) Magnetic only
c) Integrally fused

d) Current limiting

e) High interrupting capacity

2) It is required that all circuit breakers that are equipped with solid state trip unit must comply with low voltage switchgear protective devices of this Division.

a) Air circuit breakers shall be draw out type, installed in individual compartments.

b) Circuit breakers shall not be applied in “cascade”.

3) The handle operating force on all equipment shall be 75 pounds or less.

a) Provisions for Additional Circuits:

i) Size of Switchgear or Switchboard: Select a size that will provide sufficient spare spaces, complete with bus and bus ties. A minimum of one (1) fully bussed spare section shall be provided. Provide the following spare switches at the design stage:

- Four (4), 100-amp/3 poles
- Four (4) 200-amp/3 poles

b) Additional Section: Provide space in the bus arrangement (bus ties) for the addition of future switchgear or switchboard sections. Switchgear and panel boards shall be accessible with a 4-foot minimum working clearance on all sides requiring access.

4) Instrumentation shall be per “Metering” section of this Division.

5) Service to Fire Pumps: Fire pumps shall be served and protected as required in NFPA No. 20.

6) Use switchboard instead of panel board for standby systems for the purpose of future growth and expansion. The switchboard shall be equipped with metering systems as required in “Metering” section of this standard.

7) When adding switches, circuit breakers, bus plugs, or motor starters to existing equipment, the Design Professional shall include the following in the design documents:

a) The manufacturer’s nameplate data including manufacturer and catalog information of the existing equipment.

b) If the equipment is no longer manufactured (e.g., Continental, Arrow Hart, Crouse Hinds, etc.), the Design Professional will contact a company that specializes in obsolete equipment and obtain the bidding information.

c) The Design Professional will provide cost analysis to replace obsolete equipment with current technology.

17. GENERAL PURPOSE POWER AND LIGHTING CIRCUITS

A. Requirements

i. System Design: Design feeders for a voltage drop of not more than 2 percent between service entrance terminals and branch circuit breakers terminals with a capacity for 30 percent load growth at
completion of project, unless greater growth is designated by the University in the initial planning conference.

ii. Feeders: Feeder ratings shall not be such a large percentage of the main that coordination of time and current and interrupting capacities cannot be achieved.

iii. Wiring: Specify that all feeders be installed in galvanized rigid conduit or electrical metallic tubing (EMT).

iv. Distribution panels shall only serve the resident floor or level they are on and have four (4) or more ¾” diameter EMT stub-up spares that are accessible as applied to wiring methods.

v. Design branch circuits for a voltage drop of not more than 3 percent between the branch circuit breakers and the load. As a minimum, increase conductors a minimum of one size when 120-volt branch circuit home runs exceed 100 feet.

vi. Lighting circuits shall not be loaded to exceed 60 percent of panel breaker rating.

vii. Branch Circuit Panels: Panels for lighting, convenience outlets, small motors, and equipment shall be molded case circuit breaker type with thermal-magnetic trip and AC and DC ratings. Provide for spare circuits.

   a. Breakers shall be 20 ampere, 1 pole breakers, mounted in the panel with either bolt-on or stab-on connections.

      1) Trip rating of breakers for lighting and general use convenience outlets shall be 20 ampere. Provide other sizes, to the OSU FS Electric Shop, as required for special loads.

   b. Sub-Feed Breakers (for new construction): Panels shall not have sub-feed breakers. If multiple panels are supplied from a long feeder, use sub-feed lugs or separate splice box with full size tap to panel mains. Provide individual disconnects for isolation.

   c. 120/208 volt panel boards shall be designed to 50 percent fill and no more than 70 percent fill at completion of project. An additional panel board shall be installed where these conditions cannot be met. All panel boards shall have a minimum of four (4) ¾-inch spare conduits terminating in accessible space.

   d. When installing new branch circuit lighting panels on a project the following shall be considered:

      1) All new panels shall be 42 pole minimum. The Design Professional(s) shall provide each new panel with a minimum of 30 percent spare 20 amp single pole circuit breakers. Any additional spare locations shall have a breaker installed. The Design Professional(s) shall design an additional panel when these minimums cannot be met and spare breakers shall be included.

      2) New panels shall be 200 ampere minimum for 208Y/120 volt, 3 phase, 4 wire service and 100 ampere minimum for 480Y/277 volt, 3 phase, 4 wire service. Do not provide 240/120 volt, 3 phase, 4 wire tapped delta systems. Where 240 volts is required, use of buck/boost transformers is required.

      3) Any new or existing building with 3 phase service shall only have 3 phase panels provided.

   e. Power panels shall be equipped with molded case circuit breakers of adequate interrupting capacity per NEC.
18. FEEDER CIRCUITS

A. Requirements

i. System Design: Design feeders for a voltage drop of not more than 2 percent between service entrance terminals and branch circuit breakers terminals with a capacity for 30 percent load growth above initial design, unless greater growth is designated by the University in the initial planning conference. (Feeders shall be sized to the panel capacity not the calculated load.)

ii. Feeders: Feeder ratings shall not be such a large percentage of the main that coordination of time and current and interrupting capacities cannot be achieved.

iii. Wiring: Specify that all feeders be installed in galvanized rigid conduit or electrical metallic tubing.

19. MOTORS AND MOTOR CONTROLS

A. Requirements

i. Related Work: Air conditioning chiller starters and fire pump controllers shall be specified with the equipment in Divisions 21 and 23. Wiring from switchgear or switchboard to this equipment shall be specified in Division 26.

ii. NEMA and NEC Requirements:

   a. Motors and motor control equipment shall conform to NEMA voltage ratings. A motor rated at 230 volts only may not be used on a 208V system. The Design Professional shall specify a 208V motor.

   b. Motor branch circuit protective devices shall meet all the requirements of the current NEC.

iii. Motor Control Centers: Class I, Type B with terminal strip terminations.

   a. Locations: Centers shall not be located where ambient temperature could cause de-rating of overload devices.

   b. Overload heater charts shall be furnished, mounted inside doors of cabinets or separately framed, and mounted outside the equipment.

iv. Reduced Voltage Starters: Motor sizes shall be such that, if the inrush current exceeds 40 percent of the building transformer rating, then motors shall be equipped with a variable frequency drive, reduced voltage starters of the closed transition auto transformer, star-delta type, solid state soft start, or current ramp starters.

v. Variable Frequency Drives

   a. Required drive manufacturers shall be ABB or Danfoss.

vi. Operating Protection:

   a. Certification by the motor manufacturer that motors meets the voltage requirements of NEMA.

   b. Overload Relays: Polyphase motor controls shall be equipped with three (3) overload relays. Reduced voltage starters shall provide overload protection during the starting step.
c. Provide 20 percent spare starters of each size used and provide 25 percent spare positions for additional starters. Provide space on floor for one (1) additional section and appropriately sized spare conduit run from MSG to immediate area.

20. MOTOR STARTER APPLICATIONS

A. Requirements

i. Starters for 600V and Below: The design must conform to ANSI/NEMA ICS2-1983 (26). This is a requirement for magnetic controller ratings of 115-575V. AC motor starters and contactors may be used for controlling the circuit to the motor. This standard requires that starters should be carefully applied on circuits and in combination with short circuit protective devices such as circuit breakers, fusible disconnects that will limit the available fault current and let through energy level that the starter can safely withstand. This withstand rating must meet the requirements of ANSI/UL 508/1983 (29) and ANSI/NEMA ICS1-1983 (25), (26) which cover controls, systems and devices.

a. The starters shall not be used without an adjacent line switch. If unfused disconnect switch is used or installed, it must be close to each motor as much as possible. This standard forbids the installation of a remote switch with lock arrangement, switchgear, switchboard, or a unit in a control center.

b. Each starter will identify controlled device and its location and each motor shall identify its control.

21. EMERGENCY/STANDBY POWER SYSTEMS

A. Requirements

i. All new buildings and major renovations where labs, research equipment, or fume hoods are to be installed shall include a standby generator and system monitoring.

a. All conductors and associated equipment supplied by generator shall be sized for the full load potential of the generator.

b. Distribution panels shall only serve the resident floor or level they are on and have four (4) or more ¾” diameter EMT stub-up spares that are accessible as applied to wiring methods

ii. Alternate Power Sources: Where the interruption of electric power supply to a building would result in a hazard to life, major loss of research, property, or equipment, provision shall be made for a standby supply of power to be used in the event of failure of the normal supply. Details of the plans as they apply to the project shall be explained and included in the early design development submittal and meetings.

iii. Automatic Transfer Equipment: Reliable equipment and transfer switch must be specified. Where both emergency systems and standby power systems are provided, separate transfer switches shall be provided for each system. Refer to current NEC for system descriptions.

a. Design Professional shall make provisions for all transfer switches to notify Public Safety on generator start command, other than exercise.

iv. Emergency/Standby Systems: It is required that provision be made by designing an emergency system/standby power source supplied by:

a. Engine generator

b. Separate emergency source
v. Generators and transfer switches shall be Cummings or Caterpillar.
a. Emergency generators shall be natural gas or diesel engines depending on the availability of natural gas and the size of the unit.
b. Generators shall be installed outdoors.

vi. Generator enclosures shall have a minimum clearance of four (4) feet, unless otherwise specified by the manufacturer for air flow, and all doors and panels shall open to 90 degrees.

vii. Electrical lighting and power equipment fed from an emergency/standby generator shall be identified red. In both public and non-public areas, the equipment shall have a distinctive warning sign and indicate the location of both sources of power.

viii. An emergency/standby panel board shall be provided for the following:
a. Exit lights
b. Required egress lighting.
c. Fire alarms, building security equipment, and fire protection systems; this does not eliminate the need for batteries. Batteries shall be tested to indicate amp hour availability. The manufacturer shall provide documentation that indicates conformance with required rating to the University.
d. Elevators and elevator rooms
e. Emergency illumination shall be part of emergency lighting that shall include illuminating all required means of egress lighting, illuminated exit signs, stairwell lights, and all locations where emergency lighting must provide at least code required minimum illumination to allow easy and safe egress from the area involved. Inverter ballasts/drivers are prohibited.
f. Electrical Service equipment room and mechanical room lighting
g. Generator enclosure space lighting
h. Building system equipment which is used to heat the building (to prevent freeze-up in the winter) to include heat pumps, condensate pumps, control air compressors, and other equipment as may be designated by the OSU Facilities Services.
i. Motor Control Centers (MCC), branch circuits and feeders that supply fume hoods, sump pumps, condensate pumps, building control air compressors, and related equipment.
j. Building automation systems
k. Animal room exhaust
l. Use and installation of emergency or battery backup up emergency lighting shall not be installed for ANY emergency fixture installation above a hard lid. In place of these types of fixtures a wall mounted ELM should be used.

ix. Wiring for emergency systems shall be in separate conduits. Specify that all emergency system junction boxes and covers shall be labeled according to code requirements.
a. Switches for emergency lighting circuits shall not be accessible to the public without a UL 924 device.
x. All new generators are required to have load bank camlocks installed, appropriately sized to allow load bank testing at 100% of generator capacity.

xi. A minimum of four auxiliary contacts shall be provided within all transfer switches servicing the building for customer connections for monitoring status of the automatic transfer switches.

22. ELECTRICAL PROVISION FOR ELEVATORS

A. Requirements
   i. Wiring and Switching: Wiring shall be extended to heavy-duty lockable fused switches located in elevator machine room.
   ii. Emergency Circuit: An emergency circuit to the elevator machine room shall be provided for the elevator cab light, fan, and equipment room.
   iii. Pit Installations: Refer to Division 14. A light, light switch, and GFCI convenience outlet must be provided in the pit of each elevator, each on separate circuit.
   iv. Passenger elevators that serve mechanical rooms shall be connected to an emergency generator.

23. LIGHTING

A. General Requirements
   i. Lighting design shall use an appropriate combination of natural, area, and task lighting with security type lights where necessary to meet appropriate Illuminating Engineer Society (or similar) recommendations. (Efforts should be made to minimize electricity consumption from lighting by striving to reduce foot-candle levels.) Lighting should fit task-area requirements only. General-area lighting is to be selected at a lower intensity to accommodate access and non-critical sight needs.
   ii. All lighting will be provided with disconnecting means in acceptance with the current NEC.
   iii. OSU FS Electric Shop requires replacement pricing for both ballasts/drivers and lamps, to be supplied at the design phase of the project and with the electrical submittals. The use of self-luminous exit signs containing radioactive material is prohibited unless specifically approved by Environmental Health & Safety (EH&S).

24. LIGHTING SYSTEMS

A. Dimming control systems shall be reviewed and approved by OSU FS Electric Shop.

B. Worldwide Color standards: Color coordinates shall follow the proposed IEC/ANSI color standards regardless of the country of manufacture. Campus standard is 41K. 4000k is acceptable for interior LED lighting.

C. ANSI standards: Lamps shall comply with applicable ANSI standards.

D. See the end of this section for information on parking lighting and historic fixtures.

E. Areas under construction shall have temporary lighting for nighttime. If exterior lighting is disrupted by construction the project shall provide equivalent lighting for safety and access.

F. All interior light fixtures shall be accessible by a step ladder, 8 feet or less, placed in accordance with OSHA standards or one of the following:
i. A permanently installed means of access.

ii. A building specific means (supplied by the project) of access (platform lift, custom built scaffolding, etc.) stored in a readily accessible location on site and in place at the completion of the project.

iii. A 9-foot mounting height is accessible from an 8-foot ladder.

G. All exterior lights shall be accessible by means currently owned by OSU without damage to buildings or plantings. Exterior lights must be installed and operated to prevent “up lighting” into the night sky, per the City of Corvallis Land Development Code.

H. No in-ground lights allowed.

I. Fixtures incorporating lamps, other than those listed in OSU FS Stores inventory, shall not be used unless a written request to waive this requirement has been approved by the OSU Project Manager and OSU FS Electric Shop (via Design & Construction Standards Deviation Request form).

i. For unique lamps and ballasts/drivers, ten (10) of each type or 10 percent of each lamp and ballast, driver & light engine whichever is greater, shall be added to inventory designated storage room in the building served by the project. Inventory to be added by the time of project commissioning.

ii. Fixtures to have replaceable drivers & light engine (whichever is greater)/lamps/light modules – to be located in the building’s designated Storage Room

J. All recessed can luminaires shall be 120 volt and have self-ballasted lamps. Ten (10) of each type of lamp or ten percent of each lamp, whichever is greater, including any and all LED lighting, shall be added to a designated storage room in the building served by the project. All re-order information shall be provided be included in the Project closeout package.

i. It is prohibited to install recessed luminaires in non-accessible ceiling.

K. A list of all lamp types and ballast/driver types, shall be provided within the Closeout Documents provided by the Contractor to OSU.

L. All wall switches/control devices shall have an approved raceway to above an accessible ceiling.

25. ELECTRONIC BALLAST/DRIVERS

A. Performance Requirements

i. Starting Temperature: The electronic ballast shall provide for a minimum lamp starting temperature of 0 degrees F. depending on the ballast model and installation conditions.

ii. Ballast Output: The ballast output shall be protected against lamp rectification or shorted output leads.

iii. Case Temperature: The ballast shall have a maximum case temperature rating of 70 degrees C.

iv. Internal Protection: The ballast shall have internal protection to prevent catastrophic failure.

v. Ballasts shall be universal 120V/277V input.

vi. Drivers shall be accessible per NEC. If drivers cannot be easily accessed, they should be located remotely and each location identified per fixture.

26. PRODUCT SPECIFICATION
A. Warranty:
   i. The manufacturer shall provide a written warranty against defects in material or workmanship, including
      replacement, for five (5) years from date of substantial completion and include a nominal replacement
      labor allowance.
   ii. LED luminaires shall have a ten (10) year warranty on driver and light modules. Ten (10) of each type of
      driver and light module or ten percent of each driver and light module, whichever is greater, shall be
      added to the OSU FS Stores inventory by the project. All re-order information shall be provided to OSU
      Electric Shop, with all specifications.

27. LIGHT LEVELS GENERAL

A. All new lighting installations at the University shall comply with the latest version of ANSI/ASHRAE/IES
   Standards. Lighting levels are to be designed at the highest level, per chosen reference material, for the
   designed space or area. Outdoor lighting levels are to be at the highest accepted lighting standard for the
   considered space. The referenced light levels are understood to be a maintained light level. Light levels are
   measured at a 30-inch height from the floor or at the actual work surface and represent the average level for
   the area or workstation.

B. Special lighting applications, such as recreational field lighting, shall comply with the latest Illuminating
   Engineering Society (IES) standard.

C. Student Study Areas and Classrooms: Provide 40 to 60 foot-candle light level at workstation. Workstations
   equipped with video display terminals (VDTs) or computers should be illuminated with 30 to 50 foot-
   candles as recommended by the latest edition of the National Institute for Occupational Safety and Health
   (NIOSH) standards.
   i. Switching in classrooms shall provide for switching the fixtures in the front and seating area separately
      to facilitate the use of video projection, etc.
   ii. Light fixtures at workstations with video display terminals or computers should be located
       perpendicular to device in order to minimize glare and viewing difficulty.

D. Staff and Faculty Office Workstations: Provide 40 to 50 foot-candle light level at workstation.

E. Workstation Where Critical or Fine Work is performed, as in Laboratories or Drafting Rooms: Provide 50 to
   70 foot-candle light level.

F. Corridors, Stairwells, Lobbies, Waiting Rooms, Storage and Service Areas: Provide 10 to 20 foot-candle light
   level.

G. Restrooms, Lockers and Showers: Provide 20 to 30 foot-candle light level.

H. Lecture Hall and Auditorium Lighting: Provide 40 to 60 foot-candle light level at all seating locations. For a
   lecture hall stage area, provide 40 to 60 foot-candle light level. For an auditorium stage area, the lighting
   shall comply with or exceed the latest IES standard. Provide separate switching for stage and seating area.

I. Parking Ramp Interior: Provide 1 to 3 foot-candle light level in the traffic lanes, 1 to 3 foot-candles in the
   parking areas and 1 to 3 foot-candle light level at the entrance/exit. All values are average maintained
   horizontal foot-candles. Uniformity shall be 10:1 for the entire area. HPS shall not be used in a parking
   structure.
J. **Outside Security, Building Perimeter, Parking Lot and Outside Walkways:** Provide 1 to 3 foot-candle light level.

K. **Outdoor lighting levels shall be designed to comply with current IES standards for the area or as follows:**
   
   i. **Primary walkways and problem areas:** 1 foot-candles average and .5 foot-candles minimum.
   
   ii. **Secondary walkways and other areas:** .5 foot-candle average and .10 foot-candle minimum.
   
   iii. **Primary streets:** 2 foot-candles average and .25 foot-candle minimum.
   
   iv. **Parking lots:** 1 foot-candle average and .25 foot-candle minimum.

L. **Temporary Site Lighting During Construction:** Sufficient lighting shall be provided such that Campus Police may observe the entire area. Provide a light level of 1 to 3 foot-candles. The Contractor is responsible for providing temporary lighting outside of the project area if the project interrupts the normal lighting to the area.

M. **Mechanical Rooms:** Provide 50 to 60 foot-candle light level. Provide emergency egress lighting.

28. INTERIOR LIGHTING

A. **Requirements**

   i. **Recommended Fixtures:** Drivers shall be readily accessible per NEC. Incandescent lighting may be used only with the written permission of the OSU FS Electric Shop. Any department requesting approval of incandescent lighting must be willing to accept financial responsibility for the maintenance of the incandescent lighting. Where incandescent lamps are used as part of an equipment system or alarm, provide six (6) spare lamps of each wattage.

      a. High pressure sodium (HPS) lamps shall not be used indoors. For warehouse areas and high ceilings over 20 feet, LED Lamp may be used.

      b. Metal halide lamps shall only be used in areas where there is assurance that they will be turned off at least once a week; this reduces the possibility of an explosion at end of life. Their use should be limited to areas in which network television coverage is expected, accurate color rendering is required, or gymnasiums.

      c. **LED Fixtures:** All fixtures shall be independently supported from the structure above. Fixtures shall be all metal with hinged shielding where required for architectural effect. 277-volt fixtures shall be used, except recessed luminaries, where this voltage is available. Fixtures shall meet or exceed the requirements of the latest version of ANSI/ASHRAE/IESNA Standards.

      d. **Quartz lamp fixtures shall not be used.**

      e. **LED luminaires selected shall have a 10 year warranty and have standardized replacement light module and driver. (Recessed LED fixtures will be an “Edison Base” fixture.)**

   ii. **Lenses shall not be specified as an alternative for louvers.** If lenses are required for the job, the job shall be engineered for these units.

   iii. **Specify the use of exit signs utilizing Light Emitting Diodes (LED) light source with life expectancy greater than ten (10) years.**
iv. Incandescent Lamps: When approved by the OSU FS Electric Shop, specify the 130-volt, inside frosted lamp for rough duty application.

v. Lighting Safety: Stairwells in buildings shall have sufficient fixtures so that the loss of one (1) lamp or ballast will not leave the area dark. The mounting of the fixtures shall not exceed 8-feet and must be accessible from a flat landing area. Fixtures shall have lenses; no bare lamps shall be permitted. Stairwell and all egress lighting circuits shall be fed by e-panels from a generator (if available.)

vi. Provide the following spare parts with the listed quantities for all luminaires for each item and size required: Spare products shall be the percentage or the minimum, whichever is greater. Spares are to be added to a designated storage room in the building served. All re-order information, for lamps, ballasts, lighting modules, and drivers shall be provided to OSU FS Electric Shop.

   a. Ballasts/drivers: 10 percent or a minimum of ten (10) of each type.
   b. Lamp Sockets: 10 percent or a minimum of ten (10) of each type.
   c. Fixture Lenses and Supporting Hardware: 10 percent or a minimum of ten (10) of each type.
   d. Specialty lamps or light modules (those not carried by the OSU FS “Stores”): 10 percent or a minimum ten (10) of each type.
   e. Luminaries/light fixtures minimum of 5 or 5% whichever is greater.

vii. All submittal reviews for luminaires and ballasts, light engines/modules and drivers shall include the following:

   a. Catalog cut sheets and replacement costs.
   b. Lists of spare parts with quantities to be furnished.

29. EXTERIOR LIGHTING

A. Requirements

   i. Lighting for the entire site, including driveways, walks, parking areas, and the building perimeter shall be included in the contract documents.

   ii. Fixtures: fixtures mounted on the building or on suitable standards are required for all exterior site lighting. These fixtures shall be automatically controlled by photocell(s) and/or the automated building management system and also have an accessible bypass.

      a. Light control shall be provided on all exterior lighting fixtures. The fixture shall be insect proof. Vandal proof fixtures shall be used if the fixtures are mounted 10 feet or less off the ground.

         1) Exterior lighting shall not be dimmed or controlled by motion/occupancy sensors for pedestrian safety.

      b. Spares: provide the following spare parts with the listed quantities for all luminaires for each item and size required. Spare products shall be the percentage or the minimum, whichever is greater. Spares are to be added to the OSU FS Electric Shop. All re-order information, for lamps, ballasts, lighting modules, and drivers shall be provided to in the Closeout Documents.

         1) Ballasts/drivers: 5 percent or a minimum of three (3) of each type.
2) Lamp Sockets: 10 percent or a minimum of ten (10) of each type.
3) Fixture Lenses and Supporting Hardware: 10 percent or a minimum of (10) of each type.
4) Specialty lamps or light modules (those not carried by the OSU FS Electric Shop): 10 percent or a minimum of then (10) of each type.

c. Building Mounted Light Fixture
1) Lights mounted to the exterior of a building shall be approved by the OSU Electrical Supervisor via the Project Manager. For locations within the OSU Historic District, University Land Use Planning shall be consulted (via the Project Manager) for design and permitting requirements.

d. Parking Lot Light Fixture
1) Approved Parking Lot Light Fixture: KIM CCS21. The Design Professional to propose the option that best fits the lot layout.
2) Fixture: PC> Size: diameter – 21-inches.
3) Light source: 4000k LED Voltage: multi-tap transformer. Any color deviation to be approved by OSU Electrical Supervisor via a Deviation Request approval coordinated through the Project Manager.
4) Optics: Type 5.
5) Mounting arrangement: 2" Tenon fitter.
6) Color: gray.
7) Options: Slip-fit fixture arm.

e. Historic Pedestrian Light Fixture
1) See the City of Corvallis Land Development Code for down lighting requirements
2) Visco Series A
3) Cast iron base, 12-foot tapered, fluted steel pole, (14'-2" plus or minus 1" to lamp centerline)
4) #199 two piece acrylic globe.
5) Multiap ballast/driver.
6) AVISTA AVIG3 SY-30-P3-LED Assembly (3000k). Any color deviation must be approved by OSU Electrical Supervisor via a Deviation Request as coordinated by the Project Manager.
7) Available through Valley Iron and Steel Co. (VISCO) 29579 Awbrey Lane, Eugene, Oregon 97402-9639, Phone (541) 688-7741.
8) Shall be painted “OSU Black”: Benjamin Moore #80 6403-23028; 50 percent gloss. All cast iron and steel light pole parts are to be factory finished painted to “OSU Black”. All surfaces are to be sandblasted and free of any mill scale, rust, dirt, or grease prior to application of primer. Primer to be lacquer resistant, phenolic modified alkyd similar to “Barrier III Rust Inhibitive Primer” as manufactured by Rodda Paint. The primer shall be applied to give a “dry film thickness” of 1 ½ - 2 mils. The finish top-coat shall be a polyurethane, two-component
coating, that can be applied a minimum of one (1) hour after primer. The finish top-coat shall be similar to “Polycoat II” as manufactured by Rodda Paint. Two finish top-coats shall be applied with each giving a “dry film thickness” of 1 ½ - 2 mils, and has a minimum dry time of twelve (12) hours.

9) Lay out must be in straight lines adjacent to sidewalks and walkways. Location is typically on the building/facility side of the sidewalk/walkway.
10) Provide a Junction Box at the end of each lighting run. Provide an extra conduit for future capacity at every fixture. Extend conduit beyond footing and adjacent concrete so it can be easily accessed in future. Stub location and depth shall be provided on as-builts and to the OSU FS Electric Shop.

11) Banners must be mounted on dual arms to a Historic Light Fixture. Maintain a 7'-0" minimum vertical clearance for pedestrians from the sidewalk to the lower arm. See diagrams. Note that poles are tapered when ordering the arms. The arm length is 24-inches.
f. Historic Overhead Light Fixture

1) See the City of Corvallis Land Development Code for down lighting requirements.

2) Visco Series A

3) Cast iron base, 20-foot tapered, fluted steel pole.

4) Multiap ballast/driver

5) Cobra Luminaire, Catalogue Number: VI-A7-1-F/20'

6) Available through Valley Irion and Steel Co. (VISCO) 29579 Awbrey Lane, Eugene, Oregon 97402-9639, Phone: (541) 688-7741

7) Shall be painted “OSU Black”: Benjamin Moore #80 6403-23028; 50 percent gloss. All cast iron and steel light pole parts are to be factory finished painted to “OSU Black”. All surfaces are to be sandblasted and free of any mill scale, rust, dirt, or grease prior to application of primer. Primer to be lacquer resistant, phenolic modified alkyd similar to “Barrier III Rust Inhibitive Primer” as manufactured by Rodda Paint. The primer shall be applied to give a “dry film thickness” of 1 ½ - 2 mils. The finish top-coat shall be a polyurethane, two-component coating, that can be applied a minimum of one (1) hour after primer. The finish top-coat shall be similar to “Polycoat II” as manufactured by Rodda Paint. Two finish top-coats shall be applied with each giving a “dry film thickness” of 1 ½ - 2 mils, and has a minimum dry time of twelve (12) hours.

8) Provide a Junction Box at the end of each lighting run. Provide an extra conduit for future capacity at every fixture. Extend conduit beyond footing and adjacent concrete so it can be easily accessed in future. Stub location and depth shall be provided on as-buils and to the OSU FS Electric Shop.
g. Mow Collar for Historic Pedestrian Light Fixture and Overhead Light Fixture

1) Must have 24-inch radius concrete collar (see diagrams).
iii. Fixture Location:

a. Fixtures shall be located in such a manner that dark voids and excessive glare in windows are eliminated. Accessibility for servicing must be considered in locating fixtures. All fixtures shall be accessible by means currently owned by OSU Facilities without damage to landscape or plantings. Consideration must also be given to light spillage onto adjacent facilities (existing or planned) such as greenhouses, which are light sensitive. Use directional or shielded lighting as necessary to prevent light trespass and comply with City of Corvallis Land Development Code requirements.

b. Layout must be in straight lines adjacent to sidewalks and walkways. Location is typically on the building/facility side of the sidewalk/walkway.

c. Fixture locations shall be designed in concert with the Landscape Architect/Design Professional so as to prevent future blocking of fixture by vegetation at maturity.

1) Intersection and Mid-block Crossings:
Informational Report on Lighting Design for Midblock Crosswalks

https://www.fhwa.dot.gov/publications/research/safety/08053/

a) Figure 2. Drawing. **New design** for midblock crosswalk lighting layout.

![Drawing](image1)

b) Figure 4. Drawing. **New design for intersection** lighting layout for crosswalks.

![Drawing](image2)
30. LIGHTING CONTROLS

A. Requirements

i. Automated lighting controls shall not be used where safety may be jeopardized, e.g., stairwells, labs, kitchens, mechanical spaces, restrooms, walk-in coolers/refrigerators, and workspaces.
   a. Exceptions may be submitted to OSU FS Electric Shop for review.
   b. All systems will have a manual bypass feature installed.
   c. All lighting control devices and controllers shall be field programmable by OSU FS Electric Shop personnel.
   d. All devices, addresses, labels, conductor routing shall be accurately labeled and placed on a hard copy drawing and delivered to OSU FS Electrical Shop at owner training for lighting controls.
   e. All devices and lighting control components shall be connected and routed through an approved raceway system.
   f. All components associated with lighting controls shall be installed in an accessible space for future access and repair/replacement.
   g. Factory training must be provided by project for certification of two (2) members of the OSU FS Electric Shop.
h. Software for controls, designated laptop with programming installed and uploaded and all associated connections, cables, adaptors and hardware should be delivered to the OSU FS Electric Shop at owner training for lighting controls upon completion of the project. The project provided laptop and associated programming shall be used to conduct the owner training for lighting controls upon completion of the project.

ii. Multiple Switching: The use of multiple switching shall be evaluated for each space and condition. Where possible, switching shall be circuited to effectively use natural lighting from windows; to permit light reduction during partial occupancy; and to permit reduced lighting for custodial activity.

iii. Occupancy sensors shall not be used as the sole means of switching. Manual switches will be provided in all areas with occupancy sensors. Occupancy sensors shall not be used in mechanical rooms, electrical rooms, or other areas where safety would be jeopardized. At installation, set all sensors to maximum sensitivity and maximum time delay. Use manual on / auto off where applicable.

iv. All lighting control wiring in inaccessible space (walls and ceilings) shall be in approved raceway.

v. Remote switching by means of a central control should be evaluated for new construction and for large renovation projects.

vi. Dimming Control: Access to dimming controls shall be readily accessible at all times without escort of other departmental personnel.

vii. Wireless devices that control occupancy and/or dimming shall not be used.

B. Lighting control panel shall either be Cooper Greengate or Nlite.

i. The control panel/panels required for the dimming system shall have the UL label. Each dimming module shall be UL tested and tested specifically for the type of load it is controlling. Each dimmer module shall possess a means of easily disconnecting power on an individual module-by-module basis.

a. Dimming panels shall be cooled without the use of cooling fans without exception and shall be capable of operating as such in an environment of 0 degrees to 40 degrees centigrade. Satisfactory independent laboratory test results shall be required, that at +40 degree centigrade and at full load, the maximum temperatures of both filter chokes and SCRs/Triacs are not exceeded.

b. There shall be one air gap positive off relay for dimmer, either integral to the dimmer or mounted elsewhere in the same panel. Other advanced technological approaches that give the same or better operational result is highly recommended by this standard.

c. All controls shall have the capabilities of reverting back to their previous status after any duration of power outage (power failure memory), without the use of any type of rechargeable or trickle-charge type of battery.

d. All systems must be submitted to the OSU FS Electric Shop for approval.

1) This standard requires the Design Professional to review the application of dimming devices and submit recommendations to OSU FS Electric Shop before incorporating into specifications.

ii. Parking ramp interior lighting shall be circuited to permit lighting of dark interior areas during the day without lighting those areas which receive sufficient natural light. Automatic control of ramp lighting by photocell is required.
iii.  All exterior area and security lighting shall be dusk on and dawn off, powered from one (1) location in the building and controlled from the photo control, with provisions for manual override. Photo cell shall be readily accessible. Time clock control may be used on exterior or security lighting with written approval of the OSU FS Electric Shop.

iv.  All lighting controls shall be located so as to have 24/7 access without escort of departmental personnel.

31. WINDOW OPERATORS

A. Requirements

i.  Use of window operators must have written acceptance by the OSU FS Electric Shop via the Design & Construction Standards Deviation Request Form via the OSU Project Manager.

ii. Window Operators shall be the model stocked by OSU FS Stores: 24V, chain actuated, Fenestration Chain Actuator Silver Grey LM/2 350MM 13 ¾” (Vendor Part 2409072).

iii. At least 10 or 10% spare inventory provided by project.

iv.  If window operators are connected to building controls in any way, refer to Division 23.

32. CONTROLLED RECEPTACLES

A. Requirements

i.  Controlled receptacles shall be controlled by a controller or controllers that are independent of all other systems.

ii. Receptacles shall be controlled by a controller that resides on the same floor/level as the receptacles are on.

iii. Removal of tab on duplex receptacles to meet OEESC 8.4.2 shall be prohibited.
Division 27: Communication

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Section 27 10 01: Structured Cabling General Requirements

1. SCOPE

   A. This document describes general products and execution requirements relating to furnishing and installing Telecommunications Infrastructure consisting of communication rooms, spaces, power, pathways, and cabling for Oregon State University. Backbone and horizontal cabling comprised of Copper and Fiber Optic, and support systems are covered under this document. All installations are warranted and shall be pre-registered with Ortronics/Superior Essex before work begins as does Corning Fiber systems.

   B. The Horizontal (workstation) Cabling System shall consist of a minimum of (2) Category 6, 4-pair Unshielded Twisted Pair (UTP) Copper Cables to each work area outlet within office locations unless otherwise noted for specific locations. Category 6 cable will be required for conference room phones, classroom wall and emergency phones in addition to life safety connectivity (elevators, fire alarm, auto dialers). Category 6A will be required for all wireless access point horizontal cabling and research lab spaces. The cables shall be installed from the Work Area Outlet to the appropriate Telecommunications Room (TR) and routed to the appropriate rack or backboard serving that area and terminated as specified in this document.

   C. All cables and related pathways, supports, terminations, and grounding hardware shall be furnished, installed, wired, tested, labeled, and documented by the Telecommunications contractor as detailed in this document and required by contract conditions.

   D. Product specifications, general design considerations, and installation guidelines are provided in this document. Quantities of telecommunications outlets, communication room details, equipment racks, cable routing and outlet types will be provided as project specific information by bid specification and/or bid drawings. The contractor shall meet or exceed all requirements for any infrastructure system as detailed within this document. This document shall be referenced within a projects specific scope of work.

2. APPROVED CONTRACTOR

   A. The Telecommunications contractor submitting a response regarding an Oregon State University Voice/Data Infrastructure solicitation must be an approved Ortronics Certified Installer Plus (CIP) and a certified Corning Cabling Systems NPI Installer. Solicitation responses from a single contractor not certified by Ortronics and Corning Fiber Systems as (CIP/NPI) will not be accepted. Solicitation responses will only be accepted from firms certified by Comming Cable Systems and Ortronics. All RFP submissions will include corporate Corning Cable Systems NPI and Ortronics CIP certifications. The Telecommunications contractor is responsible for workmanship and installation practices in accordance with the Ortronics CIP Program and as the Corning Cabling Systems Program dictates.

   B. It is the intent of Oregon State University's Campus Infrastructure Standard to ensure that a contractor is both an Ortronics CIP and a Coming NPI installer. Contractors must possess an Ortronics CIP and a Coming NPI certification within the state of Oregon to qualify for solicitation responses at the time an RFP is due for submission.

3. SUBMITTALS

   A. Submitting requirements are per OSU Division 1 Specifications, the Contract Documents, and the Construction Contract.

   B. Submit appropriate cut sheets and samples for all products, hardware and cabling as detailed in project specifications and drawings.

   C. Work shall not proceed without OSU Information Services written approval of the submitted items.
4. REFERENCES
   A. All work shall be performed in accordance with the following Codes and industry Standards, unless noted otherwise:
      i. NFPA 70 – National Electrical Code, current version adopted by local or State AHJ.
      iii. ANSI/TIA/EIA 569-C – Commercial Building Standard for Telecommunications Pathways and Spaces, current version.
      v. ANSI/TIA/EIA 607-B – Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications, current version.
      vi. IEEE 241 - IEEE Recommended Practice for Electric Power Systems in Commercial Buildings, pertaining to communication systems.

5. WARRANTY
   A. Ortronics/Superior Essex nCompass Limited Life Time warranty for horizontal subsystem.
      i. nCompass Category 6+ Cabling, Connectivity Hardware and Patch Cables shall be covered by a, nCompass Limited Lifetime warranty labor and application assurance warranty. The application assurance portion shall provide coverage for the cabling system to support the applications that are designed for the specifications outlined in ANSI/TIA/EIA 568-C.0-2. These applications include, but are not limited to 10BASE-T, 100BASE-T, 1000BASE-T and 155 Mb/s ATM.
      ii. Corning 25-year NPI Warranty for fiber optic riser and outside plant backbone subsystems.

6. SUMMARY
   A. This Section includes general requirements specifically applicable to Division 27.
   B. The Contractor shall be responsible for:
      i. Providing material and labor for a complete turnkey infrastructure system. Including but not limited to: All permits, power, racks, pathway, cabling, fire safing, grounding, patch panels, testing, labeling, warranty and close out documentation.
   C. Intent of Drawings:
      i. Communications plan drawings show only general locations of equipment, devices, raceways, cable trays, boxes, etc. All dimensioned locations and elevations are approximate. The contractor is responsible for the field coordination of communications work with the other trades prior to beginning work.
      ii. The contractor shall be responsible for the proper placement and routing of equipment, cable, raceways, cable tray, and related components; according to the Contract Documents and subject to prior review by contractor.
      iii. Refer all conflicts between Contract Documents to owner for resolution.
7. SYSTEM DESCRIPTION

A. The owner will implement a comprehensive integrated communications distribution system, as described in paragraph B below, to provide wiring infrastructure which may be used to support one or more of the following services and systems:

   i. Telephony and Data telecommunications.
   ii. Wireless systems.
   iii. Facilities management systems.
   iv. Audio/Video telecommunications

B. The communications distribution system consists of the following major subsystems, as specified elsewhere:

   i. Interbuilding Backbone: The interbuilding subsystem refers to all twisted-pair and fiber optic backbone communications cabling connecting the Main Building Entrance Facility room (EF) to each building Main Distribution Frame room (MDF) in all buildings on the campus. Note: typically outside plant cables.

   ii. Intrabuilding Backbone: The intrabuilding subsystem refers to all twisted-pair and fiber optic backbone communications cabling connecting the Main Distribution Frame room (MDF) to each Intermediate Distribution Frame Room (IDF) in the buildings.

   iii. Telecommunication Rooms (TR): Main Distribution Frame (MDF) and Intermediate Distribution Frame (IDF).

   iv. Horizontal Distribution: The horizontal distribution subsystem refers to all intra-building twisted-pair and fiber optic communications cabling connecting telecommunication rooms (IDF’s) to telecommunication outlets (TOs) located at individual work areas.

   v. Work Area Distribution Subsystem: Patch cords, adapters, and devices located between the TO and station equipment.

C. The communications distribution system is based on a combination of the following communications transmission technologies as defined by specific project specifications:

   i. 100-ohm 4-pair unshielded twisted-pair cable. (Cat 6, Cat 6a)

   ii. 100-ohm multi-pair unshielded twisted-pair cable. (Cat 3). Note: nCompass warranty does not apply to 100-ohm multi-pair cables.

   iii. 850 nm Laser Optimized 50/125-micron multimode fiber optic cable.

   iv. 8.3/125-micron singlemode fiber optic cable.

   v. 8-position telecommunications jacks.

   vi. 8-position telecommunications patch panels

   vii. Insulation displacement connector (IDC) type field terminated wiring blocks

   viii. Factory Terminated copper patch cords

   ix. Rack mount fiber optic hardware

   x. Wall mounted fiber optic hardware

   xi. Fiber optic connectors.
xii. Factory terminated fiber optic patch cords

D. The work locations and limits of work are shown on the drawings.

8. DESIGN/ENGINEERING REQUIREMENTS

A. BICSI RCDD Certification is required for anyone performing infrastructure design, specifications and/or drawings for solicitation and construction. All drawings issued for construction shall have valid RCDD stamp. Div. 27 project engineer will submit valid RCDD certification before engineering will be accepted. RCDD certification shall be submitted to Project Manager before/as schematic design process begins.

B. Wireless RF Design:
   i. Wireless Access Point (WAP) design, access point (AP) quantities and locations will be provided exclusively by Oregon State University IT Infrastructure/Network Operations Center (NOC) utilizing manufacturer RF design software with project drawings.

C. Compliance by the contractor with the provisions of this specification does not relieve contractor of the responsibilities of furnishing materials and equipment of proper design, mechanically and electrically suited to meet operating guarantees at the specified service conditions.

D. Communication room design:
   i. Minimum communication room size for EF room shall be no less than 12’x16’.
   ii. Minimum communication room size for MDF room shall be no less than 12’ x 16’ up to 624 horizontal data ports. Exceeding 624 data ports requires a larger room and additional equipment racks.
   iii. Minimum communication room size for an IDF room shall be no less than 12’ x 14’ up to 624 horizontal data ports. Exceeding 624 data ports requires a larger room and additional equipment racks.
   iv. Communication rooms shall have card access for security on all doors.
   v. All pathways, conduits, cable trays, slots and sleeves shall not have other cabling (fire alarm, Audio Visual, security etc.) routed within them.
   vi. Each equipment rack dedicated to network equipment shall have (2) 120V L5-20 electrical outlets installed on rear of rack, within the rear vertical wire manager, 13” off finished floor.
   vii. Network Gear installation: Clarify in Telecom Room design that rooms and their spaces must be 100% completed construction. Rooms/spaces shall be cleaned free of all debris and dust. Cleaning shall include ceiling to floor, light fixtures, cable trays, cabling, all wall mounted conduit, backboards, equipment, switches, racks, vertical managers, doors etc. Room will be 100% complete to include power, lighting, HVAC and OSU master keys lock installed on doors. Once network equipment is energized the space becomes OSU Secure Space. Anyone entering the room not an OSU UIT employee requires escort. Doors shall not be left unlocked, nor open for any length of time. When Network equipment is installed within a communication room or space, the room or space becomes OSU secure space with restricted access by OSU UIT employees. Anyone other than OSU UIT employee will need to be escorted. 48 hour notice is required for escort services.
   viii. It is the intent of this specification to ensure/protect security of our communication rooms, sensitive student information, transmission compatibilities (EMI) and preservation of space for future technologies. Low voltage systems such as Fire Alarm panels, Controlled Access/Security systems, Audio Visual, Video, Point of Sale systems and Electrical panels shall not be incorporated into communication room space, racks, cabinets or walls. Communication rooms will not be shared with other entities or used for any purpose other than housing OSU’s communications distribution systems or OSU IT equipment actively connected to or supporting the network. Anything placed in these rooms
are subject to dust and debris which can shorten the life of the equipment and/or be a potential fire hazard.

a. *OSU Information Services recommends that a dedicated secure room be designated to incorporate Fire alarm, security access, Video DVR's, HVAC controls, Audio Visual, etc. This space will have its own pathway system, sleeves, backboards and equipment rack.*

ix. Audio Visual systems may require additional facilitation. Consult OSU Information Services Academic Technologies / Classroom Technology Services for specific space requirements and resources via the OSU Project Manager.

E. Mechanical Rooms

a. Mechanical Rooms shall have three (3) category 6 data ports for maintenance staff connectivity. These locations to be formally reviewed and approved by Facilities via the Project Manager.

F. Pathways

a. 4K wiremold raceways are not acceptable due to bend radius and cable fill issues with Ortronics Track Jack products. 6k wiremold raceway will be selected at a minimum.

b. All pathways, cable trays, conduits, surface, riser and cable trays shall not exceed 50% of capacity and projects completion. This includes all changes to scope during construction.

c. Work area outlets and wifi access locations shall have a minimum of 1-inch EMT conduit per faceplate.

d. All pathways, conduits, cable trays, slots and sleeves shall not have other cabling (fire alarm, Audio Visual, Lighting controls, security etc.) routed within them.

e. All conduits shall have pull strings installed when completed.

f. Outside plant design (underground) pathways with a 6-inch concrete cap shall be specified above conduit for protection, dyed Orange. In addition, a warning/trace tape shall be specified 12-inches above the concrete cap. As built & record drawings shall have sheet notes attached that clearly state the concrete cap and color Orange.

i. Outside plant conduits shall be a minimum of 4-inch diameter PVC schedule 40, large diameter fiberglass sweeps, with a minimum of three (3) 4-inch conduits servicing a building. Conduits shall have a trace locate wire installed and secured and labeled with in each vault/hand hole.

ii. Minimum of three 4-inch conduits for building service backbone fiber and copper (Outside Plant).

9. ASBUILTS & RECORD DOCUMENTS

A. The Contractor to provide detailed asbuilt documentation within 30 days of substantial completion of the work. The Design Professional to provide Record Drawings to include Contractor asbuilt information.

i. Maintain separate sets of redlined asbuilt drawings for the communications work which show the exact placement and identification of as-built system components.

ii. Provide communication pathway asbuilt drawings which indicate exact placement and routing for all components, e.g., maintenance holes, hand holes, conduit, wireway, cable tray, pull boxes, enclosures, telecommunications outlet boxes, etc.
iii. Provide communication room asbuilt drawings which indicate exact placement for all components; e.g., conduit, wireway, cable tray, backboards, equipment cabinets, equipment racks, cross-connect equipment, etc.

iv. Provide communication wiring and cabling record “Asbuilt” drawings and schedules which indicate exact placement, routing, and connection details for all components, e.g., twisted-pair and fiber optic cables, splices, cable cross-connect termination locations, enclosures, telecommunications outlets, cross-connect jumpers, patch cords, etc.

v. Asbulits/closeout documentation will require photos of all four walls for vaults, handholes, equipment rooms, racks front/rear, and splice enclosures fiber/copper to also to be photographed. Splice enclosure photos will show all cable labels clearly including end plates. Photos to be labeled accordingly for clear identification.

vi. Provide network schematics when appropriate.

10. APPROVALS AND SUBSTITUTIONS

A. Deviations from these standards are not authorized unless approved in writing with an OSU Design & Construction Standards Deviation Form by Owner’s Authorized Representative as coordinated via the OSU Project Manager.
Section 27 11 00: Communications Equipment Room Fittings

1. SUMMARY
   A. Telecommunications spaces will be referred as Building Entrance Facility (EF), Main Distribution Frame (MDF), Intermediate Distribution Frame (IDF), Data Center (DC).

2. TELECOMMUNICATIONS BACKBOARDS
   A. Wall mounted termination block fields shall be mounted on A/C 4' x 8' x .75" void free plywood. The plywood shall be mounted vertically 12" above the finished floor. The plywood shall be painted with a minimum two coats of white fire retardant paint on all (6) sides. Mounting hardware shall also be painted white for cosmetic purposes.

3. EQUIPMENT AND WIRING RACKS
   A. All racks and wire management shall be Ortronics as specified in project specifications and drawings. The equipment/wiring racks shall provide vertical and horizontal cable management on front and rear of each rack. Waterfall cable management shall be provided at the top of the rack for patch cords and for horizontal cables entering the rack channels for protection and to maintain proper bend radius and cable support. Racks and Vertical managers shall be white in color.
      i. Approved manufacturers are Ortronics Mighty MM20 Channel Rack, 16.25”D channel, 7'H, 45 RU, tapped #12-24. Ortronics P/N: OR-MM20716-W
   B. Racks shall be securely attached to concrete floor using minimum 3/8” hardware or as required by local codes. Earthquake restrictions, requirements, and zoning codes shall be strictly followed.
   C. Maintain a minimum of 36-inch clearance from the walls to the front/rear of each rack’s vertical managers. When mounting equipment/cabling on vertical walls the equipment mounting depth will need consideration for maintaining 36” clearances for all front/rear of racks.
   D. Each dedicated equipment rack shall have (2) Power distribution units (PDU) installed. Tripp- lite p/n: RS-1215-20T.
   E. All racks shall be grounded to the telecommunications ground bus bar in accordance with Section 2.9 of this document.

4. VERTICAL WIRE MANAGERS FOR EQUIPMENT AND WIRING RACKS
   A. Each equipment rack shall have (4) vertical wire managers installed. Two located on the front of rack, two located on the rear. Ortronics P/N: OR-MM20VMS710-W
      i. MM20 Vertical Manager with Cover, 10”W x 13.62”D for 7’ MM20 racks.

5. HORIZONTAL WIRE MANAGERS FOR EQUIPMENT AND WIRING RACKS
   A. At the top and bottom, front of each equipment rack, install the following horizontal wire manager. Ortronics P/N OR-60400098

6. WIRE BASKET CABLE TRAY WITHIN COMMUNICATION ROOMS (EF/MDF/IDF)
   A. 12 or 24 inches wide depending on specific project details and the amount of horizontal data ports served by the communication room, 4 inches deep, black and of steel construction.
      i. Cablofil P/N 105/300BL OR P/N 105/600BL
B. Black basket cable tray shall be required in all communication rooms and shall not have a liner. Cable tray installed outside communication rooms will have a color determined by A/E to match building paint schemes and tray liners will be required.

C. All trays will be grounded per local Electric Code requirements and ANSI/TIA/EIA-607.

D. All trays shall be cut using the Cablofil tray cutter: COUPFIL or CUTYFIL. All cut cable tray will be filed to remove burrs and painted to match color. All cutting, filing, and painting will be done outside of building.

7. GROUNDING AND BONDING

A. The facility shall be equipped with a Telecommunications Bonding Backbone (TBB). This backbone shall be used to ground all telecommunications cable shields, equipment, racks, cabinets, raceways, and other associated hardware that has the potential to act as a current carrying conductor. The TBB shall be installed independent of the building’s electrical and building ground and shall be designed in accordance with the recommendations contained in the ANSI/TIA/EIA-607 Telecommunications Bonding and Grounding Standard.

B. The main entrance facility/equipment room in each building shall be equipped with a telecommunications main grounding busbar (TMGB). Each telecommunications room shall be provided with a telecommunications ground bus bar (TGB). The TMGB shall be connected to the building electrical entrance grounding facility. The intent of this system is to provide a grounding system that is equal in potential to the building electrical ground system. Therefore, ground loop current potential is minimized between telecommunications equipment and the electrical system to which it is attached.

C. All racks, metallic backboards, cable sheaths, metallic strength members, splice cases, cable trays, etc. Entering or residing in the TR or ER shall be grounded to the respective TGB or TMGB using a minimum #6 AWG green stranded copper bonding conductor and compression connectors.

D. All wires used for telecommunications grounding purposes shall be identified with a green insulation. Non-insulated wires shall be identified at each termination point with a wrap of green tape. All cables and busbars shall be identified and labeled in accordance with the System Documentation Section of this specification.

E. Busbar shall be solid copper, 12.0 inches long x 4.0 inches wide, wall-mounted, with standoffs.

8. FIRESTOPPING

A. All penetrations through fire-rated building structures (walls and floors) shall be sealed with an approved fire stop system approved by the local fire code. This requirement applies to through penetrations (complete penetration) and membrane penetrations (through one side of a hollow fire-rated structure). Any penetration item, i.e., riser slots and sleeves, cables, conduit, cable tray, and raceways, etc. shall be properly fire stopped.
Section 27 13 00: Communications Backbone Cabling

1. RISER CABLE
   A. Voice riser cable shall be category 3, 24 AWG. OSU Information Services shall approve pair count to be installed.
   B. Data riser cable shall be Corning singlemode fiber, 24 strands, Interlocking Armor, plenum or riser rated (NEC CODE), and terminated utilizing manufacturer pre-polished duplex LC pigtail assembly. OSU Information Services shall approve pair count to be installed.
   C. Riser cable shall have fixed engraved plastic label with the type, communication room number from, communication room number to, pair/strand count, and date of installation. Label shall be attached to cable jacket colored Black letters on White background.

2. CAMPUS BACKBONE CABLE
   A. UTP cable shall be category 3, Pic-Filled, Black jacketed cable with overall sheath. PE-89.
   B. Primary Fiber Cable shall be Corning Altos. 24 strands, OS2 rated, singlemode fiber, non-conductive and be of loose tube construction.
   C. Redundant Fiber Cable shall be Corning Altos, 12 strands, OS2 rated, singlemode fiber, non-conductive and be of loose tube construction.
   D. Fusion splice all cables requiring splicing as detailed in project specifications and drawings. Mechanical splices are not acceptable anywhere within the physical system.
   E. Cable Jacket shall have a permanently attached label that identifies OSU cable number, strand/pair count and destination at every termination and/or splice as the cable enters and/or leaves a splice enclosure, vault, hand hole, building, building floor, and patch panels. The tag shall be engraved with black lettering on yellow background for fiber, white lettering with black background for UTP.
     i. Example: CA21, 1-50 Plageman Hall 11-01-2018

3. COPPER CABLE PROTECTION UNITS:
   A. All copper circuits shall be provided with protection between each building with an entrance cable protector panel. All building-to-building circuits shall be routed through this protector. The protector shall be connected with a #6 AWG green copper bonding conductor to the TMGB.

4. TERMINATION BLOCKS
   A. 110-Style Blocks: Ortronics OR-30200007
   B. Wiring troughs: Ortronics OR-806003194

5. FIBER OPTIC TERMINATION HARDWARE
   A. Fiber Optic Termination Hardware
     i. Corning Fiber Optic Patch Panel Assembly Corning P/N: CCH-04U.
     ii. Corning Cassette 24 port, shuttered duplex LC. Corning P/N: CCHCS24A9POORE.

6. BACKBONE CABLE INSTALLATION
   A. Backbone cables shall be installed separately from horizontal distribution cables.
B. A pull cord (nylon; 1/8" minimum) shall be co-installed with all cable installed in any conduit, raceway, or cable tray.

C. Where cables are housed in conduits, the backbone and horizontal cables shall be installed in separate conduits.

D. Backbone cables spanning more than three floors shall be securely attached at the top of the cable run with a wire mesh grip and on alternating floors or as required by local codes.

E. Vertical runs of cable shall be supported to messenger strand, cable ladder, or other method to provide proper support for the weight of the cable.
Section 27 15 00: Communications Horizontal Cabling

1. SUMMARY
   A. Horizontal cabling may consist of a combination of the following types of cable from the MDF/IDF to the Telecommunications Outlet:
      i. Category 6: Analog voice locations. (Conference room phones, building alarms, elevator alarms, fire alarms, irrigation controllers.)
      ii. Category 6: Data locations.
      iii. Category 6A, Data within all lab spaces, research spaces, wireless access points.

2. HORIZONTAL CABLING
   A. Category 6: Superior Essex DataGAIN, colored Green for data locations, colored Grey for analog phone locations, Plenum or riser per NEC and local fire codes.
      i. Athletics buildings and spaces require color Orange cable and jacks.
   B. Category 6A: Superior Essex, colored Purple, plenum or riser rated per NEC and local fire codes.
      i. Athletics buildings and spaces require color Black cable and jacks.

3. MODULAR JACKS
   A. Work area outlet jack
      i. Ortronics category 6, voice, 8 POS, Fog White T568B. Ortronics P/N OR-TJ600
      ii. Ortronics category 6, data, 8 POS, Green T568B. Ortronics P/N OR-TJ600-25.
         a. Athletics use Orange colored jack. Ortronics P/N OR-TJ600-43
         a. Athletics use Black data jack. Ortronics P/N OR-TJ600-00.

4. WORK AREA OUTLETS
   A. Flush mounted faceplates
      i. Work Area Outlet: Six port TracJack faceplate, stainless steel c, with recessed label fields, mounts within a single gang wall box.
         a. Ortronics 403STJ16 Stainless Steel.
         b. Example – Work Area Outlet Label Detail:
ii. Wall Phone: One port TracJack faceplate with mounting lugs for wall phone, constructed from stainless steel, mounts within a single gang wall box, RJ45.
   a. Ortronics OR-403STJ1WP.

B. Dust covers
   i. Single port dust cover for modular openings, Ortronics OR-42100002, fog white.

5. 110 VOICE TERMINATION BLOCKS

A. Wiring Troughs
   i. Horizontal trough for routing of patch cords and cross-connect wire, with mounting legs.
      a. Ortronics P/N OR-30200140.

B. 110 block labels (Cat 3)
   i. Clear plastic holder for 110 blocks with paper inserts, for blocks with legs
      a. Ortronics P/N OR-70400646.
      b. Ortronics P/N OR-70400680.

6. DATA PATCH PANELS AND PATCH CORDS

A. Category 6 & 6A modular patch panels:
   i. Category 6, 48-port, Angled, 8P8C modular jack panel, high density, 6 port modules, colored Black, IDC terminals, T568A/B wiring scheme. Ortronics P/N: OR-PHA66U48.
   iii. Category 6A, Wireless Access Points only, 48-port, angled, for, 8P8C modular jack panel, high density, 6 port modules, colored White, IDC terminals, T568A/B wiring scheme. Ortronics P/N: OR-OR-PSAHJU48-W.
      a. Category 6A Purple data jacks are required for this patch panel, 8 Pos., T568B. Ortronics P/N: OR-HDJ6A-27

B. Patch Cords
   i. Patch cords shall be included and installed by the contractor for 100% of the horizontal data ports including wireless access points. This includes work area outlet and patch panel to switch connectivity.
   ii. Ortronics Category 6, Green, horizontal work area outlets. Grey for analog work area outlets.
      a. Athletics use Orange patch cords.
   iii. Ortronics Category 6A, Purple, wireless access points and research lab space.
      a. Athletics use Black patch cords.
   iv. Patch cord lengths for TO location: 10’.
   v. Patch cord length for EF/MDF/IDF patch panels/network hardware are specific to proper routing as defined by OSU Information Services. Drawing showing proper routing of patch cords is available upon request.
7. **EXECUTION: WORK AREA OUTLETS**
   
   A. Data jacks, unless otherwise noted in drawings, shall be located in the right side position(s) of each faceplate.
   
   B. Voice jacks shall occupy the left position(s) on the faceplate.

8. **EXECUTION: HORIZONTAL DISTRIBUTION CABLE INSTALLATION:**
   
   A. A pull cord (nylon; 1/8" minimum) shall be co-installed with all cable installed in any conduit, raceway, or cable tray.
   
   B. If a J-hook or trapeze system is used to support cable bundles all horizontal cables shall be supported at a maximum of 48-inch) intervals.
   
   C. Cables shall be identified by a self-adhesive machine label in accordance with the System Documentation Section of this specification and ANSI/TIA/EIA-606. Labels shall be installed 6” from each terminated end.
   
   D. Wifi Access Point locations shall use Ortronics P/N OR-404TJ2.
   
   
   E. Labeling horizontal cabling shall consist of a numerical format example below:
      
      i. Data Patch Panels: Black on blue example D.001, D.002, D.003, etc.
      
      ii. 110 IDC blocks for analog voice: Black on Blue, example V.001, V.002, V.003 etc.
      
      iii. Work Area Outlets to have IDF room termination number, Cable ID#, and network name. IDF room number and network name Black on Blue with Cable ID# Black on White. Black on White cable tag will attached 6-inches from termination on cable jacket shall have IDF room #, cable ID #.

9. **TESTING PROCEDURES**
   
   A. All cables and termination hardware shall be 100% tested for defects in installation and to verify cabling system performance under installed conditions according to the requirements of ANSI/TIA-568-C. All pairs of each installed cable shall be verified prior to system acceptance. Any defect in the cabling system installation including but not limited to cable, connectors, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% useable conductors in all cables installed.
   
   B. All cables shall be tested in accordance with this document, the ANSI/TIA standards, the Ortronics procedures and best industry practice. If any of these are in conflict, the Contractor shall bring any discrepancies to the attention of the project team for clarification and resolution.
   
   C. Cables, jacks, connecting blocks, and patch panels shall be in their position with the building energized.
   
   D. All Unshielded Balanced Twisted Pair cables shall be tested as follows:
      
      i. All twisted-pair copper cable links shall be tested for continuity, pair reversals, shorts, opens and performance as indicated below. Additional testing is required to verify Category performance. Horizontal cabling shall be tested using an approved Ortronics certification tester (TSB 67) for category 6 and 6A compliance as specified in ANSI/TIA-568-C.

      **ALL TEST RESULTS WILL PROVIDE FOR 5Db OF HEADROOM (NEXT) AS PER THE nCOMPASS 6+ SOLUTION GUARANTEE**

      ii. A software copy of the test results, in the original tester software format, shall be provided to the Owner and Ortronics.
iii. Contractor shall provide a fully functional version of the tester software for use by the Owner in reviewing the test results.

iv. Any failed test results that cannot be remedied through re-termination (as in the case of reversed or split pairs), must be reported in writing to the Owner immediately, along with a copy of the test results.

10. TESTING AND ACCEPTANCE

A. All cables and termination hardware shall be 100% tested for defects in installation and to verify cabling system performance under installed conditions according to the requirements of ANSI/TIA/EIA-568-C.1, C.2. All pairs of each installed cable shall be verified prior to system acceptance. Any defect in the cabling system installation including but not limited to cable, connectors, feed through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% useable conductors in all cables installed.

B. All cables shall be tested in accordance with this document, the ANSI-TIA/EIA standards, the Ortronics, Superior Essex and Corning Certification Program Information Manuals and best Industry practice. If any of these are in conflict, the Contractor shall bring any discrepancies to the attention of the Owner’s Authorized Representative via the OSU Project Manager/Construction Manager for clarification and resolution.

C. Horizontal and riser fiber optic cabling attenuation shall be measured bi-directionally at both 1310 nanometer (nm) and 1550 nm operating windows using a light source and power meter.

D. Campus Backbone single mode fiber cabling shall be tested with OTDR at both 1310 nm and 1550 nm bi-directionally.

11. SYSTEM DOCUMENTATION

A. Per project contract documents.

12. TEST RESULTS

A. Submit completed test results with close out documentation on CD-ROM. Hard copy printed results are also required to be submitted via 3 ring binder(s), tabbed by BEF/MDF/IDF. Binder shall be labeled with Oregon State University Project name and project number. This applies to all Horizontal copper and all fiber optic test results.

13. IDENTIFICATION AND LABELING

A. OSP copper labels shall be engraved plastic with white letters on black background.

B. OSP Singlemode fiber optic labels shall be engraved plastic with black letters on yellow background.

C. Outlet, patch panel and wiring block labels shall be installed on, or in, the space provided on the device. Specific labeling information shall be project specific and the information will be given to the contractor by OSU Network Services.

D. All horizontal cables are to be labeled using a machine printed label at each end of the cable approximately 6 inches of the termination point. Handwritten labels shall not be used.

E. Telecommunication Outlet labeling shall be labeled with the MDF/IDF room #, name of the network, and port #.

F. All inside building cabling, termination, hardware, protection units, patch panels, and work area outlets shall comply with ANSI/TIA/EIA 606 labeling standard color codes.

G. Labeling scheme information and format to be provided by OSU Network Services.
   i. Note all labeling information on the as-built drawings.
14. FINAL ACCEPTANCE & SYSTEM CERTIFICATION:

A. Completion of the installation, in-progress inspections, receipt of the test and as-built documentation, and successful performance of the cabling system will constitute completion of the system. Upon successful completion of the installation and subsequent inspection, Oregon State University shall be provided with a numbered certificate, from Ortronics or Superior Essex and/or Corning if applicable, registering the installation.
Section 27 40 00: Audio-Visual Communications

1. MATERIALS

   A. OSU allows limited types of audio – visual equipment to be able to provide quality, cost-effective service and sustainable maintenance. The following table on the next pages lists the preferred brand and manufacturers for audio-visual equipment. If there is compelling reason for alternate equipment, the Design Professional shall provide a list of alternate audio-visual equipment to the Owner’s Authorized Representative (UIT-AV Project Manager) via the OSU Project Manager for review for approval. This process shall be done at the 100% design development stage. If this step is skipped, the Design Professional shall be responsible to use Brand/manufacturer’s below.

2. SUMMARY OF ROOM SYSTEMS 21FY

<table>
<thead>
<tr>
<th>ROOM TYPE</th>
<th>DESCRIPTION</th>
</tr>
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<tbody>
<tr>
<td>Room Type 1</td>
<td>Single Display, PC, HDMI Connection, Button Controller, Video Conference Sound bar</td>
</tr>
<tr>
<td>Room Type 2</td>
<td>Single Display, PC, Button Controller, HDMI Connection, Wireless Presentation, 4x1 Switch, Playback Speakers, PTZ Camera &amp; Ceiling Microphones (Web Collaboration)</td>
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<tr>
<td>Room Type 3</td>
<td>Single Display, PC, Button Controller, HDMI Connection, Wireless Presentation, 4x1 Switch, Playback Speakers, PTZ Camera &amp; Ceiling Microphones (Web Collaboration)</td>
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<tr>
<td>Room Type 4</td>
<td>Single Display, PC, Touch Panel Controller, HDMI Connection, Document Camera, Wireless Presentation, Presenter Microphone, 5x1 Switch, Amplifier, Playback Speakers, Instructor Microphone, ALD, PTZ Camera &amp; Ceiling Microphones (Web Collaboration)</td>
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<td>Room Type 5</td>
<td>Dual Display System, PC, Touch Panel Controller, HDMI Connection, Document Camera, Wireless Presentation, Presenter Microphone, 6x2 Switch, Amplifier, Playback Speakers, Instructor Microphone, ALD, PTZ Camera &amp; Ceiling Microphones (Web Collaboration)</td>
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<tr>
<td>Room Type 7</td>
<td>Active Learning Studio (4 Student Pods)</td>
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<tr>
<td>Room Type 8</td>
<td>Active Learning Studio (8 Student Pods)</td>
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<tr>
<td>Room Type 11</td>
<td>In-the-Round</td>
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**Project: ROOM TYPE 1**

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<th>QTY</th>
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<th>MODEL</th>
<th>DESCRIPTION</th>
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Section 27 40 16: Contracted Audio/Visual Systems

1. REQUIREMENTS

A. Supplemental: Refer to the sections identified below for additional requirements, which are supplemented by this section.
   i. 27 41 00 00 (Audio-Visual Communications Infrastructure) – reference for approved part numbers for AV infrastructure components.
   ii. 27 41 16 51 (Standard Classroom)
   iii. 27 41 16 62 (Auditorium)
   iv. 27 41 16 28 (Conference Room/Meeting Room)

B. OSU Point of Contact
   i. General Point of Contact: OSU Project Manager who will then coordinate with UIT-AT Project Manager.
   ii. All OSU projects that include Audio Visual systems will have a Project Manager assigned by University Information Technology – Academic Technology (UIT-AT) who will provide detailed requirements and specifications for all phases of said systems. All information provided in this document should be considered for preliminary bid preparation and general guidelines only.

C. Scope of Work (SOW) - The following are the list of standard systems considered audiovisual systems:
   i. Classrooms for less than one hundred (60) students.
   ii. Auditoriums for more than 100 hundred (100) students.
   iii. Conference rooms/Collaboration rooms
   iv. Any Design Professional or installers involved with an OSU project that includes non-standard audiovisual systems are strongly encouraged to consult with UIT-AT before starting work on these systems.

D. The scope of work for Design Professionals shall include to a minimum the following tasks:
   i. Qualifications: At a minimum the Design Professional responsible for the audiovisual design shall be regularly engaged in the design of audiovisual system for at least the past five (5) years. The Design Professional working on OSU projects shall have as a minimum of a Certified Technology Specialist (CTS) designation by AVIXA. It is highly recommended the Design Professional also have a CTS-D certification by AVIXA. Proof of current certification shall be provided to OSU UIT-AT department for confirmation.
   ii. Work with UIT-AT to provide system functionality, configuration and features per user’s requirements.
   iii. Establish preliminary project budgets based on the user requirements.

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<th>Custom AV Equipment Module, Standar Rack, Rear Access Panel</th>
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<tr>
<td>1</td>
<td>OSU</td>
<td>LABOR</td>
<td>Academic Technology Install Labor (5 day)</td>
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</table>
iv. Establish a responsibility matrix indicating who is providing the different components, as well as the installation of the components, systems.

v. Provide architectural considerations related to AV systems for the spaces to the Design Professional and OSU Project Manager who will coordinate with the UIT-AV Project Manager. These recommendations shall include room layout, lighting and acoustics.

vi. Provide design drawings and specifications based on the information previously collected for the project.

vii. Assist the OSU Project Manager in the bid process by checking installer’s qualifications and equipment list provided by the bidders.

viii. Establishing the scope of work for the installer and composing the complete set of bid documents (design drawings and specifications).

ix. Review shop drawings and answer RFIs.

x. Test the system with the installer after completion and verify close-out information.

E. For installers: The scope of work for the AV installer shall include, but not limited to the following tasks:

i. Installer Qualifications: The Installer or Installers directly responsible for the work associated with any of the audiovisual systems (also references hereinafter as AVS) shall be a licensed and registered contractor who is, and who has been, regularly engaged in providing the installation of audiovisual systems of similar size and complexity for at least the immediate past five (5) years.

a. Project Manager requirements: The project manager for each company participating in the installation of the AVS shall be a Certified Technology Specialist (CTS) by AVIXA. Proof of current certification shall be provided with the submittal.

b. Programmer-Installer: The AVS installers shall have a factory-trained programmer/installer, for the provided Project products, in full-time employment, as part of the Installer’s staff. AVS installers shall provide certificates of completion of training for the staff that will be taking part in the execution of this project.

c. Qualification Documentation: The Installer shall provide the following documentation with their bid package, as evidence that the requirements for the Installer qualifications have been satisfied:

d. A list of not less than five (5) references for jobs of similar size and complexity including:

• Project Names
• Locations
• Contact Names
• Contact Telephone Numbers

e. Location (specific street address) of the office from which this installation and warranty work will be performed. It is preferred that the Installer has established and maintains a permanent office within 150 miles of the project site.

f. Copies of Manufacturer certification certificates. It is required that the Installer possess the following certifications, at a minimum:

• Crestron certified installer
• Crestron DMC-E
• Biamp certified programmer

g. Copies of Licensure certificates.

h. Copies of Insurance and Bonding certificates.

i. Preparation of shop drawings, submittals, training and as-built information for the system.

ii. Id agreed upon, Procurement, installation and warranty of all AV hardware like flat panel displays mounts for displays, signal transceivers, switchers, etc.

iii. Procurement, installation and warranty of all AV cabling and wiring, including support system, and fire stopping for all low voltage cabling part of the AV.

iv. Programming labor of the AV, including initial software set up, software registration, and initial data input, unless otherwise noted in a specific specification section.

v. Attend project plan meetings with the Owner and the Design Professional to fine tune data interchange details, network configuration and other user requirements:

F. Architectural Considerations

i. General. AV Design Professional shall provide architectural recommendations for classrooms in the project. These recommendations shall include room layout, lighting and acoustics.

ii. Program Display:

a. Screen sizing. Screen height shall be estimated as 1/6 of the distance to the least favored viewer (LFV) or the worst seat in the room. The bottom of the screen reflecting surface shall not be lower than 3 feet for non-tiered rooms. The top of the reflecting surface should be at least 2 inches below the lowest device in the ceiling structure (light fixture, sprinkler head, or diffuser). Every effort shall be made to have ceiling heights that allow the screen sizes described above. Rooms where the ratio between the screen height to the LFV is lower than 1/10 are dimmed non-usable for teaching purposes.

b. Usable seating area per screen. Usable seating area for a screen shall be defined as the area between two 45-degree lines on the sides, one line parallel and close to the screen and one circular sector far from the screen. The angle is measured from a perpendicular line to the screen axis from the edge of the screen. The line parallel and close to the screen shall be separated from the screen 0.5 times the screen’s reflecting surface width. The circular sector has a center in the center of the screen and a radius equal to the distance to the LFV limitation. Any room seats outside of the usable seating area shall be supported with additional display devices. All seats in the audience shall have a line of sight of a program display.

c. Projector location. AV Design Professional or installer shall estimate throw distance and locate the optimal projector location that allows having the lens of the projector at midpoint in the zoom adjustment washing out completely the selected screen. The AV Design Professional or installer shall coordinate with other trades to avoid interference with other building systems at this location. All projectors for shall be ceiling hung where possible. In drop ceilings, a projector ceiling plate/mounting kit that replaces a 2 feet x 2 feet ceiling tile, installed per manufacturer’s recommendation, is preferred. At all projector locations 2 electrical outlets should be provided.

d. Screen quantity: In standard classrooms only one screen is required; Locations where additional screens are preferred will coordinated with AV Design Professional during normal design phase.
e. In Conference Rooms, the preferred display is a single monitor no smaller than 55", with 65" inches being the normal preference. A front projection system shall only be used in conference rooms if the LFV rule is not being met with a large flat panel display available and project viable (budget).

G. Lighting:

i. General lighting: Ideally there needs to be a contrast ratio in the screen of at least 10 for good visual presentation. Contrast ratio shall be estimated as the difference between the average light hitting the screen when the projector is displaying a white screen to the average light hitting the screen when the lights in the room are in presentation mode, and the projector is off. Average light hitting the screen when the projector is displaying a white screen shall be estimated as the rated lumen output of the projector divided by the area of the screen in square ft. The Design Professional(s) shall make every effort to comply with the requirements for contrast.

ii. Classroom lighting: Dimmable lights are not required in classrooms, but two-level lighting is recommended. To obtain the two levels 1/2 or 1/3 of the lamps in each fixture shall be controlled separately. At a minimum there needs to be two control circuits for all the light fixtures in the room, the light fixtures closest to the screen shall be on a separate switch from the rest of the fixtures in the room, so they can be turned off during presentation mode, but the remaining lights can be left on.

iii. Auditorium lighting: A software model of the lights is highly recommended for auditoriums to verify lighting levels in aisles and on projection screens. The use of a centralized standalone dimming system is highly recommended. The dimming system may be integrated into the AV presentation system by way of simple scene recall but must fully function independent of the AV presentation system. The light fixtures selected by the Design Professional(s) shall address the following scenarios:
   a. Clean-up or service lights, with 2x4 LED or other high lumen output fixtures, non-dimmable.
   b. Dimmable down lights for notes or setting different scenes.
   c. Stage lights for presenters and performers.
   d. Step lights, for safety purposes at all steps.
   e. For performing theaters or large auditoriums the use of a DMX system for stage lighting is recommended. All DMX lighting systems must include standalone operation, separate of the presentations system.
   f. Conference Room lighting: No special considerations are required for lighting a conference room with a monitor, except for avoiding locating the display devices on a wall that is subject to direct sun light. Where projectors are used, follow guidelines listed above for classroom lighting.
   g. Ambient lighting. For all rooms with front projection systems, ambient light shall be able to be controlled by using black out shades. Shades can have additional fabrics (25% or 50%) to dim lights, but those fabrics are not required for the AV. Full blackout shades are the only required fabric for the AV. Additional fabrics shall be confirmed with the program manager. If the shades are electric, they shall be operated independently of the AV presentation system, and all shades in one room shall be able to be controlled as a single location.

H. Acoustical considerations:
i. Classrooms do not require any special acoustical considerations except for the regular considerations made for privacy between adjacent classrooms. Headwall mounted point source speakers for program audio, and basic voice lift. Distributed audio systems to be coordinated as needed, based on design/program needs.

ii. Auditoriums may require special acoustical considerations. Sound modeling is highly recommended as well as acoustic treatment for walls and ceilings. Point source program, with DSP mixed voice lift speakers are preferred.

iii. Conference Rooms will use only program speakers, typically built-in or as an accessory to a flat panel display.

I. Floor boxes. Floor box location for teaching lecterns and conference tables shall be carefully selected. The Design Professional shall precisely dimension the location of the boxes to avoid misinterpretation by installers, and to accommodate all ADA access, and clearances.

J. Furniture:

i. Lecterns. Lecterns intended to have AV equipment installed inside shall allow for at least 14 RU of rack space. Lecterns shall be no less than 24 inches deep clear inside. Lecterns shall have rear access panels no smaller than the full width and height of the rack rails inside, front doors, side flip-up ADA shelf, casters, front and rear rack rails. Doors and panels shall be lockable. Lecterns shall have ventilation panels to avoid equipment overheating.

ii. AV Racks/Equipment Modules. In any space that does not contain a lectern, it is preferred to mount AV equipment in a regular freestanding rack (wall mounted rack or an AV designed credenza with rack rails). OSU UIT-AT department does not recommend mounting equipment inside casework, but if absolutely required by the program of the project, casework shall be able to hold no less than 14 RU of equipment, be 24 inches deep inside clear and designed to avoid overheating of equipment by providing ventilation with fans and feature a slide-out rack for maintaining equipment.

iii. Tables. For conference rooms, it is highly recommended to use table shapes suitable for videoconference/collaboration systems. Shapes should improve visibility of all participants in the video conference system. Tables should be able to support the installation of media control panels and interface plates.

K. Submittals

i. General: Submittal requirements are per OSU Division 1 Specifications, the Contract Documents, and the Construction Contract.

ii. The AVS installers shall prepare submittals during different stages of the construction process. This is the list of required documentation for each stage:

iii. Issuance of Submittals: A maximum of 60 days after the AVS installers receives a notice to proceed on the project, but no sooner than a year before substantial completion, the following information needs to be submitted:

a. Cut sheets with all specifications of all cables and connectors to be used in the project.

b. One-line diagrams with all devices included in the systems separating power, video, audio and control. Each system in a different sheet.

c. User interface and faceplate color submittal. The AVS installers shall prepare a separate submittal with the shape and color of all user interface plates to be approved by the Design Professional of the project or the Owner.
d. Proposed construction details for any custom fabricated items or finishes, including speaker rigging, large display mounting, etc. These details shall include dimensions, materials, finishes and colors.

e. List of all MAC addresses requiring IP addresses needed for the AVS.

f. Rack elevations of all AV equipment for all rooms in the project.

g. Conduit rough-in requirements of all wall and ceiling mounted devices/all equipment part of the presentation system.

iv. Construction/Installation Submittals: During the construction process the AVS installers shall submit different information to get approval on continuing with the installation process. The AVS installer shall submittal the following information:

a. Before starting the programming process the AVS installers need to provide the following information:

b. A schematic presentation of the layout of all the user interfaces in the project and screen shoots if differing from OSU standard UI. The AVS installers need to get approval of this submittal before starting any programming.

c. Meeting minutes from all project plans between the Owner and the AVS installers.

d. Any design changes whether originated by the Owner, the Design Professional, or by the AVS installers as a VE suggestions need to follow the same submittal process described in the previous paragraph for all equipment involved on the change.

e. Thirty (30) days before starting the training sessions the AVS installers need to provide the following information:

   • A detailed training chronogram indicating all training sessions requested in this section.
   • An outline of the training sessions.
   • Samples of the training manuals for each session.

f. Failure to comply with all the submittals listed above and getting the proper approval from the Owner and the Design Professional for each submittal will cause the AVS installers to replace installed unapproved equipment at no additional cost to the Owner.

L. Project Specific Source Code Ownership

i. Definition of project specific source code: Project specific source code includes all source code created to generate an executable file to be intended to run in any equipment used in the installation of the AVS. Examples of project specific source code include source code used to generate executable files for control processors, DSP processors and touch panels. Project specific source code does not include source code used to create programming tools and compilers or source code used to generate operating systems or application programs running in PC based workstations.

ii. Ownership: Any project specific source code used in this project shall remain the exclusive property of the OSU UIT-AT. By accepting the contract to perform the work included in this project, the AVS installer or Design Professional (and any other companies working creating project specific code during this project) relinquish the right of ownership of this source code and waive any licensing fees or royalties for the use of source code by OSU UIT-AT (or any company authorized by the owner to perform changes in the source code after the project is substantially completed).

2. EQUIPMENT
A. Equipment Specified

i. Specific equipment: Where design drawings indicate a specific manufacturer and model number for a piece of audiovisual equipment, the AVS installers shall provide the same device as indicated. Substitutions for this type of equipment are not acceptable.

ii. Non-specific equipment: When the design drawings do not indicate a specific manufacturer and model number, the AVS installers are free to select any equipment that meets the minimum specifications indicated in this section. However, AVS installers must submit the manufacturer and model selected as part of the submittal process, and OSU retains the right to approve all selections.

iii. Note to Design Professional(s): OSU maintains a specific list of equipment that is required for AV projects. Since this list changes frequently as technology advances, the Design Professional should check with OSU UIT-AT, via the OSU Project Manager, for the current list of equipment.

B. System Functions

i. System Signals for all Systems

a. General: The completed systems shall be capable of receiving, processing, routing and distributing the associated signals, as indicated in the functionality description for each system.

b. Audio systems will have full range frequency response 100 Hz to 18 kHz at a level of at least 60 dB above the ambient noise floor with a Total Harmonic Distortion (THD) of less than .5%.

c. Analog video signals through the system shall be maintained to the minimum quality requirements as follows:
   - Digital video signals through the system shall be capable of delivering 1920 x 1080 resolutions at 24 fps from end to end.
   - Control signals through the system shall be maintained to the minimum level established by the control equipment manufacturer for the control protocol utilized. This level shall be correct at all connection points in the system.

ii. Remote Asset Management Software

a. General: The Remote Asset Management Software selected by OSU for all projects is Crestron Fusion. When referenced in the contract documents within the room functionality, Fusion shall be able to provide the functionality described in these paragraphs.

b. Programmers of Crestron system using Crestron SIMPL Windows shall follow the IDs referenced herein for programming:
   - Touchpanel IP ID = 15
   - Xpanel control = 03
   - Fusion ID = 04
   - Displays ID = 08, 09

c. Additional software customization: The AVS installers shall customize the user interface of Fusion according to the project specific requirements. The AVS installers shall meet with the Owner and Design engineer during the construction process and agree on the additional features that will be used by the owner on the project. Once this step is completed, the AVS installers shall program the Fusion interface based on the conclusions of that meeting.

d. Training: The AVS installers shall provide administration level training for specific Fusion features programmed during a project.
e. Delivery: The AVS installers shall provide OSU UIT-AT electronic copies of all programs in executable and source code format. Each file shall be properly labeled with the room description and the room number.

iii. Owner Furnished Equipment (OFE)

a. General: When indicated in the drawings the AVS installers shall interface with equipment provided by the owner or by third parties. Refer to the design drawings for audio, video and control lines required for OFE.

b. Scope of work: It is in the scope of work of the AVS installers to run, terminate and connect the audio, video and control lines to OFE as shown in the design drawings. When control lines are indicated in the design drawings, the AVS installers shall program all control features described in each system functions per controllable room, including all features related to owner provided equipment or third-party equipment.

C. Wire, Cable, Connectors, and Accessories

i. General: The AVS installers shall provide the system components and materials necessary to properly install, support, and terminate all audiovisual cabling. The AVS installers shall coordinate with the installer of the raceway system final locations of all outlet boxes. The AVS installers shall also provide and attach all required cable connectors. Label all cable with source and destination.

ii. Cable: The AVS installers shall provide all cabling associated with, and required to, provide a complete, operable system in accordance with the Contract Documents. All cable provided by the AVS installers shall be of a manufacture and quality consistent with the design intent and shall be reviewed by the Engineer prior to installation. For Preferred cable part numbers, refer to UIT-AT-AV Infrastructure sheet.

iii. Cabling in air handling spaces. The AVS installers shall provide cables with plenum rated jackets for all cables run above ceiling spaces. For all cables run in vertical shafts or conduits, the AVS shall provide riser rated cables.

iv. Cabling below grade: When cable part of the AVS have to be run in conduits below slab and grade level, the AVS installers shall use only cables with water-blocking jackets.

v. Cable signals: The following is a list of signal types and the cables to be used for those signals:

a. Line level audio signal cable: Provide one (1) twisted pair cable for mono signals and two (2) twisted pair cables for stereo signals. Twisted pair cables to be 22 AWG stranded (7x30) tinned copper conductors with overall foil shield (100% coverage), with 22 AWG stranded tinned copper drain wire.

b. Microphone level audio signal cable: Provide one (1) twisted pair cable, 22 AWG stranded (7x28) tinned copper conductors, overall foil shield (100% coverage) with a 22 AWG stranded tinned copper drain wire.

vi. Serial Digital video cable: Provide one (1) RG-6 coaxial cable, 18 AWG solid. Characteristic impedance 75Ω. Color jacket for these cables shall be blue or black.

vii. Control cable (i.e. Crestron CRESNET): Provide one (1) cable with one (1) twisted pair 22 AWG stranded copper conductors with overall aluminum foil (100% coverage) and a 24 AWG tinned copper drain wire, and one (1) unshielded twisted pair, 18 AWG stranded bare copper conductors.
viii. Control cable (i.e. RS-232, RS-485 Signal, IR or Contact Closure): Provide one (1) cable with 1 or 2 twisted pair 22 AWG stranded bare copper conductors with overall aluminum/polyester foil (100% coverage) and a 24 AWG tinned copper drain wire. Pair count depends on manufacturer’s specifications.

ix. Digital video, audio and control over twisted pair. Provide one or two cables UTP or STP as required by transceiver equipment manufacturer to ensure the digital signal is transported properly up to 328 feet, at maximum resolution indicated in Subparagraph 2.01, System Functions above. If equipment manufacturer supports the use of UTP Category (5e, 6 or 6A) for this application, the AVS installers shall provide cables in compliance with Section 27 10 00, Structured Cabling System, and all cables part of the AVS. Color jacket for these cables shall be blue.

x. UTP Category cables. Provide UTP Category cables for all Ethernet connection part of the AVS as indicated in Section 27 10 00, including horizontal cables, patch cords and station cables. All cables part of the AVS shall be included in the same warranty as all cables provided under Section 27 10 00. Color jacket for these cables shall be blue.

xi. Speaker Cable: Provide two (2) 16 AWG stranded conductors, with overall jacket.

xii. HDMI Cables. HDMI cables may be no longer than 15 feet and meet attached equipment manufacturer’s specifications.

D. Connectors and plates: The AVS installers shall provide connectors and plates to terminate all wiring part of the AVS, regardless of if indicated on the design drawings. As a general guideline, the AVS installers shall follow these recommendations:

i. Compression type connectors on BNC cables.

ii. When custom panels or plates are required in the project, the AVS installers shall submit detail drawings of all plates for approval by OSUUIT-AT and the Design Engineer.

iii. For general connection panel applications refer to 27 41 00 00 (Audio -Visual Communications Infrastructure) for appropriate connector, part number, and keystone plate call out.

iv. All termination of UTP Category (5e, 6 or 6A) cables shall be done in accordance to Section 27 10 00.

E. Media Control Systems

i. OSU has standardized on Crestron media control systems at this time. Integration with Crestron Fusion is required. Please consult with the OSU UIT-AT, and project manager for any additional control system information needs...

ii. User interfaces shall be a touchscreen no smaller than 5 inches. In classrooms and auditoriums, the user interface should be on the lectern. For conference rooms requiring non-wall mounted control interfaces on top of the table is preferred.

F. Microphones

i. All wireless microphones must be in the frequency range of 516-558 MHz.

ii. Classrooms require one wireless lavalier microphone for instructor use with classroom capture.

iii. Auditoriums require one wireless lavalier microphone for instructor use with classroom capture and voice reinforcement. One wireless handheld microphone is also required.
iv. Conference rooms require at least one tabletop or ceiling-mounted microphone for web-based video conferencing.

v. When several microphones are in any room, the use of a separate DSP processor is required.

G. Power

i. An IP controlled power conditioner is required in all classroom lecterns and/or racks.

ii. For each lectern and/or rack in any AVS, the Design Professional must provide load calculations to OSU for distribution to project electricians.

H. Assisted Listening Devices

i. All general-purpose classroom spaces require the installation of an assisted listening transmitter.

ii. Auditoriums require installation of an assisted listening transmitter.

iii. For all other types of spaces, please consult with OSU UIT-AT or AV project manager.

I. Monitors/Digital Displays

i. All monitors should be commercial-grade only and include HDMI inputs.

ii. Monitors for use in digital signage applications must be 24/7 rated.

iii. Monitors for use in conference rooms must include audio line outputs.

iv. All Monitors must include LAN for use with remote connectivity, and system control.

3. EXECUTION OF THE WORK

A. General: Refer to the requirements of the related documents identified in Subparagraph 1.1 above, for execution of work requirements supplemented by this section.

B. Workmanship: The AVS installers shall adhere to, at a minimum, the following installation practices:

i. Securely mount equipment plumb and square in place. Where equipment is installed in cabinets, provide mounting bolts in all equipment rack fastening holes. Any equipment packaged by the manufacturer without mounting accessories: The AVS installer shall provide all required accessories necessary to mount the equipment within the designated cabinets and/or rack locations. These accessories may include (but not limited to) rack ears, brackets, shelves, and security mounts.

ii. Provide appropriate ventilation panels, vents, and/or fans to assure sufficient ventilation for adequate cooling of all equipment. The AVS installer shall provide solutions to avoid overheating when equipment is to be installed in casework or closed lecterns.

iii. Confirm the polarity and phasing of system components before installation. Connect to maintain uniform polarity and phasing.

iv. Insulate all non-insulated, stranded conductors before making termination when connecting to equipment terminals.

v. All wiring is to be free from ground loops, shorts, opens, and reversals.

vi. Neatly tie all cabling within equipment cabinets, housings, and terminal cabinets with hook-and-loop fastener straps (commonly referred to as “Velcro”) at not more than 12 inch intervals. Install in accordance with the latest EIA installation standards. Design Professional approved wiring trough may
be used in lieu of tie-wraps. Cable routing shall not braid or cross with other wires in parallel more than once.

vii. Secure all cables in equipment cabinets and terminal cabinets to provide strain relief at all raceway exits in accordance with NFPA 70 including all supplements. All plugs and receptacles are to be the grounding type.

viii. Connect all equipment power to power conditioner or UPS.

C. Raceways - all raceways for audiovisual devices shall have the following specifications:

i. All cables for speaker level signals, regardless of their level shall be run separate from other low voltage cables.

ii. All cables for microphone level signals, regardless of their level shall be run separate from other low voltage cables, unless pre-approved by UIT-AT.

iii. Separation of Raceways: OSU does not allow the use of raceways or cable trays design for structured cabling systems to be used for AVS cables except for fiber optic cables, unless pre-approved by OSU-UIT.

iv. Raceways for AV outlets: Outlets for AV cables shall be composed of electrical boxes (sized for the number of connectors) and a conduit(s) to the nearest accessible ceiling space. All AV outlet boxes shall be at least 2.5 inches deep.

v. All indoor rated cables can be supported with j-hooks or cable hangers above accessible ceiling spaces. J-hooks shall be spaced no longer than 6 feet.

D. Labeling - any type of write-on labels, handwriting on cable jackets or directly on equipment, labels made with masking tape, or any other type of non-approved tape are not acceptable and shall be corrected with approved labeling methods at no additional cost to the owner. The only approved types of labels for cables and devices part of the broadband distribution system are:

i. Non-laminated thermal transfer labels printed with a high-quality thermal transfer printer.

ii. Laminated thermal transfer labels printed with a high-quality thermal transfer printer.

iii. Thermal transfer polyolefin tape printed with a high-quality thermal transfer printer.

iv. Self-laminated dot-matrix labels printed with a high-quality dot matrix printer.

v. Non-laminated dot-matrix labels printed with a high-quality dot matrix printer.

E. Engraving - all push buttons in user interfaces part of the AVS shall be engraved with descriptive wording of the use of the button.

i. The AVS installers shall submit and receive approval for the proposed wording in each button before doing the engraving. Failure to follow this step might cause the AVS installers to replace the buttons in interfaces where the Owner is not satisfied with the wording of the label at no additional cost to the Owner.

ii. The color of the wording in the engraving shall have high contrast with the background color of the button.
F. Projector Installation - the Installer shall adhere to, at a minimum, the following installation practices for projectors:
   i. Projector shall be provided with corresponding mounting brackets depending on the projector selected.
   ii. All anchors and supports whether prefabricated or customs, required to mount the projector where indicated in the design drawings are in the scope of work of the AVS installers, unless agreed upon by Project Manager and UIT-AT
   iii. Refer to UIT-AT-AV Infrastructure sheet for approved projector mounting hardware.

G. Flat Panel Display Installation - the AVS installers shall adhere to, at a minimum, the following installation practices for flat panel displays:
   i. All anchors and supports whether prefabricated or customs, required to mount the displays where indicated in the design drawings are in the scope of work of the AVS installers, unless agreed upon by Project Manager and UIT-AT
   ii. All walls where flat panel displays will be installed shall be re-enforced with sheet metal, or ¾" plywood behind the drywall. The extent of the re-enforcing shall be the contour of the flat panel display to be installed and no less than twice the distance between 2 drywall stud frames.
   iii. When flat panel displays are installed inside a wall niche, the AVS shall provide a wall mount with adjustable depth that allows the flat panel display to be installed flush with the exterior wall.
   iv. Power and AV outlets to be installed behind flat panel displays shall use a CHIEF PAC526 or approved equal box.

H. Speaker Installation - the Installer shall adhere to, at a minimum, the following installation practices for speakers:
   i. All ceiling mounted speakers shall have a support wire tie to the building structure and shall not be supported exclusively from the ceiling grid.
   ii. All ceiling mounted speakers shall be plenum rated.
   iii. All in/on-wall speakers shall be installed with pre-construction brackets.

I. Equipment Rigging - when speaker assemblies or arrays weight more than 100 lbs., the AVS installers shall follow all rigging instructions from the manufacturer and shall be done by an experienced rigger. The AVS installers shall also adhere to the following practices:
   i. Only the rigging equipment and method listed by the manufacturer of the equipment are approved for the installation No substitutions are accepted.
   ii. Only the rigging points available in the speaker assembly are accepted as means of support.
   iii. All anchors and supports whether prefabricated or customs, required to mount the speakers where indicated in the design drawings are in the scope of work of the AVS installers.
   iv. Shop drawings for rigging methods shall be signed and sealed by a licensed structural engineer.

J. Millwork Openings - when AV equipment like flip tops and plates will be mounted in millwork provided by the owner or third parties, the AVS installers shall provide cut out dimensions for all the AVS equipment listing location in the millwork where the cuttings need to be done. It is the AVS installer’s responsibility to install those devices in the millwork, once the openings have been done. All millwork opening shall be done by the furniture manufacturer.

K. Floor Boxes- floor boxes used for connection to teaching lecterns shall have at least the following minimum requirements:
i. Floor boxes shall be large enough to have at least 3 different compartments, one for power one for voice/data cables and one for AV cabling.

ii. Each low voltage compartment shall have a separate raceway back to the accessible ceiling space, or serviceable junction box. If speaker wires are run from the lectern, the AV compartment shall have at least one 1 inch conduit from the AV compartment to the accessible ceiling/junction box. Additional conduits might be required depending on the application, and should be coordinated with OSU-UIT-AT.

iii. Floor boxes shall have a recessed compartment to hold connectors. Floor boxes that leave AV connectors flushed with the floor are not desirable since they become tripping hazards and could be easy broken with the lectern when moved.

iv. AV compartments shall have termination plates and connectors for all cables coming from the accessible ceiling space. All connectors shall be properly secured to the plates in the floor box. All unused compartments shall have blank plates.

v. Refer UIT-AT-AV Infrastructure sheet for approved AV floor boxes, and covers.

L. Structured Cabling Infrastructure - the AVS installers shall adhere to Section 27 10 00 for all requirements of structured cabling components to be used as part of the AV system. The structured cabling components include but are not limited to:

i. All unshielded twisted pair Category cables and fiber optic cables

ii. Termination devices like termination jacks, patch panels and faceplates.

iii. All UTP and fiber optics patch cords.

iv. All testing procedures for Category and fiber optic cables.

M. IP/MAC Addresses - all IP addresses will be provided by OSU unless UIT-AT specifically pre-approves the use of a separate network for the AVS. Reprogramming of AVS due to un-approved IP address use by the AVS installer shall be at the installer’s expense. The AVS installer shall provide a list of all equipment requiring IP addresses to OSU UIT-AT in advance of installation. This list shall include:

i. Device manufacturer and model number.

ii. Device MAC address

iii. Device serial number

4. SOFTWARE PROGRAMMING AND TESTING

A. The software programming and testing of the AVS system will be a multi-step process. The AVS installers shall provision in the proposal for the time indicated in each of the steps below.

B. Briefing Step - after receiving the notice to proceed, the AVS installer shall request one or more briefing sessions with the Owner and/or design engineer to go over the expectation of each system and clarify any points that might not be clear in the design documents. Some important notes about this step are:

i. The AVS installers shall have software programming submittals approved as described in Section 27 40 16 01, Part 1 above.

ii. The AVS installers shall prepare meeting minutes of the key decisions made during these meetings. The approval of these meeting minutes by the Owner and Design Engineer will be accepted as approval notice of this step.
C. Shop Programming Step - once the briefing step has been completed and approved, the AVS installers shall allocate off-site programming time to accomplish all the requirements listed in this section and the clarifications done in the previous step. It is the sole responsibility of the AVS installers to estimate how many man hours are required for this step. This step does not require approval by the Owner and/or Design Engineer.

D. Field Verification Step: After all AVS equipment has been installed on site and the system has been programmed, the AVS installers shall request one or more working sessions with the Owner and/or design engineer to verify in the field the functionality of the AVS system. Some important notes about this step are:

i. The AVS installers shall have different AV media and sources to test all features in the AVS system.

ii. Physical installation of all devices will be checked by the Owner (OSU-UIT-AT). Any deviations in the installation of the equipment part of the AVS from this section and previous meetings, will be noted by the Design Engineer in a “punch list”. This punch list will be sent to the AVS installers within the next 5 days of the working session for immediate corrective action. One punch list will be prepared for each room with AVS.

iii. The AVS installers shall prepare meeting minutes of the key decisions made during these meetings that affect the programming sequence. The approval of these meeting minutes by the Owner and Design Engineer will be accepted as approval notice of this step.

E. Final Adjustment Step - once the previous step has been approved, the AVS installers shall allocate time to make any corrections to the AVS system on site based on the conclusions of the punch list. It is the sole responsibility of the AVS installers to estimate how many man hours are required for this step. This step does not require approval by the Owner and/or Design Engineer.

F. Final Acceptance Step - once the AVS installers has completed the previous step the AVS installers shall allocate time to review the complete AVS system with the Owner and/or design engineer, for compliance with this section, previous punch list and conclusions in previous meetings and working sessions. Some important notes about this step are:

i. It is the sole responsibility of the AVS system installer to estimate the time allocated for this step. It is assume that at this point in time all the features of the AVS system are clear to the Owner and the AVS installers so this step is just to make sure that all the features are working properly as agreed.

ii. The AVS installers shall have different AV media and sources to test all features in the AVS system.

iii. Physical installation of all devices will be checked again by the Owner and/or the Design Engineer. All previously noted punch list items shall have been corrected by the AVS installers.

iv. Failure to complete one or more of the previously issued punch list items or failure to correct any programming changes previously noted will revoke acceptance of the room or system being tested.

v. Final acceptance will be granted on a room-by-room basis.

vi. Data Wiring and Fiber Optic Testing: Testing of UTP data wiring, copper patch cords, fiber optic cables and fiber optic patch cords shall be done as indicated in Section 27 10 00. Testing results shall be submitted as indicated in the same section.

vii. Test Equipment: The AVS installers shall supply all testing instruments required for the equipment programming and system tests. The AVS installers shall use test equipment meeting the minimum specifications, identified herein, to perform system calibrations and adjustments. The AVS installers shall make available the same test equipment available, for inspection by the Engineer, during Final Acceptance step.
a. Audio Impedance Meter.
b. Digital Multimeter.
c. Sound Level Meter – ANSI & IEC Type 2.
d. Digital Video Signal Test pattern generator.
e. CAT6 cable tester

viii. Signal Adjustment - the AVS installers shall ensure that the following adjustments, tests and measurements, at a minimum, have been completed:

a. The system shall be measured and adjusted for optimum signal quality and minimum signal loss, to all audio and video signals, through the system channel, using appropriate test equipment and standardized testing procedures.
b. The system shall be measured and adjusted for optimum signal-to-noise ratio and maximum headroom in the system electronics.
c. The system shall be measured and adjusted to eliminate distortions or degradation of signal resulting from, but not limited to, clipping, hum, noise, and RFI interference.
d. The Installer shall check the quality of each signal, at its source, and compare it against the quality of the signal at various points of its transmission through the system.

5. TRAINING

a. The AVS installers shall provide the owner with different types of training as described herein.

b. System Administration Training - the AVS installers shall provide system administration training at the job site as described below:

i. Duration of system administration training will be indicated for each AVS in the corresponding section.

ii. Travel time will not be counted as part of the training sessions.

iii. Training will be broken down to several sessions in different days. Each session shall be no longer than 6 hours. The number of sessions will be indicated for each AVS in the corresponding section.

iv. The objective of the system administration training will be to properly operate, troubleshoot, calibrate and perform specific field repairs to AVS equipment.

v. Field repair and calibration training will be limited to those repairs noted by the manufacturer of the equipment as field repairs done by non-factory trained personnel.

vi. Training shall be done at the job site with all the equipment operational after final acceptance.

vii. Training will be limited to a maximum of 5 attendees per session.

viii. Operation and Maintenance manuals shall be delivered at the beginning of these sessions.

c. User Training - the AVS installers shall provide user training at the Job site as described below:

i. Duration of user training will be indicated for each AVS in the corresponding section.

ii. Travel time will not be counted as part of the training sessions.

iii. Training will be broken down to several sessions in different days. Each session shall be no longer than 6 hours. The number of sessions will be indicated for each AVS in the corresponding section.
iv. The objective of the user training will be to properly operate the AVS.

v. Training will be limited to a maximum of twenty (8) attendees per session.

vi. User short form guides shall be provided to all attendees of the sessions.

vii. Short form guides shall provide the users with quick finding ways to operate the system. If AVS operation is different from one room to the other, one separate short form guide shall be provided for each room.

d. Other Training Requirements - the AVS installers shall also comply with the following

Training requirements:

i. At least one of each type of training sessions may be recorded by OSU UIT-AT for review on a later date.

6. COMMISSIONING

A. Note to the Design Professional(s) - OSU might choose to have third party commissioning of audiovisual system. The Design Professional shall confirm with the OSU AV Project Manager, via the OSU Project Manager, if this is a project requirement. If so, the Design Professional shall include a description in this section of the commissioning process so the AVS installer can factor the required commissioning time in their bid.

7. WARRANTY

A. Equipment Warranty - all manufacturer’s warranties for equipment included in the project shall be transferred to OSU upon completion. The AVS installer shall provide a list with all equipment in the project and duration of the warranty as issued by the manufacturer. AVS installer shall aid in the event manufacturer’s warranty requires AVS installer to facilitate repair and/or service instead of OSU

B. Installation and Programming Warranty - the overall AVS installation and software shall be warrant for at least one (1) year. The warranty shall start from the day the AVS installers receives the approval of the Final Acceptance Step.

C. During the warranty period the AVS installers shall visit the site as many times as required to fix any issues in the system.

8. CLOSE-OUT DOCUMENTATION

A. General - refer to the requirements of the related documents identified in Section 27 40 16, 1.01, Related Documents above, for close-out documentation requirements supplemented by this section. The following is a list of required close-out documentation:

i. As part of the Asbuilt (from Contractor) and Record Drawings (provided by Design Professional) to indicate final floor plan locations of all AV devices in full-size paper and digital formats.

ii. One line diagrams with all devices connected in the system in full-size paper and digital formats.

iii. All programming source code done by the AVS for this project for all pieces of equipment in digital format (no printed copies accepted).

iv. Compiled executable files as requested for Computer based user interface.

v. All Operations and Maintenance Manuals (digital format preferred).
vi. All printed test results.

vii. Inventory of all equipment used in the project (digital copy only, in spreadsheet or csv format) containing the following information:

   a. Manufacturer
   b. Model
   c. Description
   d. Serial Number
   e. MAC address (where appropriate)
   f. Installation Location (building and room).
   g. Duration of warranty.
Division 28: Electronic Safety and Security

Section 28 13 00: Access Control
1. PRODUCTS

Section 28 31 00: Fire Detection and Alarm
1. SUMMARY
2. PRODUCTS
3. EXECUTION
Section 28 13 00: Access Control

1. REQUIREMENTS
   A. Any deviations to be approved with the OSU Access Lock & Key Shop per the Deviation Request Form/Process via the Project Manager.

B. PRODUCTS
   A. Controllers
      i. The controller shall be Identiv Hirsch MX8 with a SNIB3 communication device and a MELM3 Line Module.
      ii. Elevators going on access control will need their own controller separate from the controller for the doors. In these cases it is ok to deviate from a MX8 to a MX2 or MX4 depending on the needs of the building.

   B. Power Supplies
      i. The power supply will be a Schlage PS904 with an 8 door relay.
      ii. A Schlage PS914 power supply can be used if the Panic Devices installed require a high in-rush current to operate.
      iii. The Hirsch MX8 controller will be installed in a location agreed upon by OSU Access Lock & Key Shop. The power supply will be installed directly underneath the MX8 controller. All electrified hardware on a MX8 controller will go back to the PS904 power supply that is underneath it, not above the associated door or any other location unless specifically approved via a Deviation Request. The MELM3 Line Module will be installed above the door that it is wired into. (This does not include Accessible/ADA Restrooms. See Accessible/ADA Restroom standards in Section 08 71 00.)
      iv. Both the controller and power supply will be connected to the emergency generator in case of a power outage.

   C. Card Readers
      i. The readers will be Schlage MT15 or MTK15 (depending on customer needs).
      ii. IMT11 is acceptable for mullions only.
      iii. OSU Access Lock & Key Shop will work with installer to assist in encryption of readers to work with OSU issued ID Cards.

   D. Electrified Lock Hardware
      i. Cylindrical Locks will be Schlage ND Series Electrified 24V with Rhodes elver and a built in request to exit in a 626 finish prepped for a SFIC.
      ii. Mortise Locks will be a Schlage L Series Electrified 24V with Rhodes lever and a built in request to exit in a 626 finish prepped for SFIC.
iii. Exit Devices will be a Von Duprin 99 QEL Electrified 24V with a 990NL (for keyed entry) or 990DT (Dummy trim for non-keyed entry) and a built in request to exit in a 626 finish prepped for a SFIC.

E. Electrified Strikes
   i. Von Duprin 6400 Series 24V in a 626 finish for non-electrified mortise locks.
   ii. Von Duprin 6200 Series 24V in a 626 finish for non-electrified cylindrical locks.
   iii. Von Duprin 6300 Series 24V in a 626 finish for non-electrified exit devices.
   iv. Electric Strikes will not be installed on removable mullions. If a removable mullion is necessary than the locking hardware must be electrified on doors that are being added to the electronic access system.

F. Electrical Power Transfers
   i. Electrical Power Transfers will be Von Duprin EPT-10 in a 626 finish.

G. Request to Exit Sensor
   i. The Request to Exit Sensor will be a Bosch DS160 in a white finish. Request to exit sensors will only be installed on openings where a built RX is not available.

H. Locking doors that have an ADA operator will be programmed to not open when exterior side is locked but still allow the interior side to operate regardless of the doors locked/unlocked state. Both sides should open where the door is in an unlocked state. (This does not include ADA restrooms, for ADA restroom standards see section 08 71 00.)
   i. .
Section 28 31 00: Fire Detection and Alarm

1. SUMMARY

A. This standard is established to aid the Design Professional of Record in development of the design and construction documents. Contents and requirements stated herein are to be incorporated into the final contract documents and the construction shop drawings.

i. Fire alarm systems shall be designed by a National Institute for Certification in Engineering Technologies (NICET) Design Professional certified at Level III or Level IV in Fire Alarm Systems. The fire alarm Design Professional will also have the necessary credentials as required by the State of Oregon and the City of Corvallis.

B. Design Criteria

i. The Fire Alarm System design shall comply with the latest adopted edition of the following codes and standards:
   a. Oregon Structural Specialty Code (OSSC)
   b. Oregon Fire Code (OFC)
   c. National Fire Alarm and Signaling Code – NFPA 72
   d. Oregon Electrical Specialty Code (OESC)

ii. Related Divisions/Sections in OSU Construction Standard
   a. Section 08 71 00 – Door Hardware
   b. Section 21 10 00 – Water-Based Fire Suppression Systems
   c. Division 23 – Heating, Ventilation and Air Conditioning (HVAC)
   d. Section 25 30 00 – Integrated Automation Instrumentation and Terminal Devices
   e. Section 26 00 00 – Electrical

iii. Where portions of a building remain occupied during a construction project, the fire alarm system will remain operational throughout the duration of the project. Construction phasing plans or planned fire watch periods will be included in the project design documents. The Contractor shall coordinate project phasing and shall provide temporary protection and system programming to accommodate the phased construction, alteration, and demolition activities.

iv. Where an expansion/renovation project requires additional Fire Alarm Control Panel (FACP) capacity beyond that existing, a complete, new system is required. The use of multiple main control panels in a single building is not permissible.

v. The main Fire Alarm Control Panel (FACP) shall be installed at the primary fire department entrance to the facility.

vi. Evaluate feasibility of a smoke detection system design where area smoke detectors are provided for smoke damper and air handler control in lieu of duct mounted smoke detectors. If duct detectors are installed and not “readily accessible” a remote test switch will be added to a “readily accessible” location.
vii. Alarm Verification shall be permitted for smoke detectors where the conditions or activities are anticipated to cause nuisance alarms.

viii. Only the detectors adjacent to fire shutters or elevator smoke doors will activate the door release function.

ix. Provide FACP software bypass switches for the following points:
   a. Notification Appliance Bypass
   b. Fire Sprinkler/Fire Pump Input Bypass
   c. HVAC Shutdown/FSD Closure/Door Holders Output Bypass
   d. Elevator Recall/Shunt Trip Input/output Bypass

x. A document storage cabinet will be provided at the main FACP location, or other location as determined by the University. The cabinet will be sized to contain the record drawings, the testing and completion documents, and will contain a permanently mounted electronic storage device for a copy of the FACP resident software, a copy of the programming software (current version), BIN files and any other panel related files, CAD files of as built, and a list of programmed points.

xi. System shall be designed class “B”.

xii. Fire/smoke dampers are to have individual over current protection and disconnect. The fuse shall be sized for 125 percent for non-impedance protected motors and 200 percent for impedance protected motors. The combination over current/disconnect means shall be located within six (6) feet of the fire/smoke damper motor. The combination over current/disconnect means shall be either a little fuse #LSSY, for one (1) Edison-base fuse and one (1) single pole toggle switch. All fire/smoke damper overcurrent protection shall be accessible without disassembly of mechanical equipment or ceiling.

2. PRODUCTS

A. The new fire alarm system will be manufactured by Edwards EST4 or the latest version of the Edwards fire and life safety system may be applied to smaller structures. Existing control equipment of a different manufacture will be allowed to remain for expansions of existing systems which do not warrant a complete fire alarm replacement.

B. All fire alarm initiating devices will be intelligent/addressable and will be programmed with an individual device address.

C. Smoke detectors shall be located within electric rooms, elevator lobbies, and control rooms, and at other locations required by Code. Smoke detectors shall be photoelectric type, except where ambient conditions dictate that another type of early warning detection should be used (such as heat detection).

D. All fire alarm notification appliances will be intelligent/addressable.
   i. Visual strobe units shall be provided in all public use and common use areas, and shall meet the public mode signaling requirements of ADA, UL, and NFPA 72.
   ii. Audible notification devices shall be arranged to provide a minimum of 15dbA above ambient sound levels in any space. Trumpet-type loud speakers may be required in mechanical spaces (or similar areas with high ambient noise) to ensure that this requirement is met.
iii. Notification devices should be red in color, unless permitted by the Project Manager and AHJ. Where speakers are used for EV/ACS signaling, the device shall not be labeled “FIRE” or have any other signifying marks to restrict its use for fire alarm only.

iv. In renovation activities, new strobe appliances within the work area shall be listed for use with existing devices. In the event that new and existing devices are not compatible or if the provisions for strobe synchronization cannot be met, all devices within the affected area shall be replaced to comply with the applicable codes.

E. Provide a fire alarm transmitter capable of communicating over the OSU campus Ethernet. Program the transmitter to fully interface with the OSU Campus Safety receiving station in Cascade Hall. Provide point identification for all alarm, supervisory and trouble signals as well as all intelligent/addressable devices and appliances.

i. Provide the following spare parts:
   a. Fuses – (2) of each size used in the installed system.
   b. Manual Pull Station – Minimum of one or 2% of total installation
   c. Spot Type Area Smoke Detector – Minimum of one or 6% of total installation
   d. Spot Type Heat Detector – Minimum of one or 6% of each type used in the total installation
   e. Detector Base – Minimum of one or 2% of each type used in the total installation
   f. Interior Notification Appliance – Minimum of one or 4% of each type used in the total installation
   g. Exterior Notification Appliance – Minimum of one or 2% of each type used in the total installation
   h. Intelligent Modules – Minimum of one or 4% of each type used in the total installation

F. Submittals

i. Submittal requirements are per OSU Division 1 Specifications, the Contract Documents, the Construction Contract, and Minimum Required Documentation sections of NFPA 72.

ii. The Contractor’s fire alarm shop drawings and product data sheets shall be submitted to the OSU Facilities Alarms Shop for review, including the Design Professional’s review comments/submittal dispositions.

3. EXECUTION

A. Installation

i. Fire alarm system installation shall be supervised by a contractor NICET certified at Level II in Fire Alarm Systems.

ii. Provide a complete metallic raceway for fire alarm systems. Provide a minimum 3/4 inch Electrical Metallic Tubing (EMT) for fire alarm wiring. A single cable run to a single device may be installed in 1/2 inch EMT. Provide a minimum 4 inch square box for junctions and terminations. Fire alarm wiring/cabling to be marked as such every 50-ft or as reasonable for identification.
a. For EV/ACS systems employing relocation or partial evacuation, a Level 2 or Level 3 pathway survivability shall be required. Where notification zones are separated by not less than 2-hour fire-rated construction, a pathway survivability of Level 1, 2, or 3 shall be permitted.

b. For EV/ACS systems that do not employ relocation of partial evacuation, Level 0, Level 1, Level 2, or Level 3 pathway survivability shall be permitted.

c. Pathway survivability levels for in-building and/or wide-area MNS shall be determined by the risk analysis.

d. In Area of Refuge wired emergency communications systems, a Level 2 or Level 3 pathway survivability shall be required. Where notification zones are separated by not less than 2-hour fire-rated construction, a pathway survivability of Level 1, 2, or 3 shall be permitted.

iii. The main FACP and any additional Notification Appliance Circuit (NAC) panels will be connected to life safety branch circuits and provided with transient surge suppression.

a. Each control panel and NAC panel shall have a system smoke detector placed within 10-ft.

iv. All fire alarm notification appliances will operate from one pair of conductors. Exceptions are allowed for Emergency Voice Alarm Communications Systems (EVACS) and for certain weatherproof or hazardous location applications.

v. Emergency control functions shall have bypass switches located at the FACP.

vi. Door holder circuits will be 24VDC from dedicated, battery backed power supplies. Powering of non-fire alarm loads from the FACP is prohibited.

vii. Duct mounted smoke detectors will report as supervisory alarms at the FACP.

viii. Photoelectric Beam-Type smoke detectors will be provided with remote test capability. The test station will be installed in an accessible location.

ix. Provide isolation modules on Signaling Line Circuits (SLC) serving multiple floors or more than 50 devices on a single floor.

x. Provide labeling of all devices and appliances with their respective system address. Label to be produced from an electronic labeling system visible from the floor without magnification. Hand written labels are not acceptable.

xi. Provide labeling of all conductors and cables at termination points in panels, cabinets and junction boxes. Label to be produced from an electronic labeling system. Hand written labels are not acceptable.

xii. Roll-down fire doors shall be equipped with electric motor up/motor down controls interfaced with the FACP. Roll-down fire door and Fire Curtains shall be closed only by the nearest smoke detector in alarm on either side of the door. Roll-down fire doors and Fire Curtains shall automatically be restored to the open position upon fire alarm system reset to normal.

B. Impairments and Safeguards

i. Safeguarding of the building during demolition, alteration, and construction shall be a joint cooperative efforts involving the entire project team, include the fire protection contractor, the fire alarm contractor, the Construction Manager/General Contractor (CMGC), Owner, and AHJ.
ii. The Contractor shall ensure proper building protection and safeguarding at all times in accordance with all applicable codes, standards, and regulations, including but not limited to the OSSC, the OFC, and the current edition of NFPA 241 *Standard for Safeguarding Construction, Alteration, and Demolition Activities*.

iii. During times when the existing, modified and/or new building fire protection systems are impaired, the Contractor shall provide appropriate safeguarding of the renovation work area, to include temporary heat detection or adequate alternate protection throughout the space as coordinated with, and approved by, the building manager, project manager or construction manager, and AHJ.

iv. Safeguarding shall also apply to all related phasing, shut-downs, swing spaces, temporary facilities and relocations, etc. Detection shall be located and installed in accordance with the products' listing and manufacturer's instructions and shall be tested and maintained until such time that the permanent building protection is restored. Alternative safeguarding such as, but not limited to, fire watch personnel, or temporary fire protection systems, may be considered if acceptable to the project manager or construction manager, and AHJ. Refer to, and coordinate with, fire alarm systems documents, and safeguarding and impairments notes and specifications. Coordinate with fire alarm system contractor and all other trades.

   a. Temporary detection shall be provided while portions of the existing fire protection or alarm systems are impaired or out of service for an extended period (generally 8-hours or more) during construction, alteration, and demolition activities.

   b. Temporary notification equipment shall include ADA compliant combination audible/visual notifications appliances where required by Code.

   c. All temporary alarm devices shall be connected to the building fire alarm system and shall function as permanent until replaced with final systems components.

   d. Bagging, or the temporary covering of smoke detectors, shall not be allowed during construction unless specifically permitted by the Project Manager/AHJ.

v. The Contractor shall be required to submit a complete demolition, alteration, construction, phasing, and impairment plan to include the information above, a schedule of project milestones and related work, and an anticipated schedule for installation, impairments, programming and all phases of final testing and completion of the work. This plan shall be coordinated with all AHJ's, the project fire prevention program manager, construction manager, and shall include any and all information, drawings, and graphics to meet the approval of the AHJ's, the Project Manager, or the relevant insurance underwriters (when applicable).

C. Training

i. Provide factory training for any untrained OSU Alarms Shop personnel. Training to be provided for both Operator and Technician levels and training hours distributed accordingly. Operator training to include all control panel functions and creation of reports. Technician training to include hardware repair and maintenance by University personnel of all building panels, devices, and appliances, diagnostic procedures, system expansion and maintenance techniques. Factory training shall include tuition, travel and lodging.
ii. For control equipment other than that specified in the Division 28 Products section, provide factory sponsored certified technical training for the system installed. This training shall certify two University technicians to maintain, service, and program the installed system. Provide for tuition, transportation and lodging for University technicians to attend this training. Include a subscription for direct manufacturer’s technical support for the system.

D. Close Out Documentation

i. Provide all of the requirements of the Completion Documentation and Minimum Required Documentation sections of NFPA 72.

ii. Provide the NFPA 72 Inspection, Testing and Maintenance Documentation.

iii. Provide permanently mounted zone map adjacent to each FACP and FAA (fire alarm annunciator?). Maps sized to be clearly visible without magnification.
Division 31: Earthwork

Section 31 00 00: Earthwork
1. REQUIREMENTS
2. EROSION CONTROL
3. GRADING
4. TREE PROTECTION
Section 31 00 00: Earthwork

1. REQUIREMENTS
   
   A. For all earthwork, the Design Professional shall include provisions for utilizing geotextile fabric, and over-excavation for times when conditions warrant.
   
   B. All aggregate base rock, asphalt, and other materials are to be specified in accordance with the latest version of standard construction specifications of the local jurisdiction.
   
   C. Pea gravel is not permitted as bedding or fill material.
   
   D. All base rock under asphalt and concrete paving sections should be \( \frac{3}{4} \)" - "0", and specified for compaction to a minimum 95% of ASTM D1557.
   
   E. All layers of base rock shall be compacted at a maximum depth of 12-inches.
   
   F. The Design Professional needs to include provisions in the specifications requiring the Contractor to coordinate for special testing, including compaction tests, asphalt placement, and concrete placement.

2. EROSION CONTROL
   
   A. The Design Professional must review and confirm to the OSU Project Manager that erosion control has been installed per AHG requirements, prior to the commencement of any grading.
   
   B. All erosion control information shall be clearly indicated on plans and specifications and designed in a manner consistent with all applicable code requirements.
   
   C. The Design Professional shall show that sediment and erosion control barriers within tree protection areas shall not be installed below the existing soil surface utilizing trenching or other excavation methods that will adversely affect tree root zones. Sediment fencing shall be anchored utilizing surface weighted fiber filled mesh filtration bags or similar approved system.
   
   D. The Design Professional shall show that the Contractor is responsible to apply and obtain an erosion control permit from the local jurisdiction prior to commencing any grading activities on the project site. The approved permit shall be obtained from the local jurisdiction and provided to the OSU Project Manager prior to the beginning of construction.
   
   E. The Design Professional is responsible to determine if a NPDES 1200 – C permit is required for the project and local AHJ requirements. Permit application to be coordinated with OSU Project Manager.

3. GRADING
   
   A. The Design Professional to work with the OSU Project Manager/Construction Manager who will be responsible to apply for and received a grading permit from the location jurisdiction.

4. TREE PROTECTION
   
   A. The Design Professional needs to show clearly labeled six foot wire mesh tree protection fencing per the local jurisdiction requirements, with direction to the contractor for implementation.
   
   B. Refer to OSU Construction Standards 01 56 39 Temporary Tree and Plant Protection for additional guidance.
Division 32: Exterior Improvements

Section 32 10 00: Bases, Ballasts, and Paving
1. REQUIREMENTS

Section 32 33 00: Site Furnishing
1. REQUIREMENTS
2. MATERIALS

Section 32 35 00: Screening Devices
1. GENERAL
2. VEGETATIVE SCREENING
3. FENCE AND POST DETAILS
4. ROOF TOP SCREENING
5. FALL PROTECTION GUARD RAILS

Section 32 39 13: Bollards
1. REQUIREMENTS

Section 32 80 00: Irrigation
1. GENERAL
2. MATERIALS

Section 32 90 00: Planting
1. BACKGROUND
2. PLANTING
3. PLANTS
4. TURF
5. SOIL
6. SOIL VOLUMES
7. TREE WELL PLANTING STANDARDS
8. SOIL VOLUME PLAN REQUIREMENTS
Section 32 10 00: Bases, Ballasts, and Paving

1. REQUIREMENTS

A. Asphaltic Paving Sections
   i. The use of permeable paving should be considered as appropriate to meet OSU sustainability initiatives.
   ii. Multi-use paths require a minimum of 4-inches of Class “C” asphalt (2-2 inch lifts) over 6-inches of ¾”-0” base rock and subgrade geotextile.
   iii. The design should try to match existing grade, in order to minimize elevation differences at the edges.
   iv. Compaction of exposed edges should be called out on design.
   v. Non-thoroughfare paving sections (i.e., parking lots) accessible to cars require 4-inches of Class “C” asphalt (2-2 inch lifts) over 12-inches of ¾”-0” base rock.
   vi. Streets, alleys, and access ways for trucks and buses, including thoroughfares through parking lots require, at minimum 4-inches of Class “C” asphalt (2-2 inch lifts) over 18-inches of ¾”-0” base rock.

B. PCC Paving Sections
   i. All Portland cement concrete (PCC) paving and slab sections are required to have 6-inches of ¾”-0” base rock and 6-inches of 4,000 psi concrete, as a minimum.
   ii. If vehicles have any possibility of access to the paving section, then reinforcing bars (ASTM A615, Grade 60) should be specified.
   iii. If vehicles do not have the possibility of access to the section, then wire fabric conforming to ASTM A185 may be used.
   iv. If wire fabric is allowed, proper specifications are required to ensure it is placed properly during concrete placement, and not left in contact with the ground.
   v. Portland cement concrete (PCC) paving sections for main thoroughfares, including heavy trucks, buses, and heavy equipment require a minimum of 8-inches of ¾”-0” base rock and 8-inches of 4,000 psi concrete.
   vi. All concrete sections designed for vehicular traffic, requires reinforcing steel, and a 2-inch thicker concrete section within 12-inches of all edges.

C. Sidewalks, wheelchair ramps, driveways
   i. All sidewalks, wheelchair ramps, and driveways shall be designed per latest City of Corvallis Standard Construction Specifications and associated detail drawings, with the following exceptions:
      a. Minimum depth of base rock shall be 4-inches, rather than 2-inches.
      b. All concrete shall have a minimum strength of 4,000 psi.
      c. All sections of sidewalk, are required to be a minimum of 6 inches thick and reinforced per “PCC PAVING SECTIONS” in this Design Criteria.
d. The maximum cross slope for sidewalks and walkways shall be 1.5% (1:66.7). This is to ensure that, with construction tolerances, the resulting slope will be less than 2% (1:48). The specifications or drawings shall state that any walkways constructed with a cross slope exceeding 2% (1:48) shall be removed and replaced by the Contractor at the Contractor’s cost. Determinations of non-compliant slopes will be at the discretion of OSU, measured using a 2 foot digital level.

e. Cross slopes for ramps and landings shall also comply with (C.i.4.) above.

f. The use of exterior ramps should be avoided unless existing grades dictate a need for a ramp. If a ramp is deemed necessary, the maximum running slope on a ramp shall be 1:16 (6.25%).

g. The Design Professional(s) shall use this OSU practice as initial design standard when designing ADA ramps for building entries.

h. When the use of the best practice standard is not technically feasible, then the most practical percent slope shall be used.

i. Any diversion from this best practice will need to be communicated and coordinated with the Office of Equity and Inclusion prior to a decision not to use the best practice standard.

j. Refer to Section 01 10 02 Accessibility Best Practices for OSU for additional standards.

D. Parking Lots

i. Parking lot designs shall comply with the latest versions of the City of Corvallis “Off-Street Parking and Access Standards” and the Oregon Transportation Commission “Standards for Accessible Parking Spaces”, as applicable. The Consultant and/or Contractor are responsible for obtaining copies of these documents.

ii. For improved parking access and occupancy management, all new parking lots shall have a single point of vehicular access. Vehicular exit can be from the same access or a separate exit only. Any deviations to be coordinated through the project’s Project Manager as a Deviation Request with Transportation Services and University Land Use Planning (ULUP).

E. Pavement Markings

i. All new private (University owned) pavement markings and signage as part of a project shall be designed and installed in accordance with the Manual for Uniform Traffic Control Devices (MUTCD) and the local jurisdiction standards.

ii. Newly resurfaced access ways and streets shall utilize durable pavement markings. Pavement marking repairs shall match existing or better materials.

iii. All striping and pavement marking details shall be per ODOT or the local jurisdiction standard details unless pre-approved by the OSU Project Manager.

iv. Pavement marking and/or signage plans shall be required with any and all alterations in existing striping and signage layout. See OSU Construction Standard 10 14 00 for information about signage.

v. Pavement markings that are painted on parking lot or road surfaces shall be applied using:

   a. Sherwin Williams, Setfast Waterborne pavement marking paint.
b. Touchups and small applications can be made using Sherwin Williams SherLiner solvent based aerosol inverted spray cans.

c. Pavement markings for accessible parking spaces shall be painted with retroflective pavement marking paint. The overall symbol size shall be a minimum of 3’-6” by 3’-6” with a 4” white border. The size of the white symbol shall be minimum 2’-6” tall by 2’-0” wide. See diagram below.

![Diagram of accessible parking symbol]

vi. Thermal Pavement Markings

a. All new pavement markings in streets and access drives shall utilize thermoplastic type durable markings for all pavement marking symbols.

b. Thermal (melt down) pavement markings are supplied by either 3M or Flint Trading INC and are applied according to manufacturer’s specifications,
Section 32 33 00: Site Furnishings

1. REQUIREMENTS

A. The products identified herein are the preferred products for placement on OSU campus. Substitutions may be made provided the vendor, Contractor, Design Professional, etc. receives written approval from the University Land Use Manager, via the OSU Project Manager, for the suggested substitution via a OSU Design & Standard Deviation Request Form (and a formal Construction Substitution Form if during construction)

B. The paint color for all furnishing, regardless if substitution is granted, is to be:
   i. OSU Black – Paint: Benjamin Moore #80; 50% gloss. Powder coat: Cardinal BK78 Black.
   ii. OSU Orange – PPG # 90-313 – “Safety Orange”.

C. Cast in place retaining walls/seat walls and benches must be chamfered with grooves, for sufficient depth installed on all edges, to deter skateboards.
   i. Continuous surface/edge without skate deterrent must not exceed 4 ft.

D. All site furnishings will be designed with an appropriately engineered footing, where required.

E. Exterior trash and recycling stations are recommended for all building entries that do not have standard recycling/trash stations inside the entrance way or lobby of a building.
   i. Exterior trash and recycling stations are Contractor Furnished and Contractor Installed (CFCI).
2. MATERIALS

A. Benches
   i. Campus Standard Bench
      a. Radius Pipe Bending Matt’s Bench. 6-foot, powder-coated steel, color: black.
   ii. Accessible Bench
      a. Radius Pipe Bending custom OSU accessible bench. 6-foot, powder-coated steel, color: black. Provide with one open end (no armrest).

B. Tables with seating
   i. Carousel; Catena table top, grid chairs with backs or without backs, powder coated, color: black
   ii. 3 - 5 seats to meet ADA
   iii. table: 42” diameter x 29” height
   iv. Manufacturer: Landscape Forms, 800-521-2546

C. Sign Posts: Refer to Construction Standards 10 14 00 Signage for information

D. Bicycle racks
   i. Refer to Section 34 00 00 Transportation/Campus Circulation for bicycle access requirements.

   ii. OSU Campus Standard Bike Racks
       a. All bicycle racks must be fixed in place.
       b. Various length, depending on number of hoops (2-5 hoops available) Hoop-Style, tubular steel Bike Rack; whereas, 5- hoop racks is encouraged to provide flexibility in relocation.
       c. Black (OSU Black) powder coated finish.
       d. Provide pipe cross bar at 18” height at ends of bike racks where they are open to pedestrian traffic.
       e. Available at Radius Pipe Bending Co.; Prairie Road, Junction City, OR 97448.
       f. All racks to be welded to 2” channel iron base rails. Embedded racks are prohibited.

   iii. Skateboard Rack
       a. Boardloch
          1) Genesis or approved equal
       b. 7 wall or approved equal skateboard rack

E. Bike Shelters – See Diagram 32 33 00A-D at the end of this section
   i. Covered Bike Shelter design is to match the design of the diagrams 32-33 00A-D; however the Design Professional of Record is responsible to provide the architectural and engineering construction documents for permit approval and construction.

   ii. Paint color of Bike Shelters and racks to be OSU Black.
ii. Covered Bicycle Shelter Lighting
   i. Light Fixture
      1) Lithonia Lighting
      2) Contractor Select CSVT LED Vapor Tight or approved equal

ii. Single Bike Shelter
Single Width Bicycle Shelter Foundation Plan

Single Width Bicycle Shelter Plan View

Single Width Bicycle Shelter Elevations
iii. Double Bike Shelter
F. Secure Bike Parking

i. Secure Bike Parking is defined as access controlled bicycle parking contained within a building or free-standing structure that provides weather protection via a roof, and is enclosed by walls on all sides. Secure bike parking can be a room inside of a building (hereafter referred to as a “Bike Room”), or an enclosed area within a parking structure or a free standing structure (hereafter referred to as a “Bike Garage”).

ii. Bicycle Racks:
   a. As noted above in Section D. or
   b. Two-tiered stacked bicycle racks such as Dero’s Dero Decker or approved equal. Bicycles must be horizontal when in the final stored position, and racks must include a vertical stagger in the manufacturer design. The rack must include a mechanically-assisted lifting mechanism to raise the bicycle to the top tier.
   c. All bicycle racks must be fixed in place.

iii. Minimum Dimensions for Bicycle Parking Spaces
| Standard Bicycle Spacing (for hoop racks) | 6'-0" | 2'-6" | 3'-4" | 5'-0" |
| Stacked Bicycle Spacing (for offset two-tiered racks) | 6'-6" | 2'-10" | 8'-10" | 5'-0" |
| Large Bicycle Spacing | 10'-0" | 3'-0" | 3'-4" | 5'-0" |

Hoop Rack Bike Parking Minimum Spacing

Stacked Spaces
iv. A minimum five-foot access aisle shall be provided within the Bike Room or Bike Garage. An access aisle may be shared by two parallel rows of racks.

v. Access control shall be provide via OSU ID Cards. All door hardware and access control devices shall be consistent with OSU Design & Construction Standard 08 81 00 Door Hardware.

vi. Door systems shall meet OSU Design & Construction Standards including door hardware, locking mechanism, access panel and all associated materials. Exterior doors shall be composed of solid metal to prevent manipulation of the interior handle or panic bar from the exterior.

vii. Where possible, and where required by code, more than one means of egress shall be provided.

viii. Security cameras shall be installed to monitor and record all entrance door(s) at a minimum.

ix. It is preferred that at least 25-percent of bike spaces shall have an electrical outlet accessible within 3-feet of the rack for e-bike charging purposes.

x. A minimum of two Large Bicycle Spaces shall be provided (with one hoop rack). Exceptions may be made for facilities where access or space make such a provision impractical and as documented with an approved Deviation Request as coordinated with the Project Manager.

G. Bike Rooms: Standards applicable to building interiors, including new building construction or conversion of exiting interior space.

i. Access to the Bike Room shall be provided by a direct, ground level exterior entrance separated from the main building entrance for all new construction, and where feasible for renovation of existing buildings.

ii. In the case of Residence Halls, or other buildings with restricted access, access control may be provided at the primary building entry. All other buildings must provide secure access control at the entrance to the bike parking facility.

iii. Where the exterior entrance is not at ground level, a ramp or stairway runnel shall be provided.

iv. For Bike Rooms with direct building exterior access, a door from the Bike Room shall lead to the interior of the building, preferably to a hallway.

v. Bike Rooms may share space with other uses, but these uses may not inhibit use or access to the bike room at any time.
H. Bike Garages: Standards applicable to free standing exterior secure bike parking structures.
   i. Freestanding secure bike parking facilities shall be covered by a roof. Roof design may be barrel vaulted or shed style.
   ii. Walls shall completely enclose the structure on all sides to within 6-inches of the floor and roof. Walls to be constructed of polycarbonate, brick, metal bars, and/or perforated metal. Chain link is not permitted.
   iii. Interior height shall allow for the installation and operation of stacked bike racks, even if that style of rack is not proposed for installation at the time of construction.
   iv. Any metal material shall be finish in OSU Black. Powder coat shall be Cardinal BK78 Black. Paint shall be Sherwin Williams “Tricorn Black” SW 6258; 50-percent gloss.
   v. The interior of the Bike Garage must be lighted to 10-20 footcandles, consistent with the standard for Corridors, Stairwells, Lobbies, Waiting Rooms, Storage and Service Areas as stated in OSU Design & Construction Standards 26 00 00 27. F. Electrical: Lighting Level General Lighting.
   vi. If the Bike Garage is sited within an automobile parking garage, entrance to the bike parking facility will be provide separate from motor vehicle traffic.
   vii. Bike Garages must have gutters to address stormwater.
   viii. Pre-manufactured products may be used provided that they meet these standards. Transportation Services to pre-approve use of a pre-manufactured product via coordination with the Project Manager.

I. Exterior Walkway Recycling/Trash Stations-
   i. General: Walkway disposal stations shall include containers to meet the current waste prevention and diversion goals of OSU. Stations may include, but are not limited to, one recycling container and one trash receptacle. Where separate stand-alone containers are used, containers shall be placed, at minimum, within 5 feet of each other to provide optimal recycling participation and meet acceptable recyclable material quality standards.
   ii. Exterior trash and recycling stations are Contractor Furnished and Contractor Installed (CFCI).
   iii. Placement: Combination recycling-trash receptacles should be placed where appropriate in landscape and site design and to maximize collection while matching pedestrian flows. Outdoor receptacles are available in a 2, 3, or 4-chamber design. The size and number of chambers to be used shall be based on the projected disposal capacity needs and collection services available.
      a. Receptacles cannot be located within the minimum effective width of sidewalks and walkways.
   iv. Equipment Standard: Combined 2, 3, or 4-chamber receptacle with hood, manufactured by RJH Enterprises, Inc. Corvallis, OR. Sorting configuration should be at minimum: 1) bottles & Cans and trash. One or two sorting chambers may be devoted to bottles & cans or trash; other available chambers may be designated for separating mixed paper, reusable food containers (i.e. “Eco2Go”), or compost, depending on the current Campus Recycling Program requirements. These receptacles hold Rubbermaid 23-gallon lightweight “slim jims,” have locking swinging doors that meet fire code for exterior use, and are constructed as per the drawings below. Receptacles must be powder-coated (black semi-gloss) or stainless steel. Confirm color/finish with OSU Recycling Manager.
      a. Vendor is not to place decals or labeling on the bins as this will be done by OSU.
b. Receptacle design.

![Diagram of Receptacle Design]

4 CONTAINER RECYCLE CABINET

![Diagram of Container Recycle Cabinet]

Plastic insert for 3- or 4-chamber recycling-trash receptacles

J. Transit Shelter

i. Transit Shelter: Tolar Manufacturing, Signature Sunset Transit Shelter, [https://www.tolarmfg.com/](https://www.tolarmfg.com/)
   a. Shelter Length variable (10 feet to 16 feet), depending on site needs
   b. Offset radius roof design with 1/8-inch aluminum roof panels.
c. Rear wall partial or full, depending on site needs.

d. 3/8-inch clear tempered glass - full panel on the back and half panel at end walls.

e. Support posts with adjustable leveling shoes and spun escutcheon shoe covers.

f. All metal surfaces powder coated in jet Black (RAL 9005).

g. Rear wall branding plaque for street name.

h. Any seating included under the shelter should allow adequate space for a wheelchair.

i. No illumination, unless warranted as reviewed by Design Professional and approved by Facilities Electrical, ULUP and OSU Transportation as coordinated by the Project Manager.

j. No disc sign.

k. No trash receptacles.

l. If there is seating located under shelter, space is also to be provided for wheelchair.

ii. Transit Shelters shall be located on hardscaped areas outside of sidewalk/walkway minimum effective width (refer to Diagram 32 33 00G: Transit Shelter - Pedestrian Facility Size).

iii. Transit shelters shall be ADA accessible, and meet all applicable local and state codes.

iv. Transit shelters shall not obstruct required vision clearance areas and sight lines.
Section 32 35 00: Screening Devices

1. GENERAL

A. All service areas, mechanical equipment, above grade utilities, trash/recycling collection bins, and outdoor storage areas should be permanently screen from view as part of building construction or with landscaping, masonry walls, metal, solid wood fencing, or a combination of these materials. In the City of Corvallis Land Development Code, “view” is generally defined as from sidewalks/walkways, building entrances, rights-of-way, and adjacent neighborhoods.

i. See OSU Design & Construction Standard Section 26 00 00, Electrical for clearance requirements.

B. Screening materials should be similar to those used on or near adjacent buildings.

C. Screening materials may include combinations of the following:

i. Vegetation

ii. Masonry (e.g., brick, stone, concrete, concrete masonry unit)

iii. Metal

iv. Wood

v. Iron fencing

vi. Other commonly used fencing/wall materials.

vii. Coated, black vinyl chain link fences, with or without slats, may be used at athletic and recreational facilities, or other locations as approved by OSU project design team and University Land Use Planning.

viii. The use of barbwire, chain link, chain link with slats is allowed within agricultural areas or around substations when not visible from a street, sidewalk, or walkway.

D. Screening shall not obstruct required vision clearance areas and sight lines.

E. The choice of screening materials and their placement should be in consideration of public safety and visual clearance requirements.

F. Screening shall be in compliance with the Land Development Code Chapter 3.36 or applicable local regulations if outside of the City of Corvallis.

G. Screening shall be in compliance with the Land Development Code Chapter 2.9 if the project is within the OSU National Historic District.

2. VEGETATIVE SCREENING

A. Plants may be used to visually screen undesirable views, such as service areas, trash and recycling stations, and above grade utilities.

i. Plants used for screening should be selected based on the ability to provide year-round screening, the material’s ultimate size and requirements for healthy growth without shearing or excessive pruning.

ii. Plants should provide the desired height and density taking into consideration circulation requirements, safety, the needs of the use being screened, ingress and egress requirements as well as aesthetics.
iii. In many cases, plant materials used in conjunction with constructed screening devices provide the most appropriate and functional solution.

B. Vegetative screening, when used, should provide visual screening year round.

C. Where landscaping is used for required screening, it shall be at least six feet in height and be at least 80 percent opaque, as seen from a perpendicular line of sight, within eighteen (18) months following establishment of the primary use of the site.

3. FENCE AND POST DETAILS

A. All materials shall be treated wood, wood of natural resistance to decay, hot-dip galvanized steel, or powder coated.
   i. All wood shall be construction grade 2 or better.

B. Fence post size shall be based on site conditions or engineering specifications.

C. Fence posts shall be placed a maximum of eight feet on center unless reviewed and approved by OSU Landscape Manager (in writing via Design & Construction Standards Deviation Request form).

D. Fence posts shall be set a minimum of two feet deep or as specified by the project’s Design Professional.
   i. Surface mounted posts shall not be permitted.

E. All material should be fastened by screws. No nails or staples are permitted.

4. ROOF TOP SCREENING

A. Screening materials should be similar to or compatible with those used on the building.

5. FALL PROTECTION GUARD RAILS

A. Proposed added guard rails for existing roof fall protection must be reviewed and approved by the University Architect and ULUP Manager via the OSU Project Manager.
Section 32.39.13: Bollards

1. REQUIREMENTS

   A. Permanent & Removable Bollards: VISCO # VI-BO-14, factory-finished OSU Black

       i. Permanent Bollards Material: Cast Iron
ii. Removable Bollards Material: Cast Iron or Aluminum in high use areas only
B. Lighted Bollards: VISCO #VI-BO-14L, LED, 1,250 LUMENS, 3000K TEMP, factory-finished OSU Black

- 1,250 LUMENS, 120 V, 4000K TEMP.
- LED module with heat-sink, driver and internal frosted acrylic lens
- ASTM A68-83, CLASS 30, CAST IRON BOLLARD WITH REMOVABLE ACCESS DOOR
- (3) 1” SLOTS ACCEPTING: (3) 3/4” X 15” F1554 GALVANIZED ANCHOR BOLTS
- 4” I.D.
- 6” BOLT CIRCLE
- BASE DETAIL
- VI-BO-14L
- QUANTITY: 2
C. Collapsible Bollard: Maxiforce’s Collapsible Standard Bollard Kit includes Mounting Base (Part # MCSP-SS2-EZ/ Painted: OSU Black affixed with sticker stating “Fire Access”. Facilities Services will supply sticker (OFCl).

   i. Collapsible bollards are only allowed in a Fire Lane.

   ii. Location to be approved by Project Manager after review with ULUP Manager and Facilities.
Section 32 80 00: Irrigation

1. GENERAL

A. All new, repaired and/or modified irrigation systems required as part of the project shall be designed and installed in accordance with all applicable codes and regulations.

i. All new, repaired and/or modified irrigation systems shall be designed to water within a specified water window. Mainline sizing shall be large enough to fully operate multiple zones at one time and allow all controllers on that point of connection to finish within the specified water windows. Use Peak irrigation season, highest ET (evapotranspiration rate) demand for this calculation.

a. Campus, in general, water window not to exceed 7-hours.

b. Program spaces and quad-like areas not to exceed 5-hours.

ii. Irrigation designs on a slope shall account for surface runoff. Design zones to separate the top and the toe of the slope.

iii. Irrigation Drawing shall show and account for all existing utilities and surface features.

iv. Red line markup/as built drawings must be kept during installation to illustrate actual as-built locations for all irrigation equipment.

a. Updated daily and available for review at request. This set not to be used for construction.

b. Must include dimensions and clear notes for all changes.

c. Submit as-built drawings for approval to Owner representative and OSU Landscape manager/designee.

d. An electronic copy of as-built drawings (after OSU review) to be provided prior to water audit.

e. 

v. Provide two laminated zone layout maps and schedules upon completion, prior to water audit. Map shall incorporate all pre-existing and new zones.

a. 11x17 as standard size. 8.5x11 may be used on small sites with deviation request.

b. Provide digital PDF copy of map and schedule.

vi. Irrigation design velocities shall not exceed five (5) feet per second.

a. Plans and specifications shall include a flow chart for proper pipe sizing.

vii. All irrigation systems shall have a designated meter service and backflow. Deduction meters off domestic service for irrigation will not be acceptable. Refer to Division 22 Plumbing for specified backflow.

viii. The University operates its automated irrigation from a Maxicom Multi-Site Irrigation Central Control System. Irrigation must be designed to work with this system.

ix. Refer to Section 22 05 00, Common Work for Plumbing, for additional guidance.
x. Irrigation controllers shall be on a dedicated, standalone circuit. See OSU Construction Standard Section 26 00 00, Electrical.
   a. Controllers shall have grounding grid per manufacturer’s installation guidelines.
   b. Irrigation controllers shall be connected to telecom voice cabinet.

xi. Master Valve must be counted in total number of zones and wired to last station on controller.

xii. Existing landscape must remain irrigated throughout the duration of the project.
   a. If automated OSU landscape will continue to run irrigation.

xiii. If manual irrigation is provided it will be the Contractor’s responsibility to maintain and operate. Isolation valves shall be installed at logical locations on the mainline run and at every connection to pre-existing mainline.

xiv. Material storage on site shall be designated by Owner and/or General Contractor.
   a. Store materials in clean dry area.
   b. Store all plastic pipe and fittings protected from direct sunlight.
   c. Use all means necessary to protect irrigation system materials from damage, theft, and vandalism.

xv. Extra Materials shall be furnished to match products installed and equal to two-percent of the amount installed for each type and size indicated but no fewer than two of each size.
   a. Spray bidies
   b. Spray nozzles
   c. Rotor nozzles
   d. Rotor heads/bodies
   e. Bublers
   f. 

xvi. A water audit performed by an Irrigation Association (IA) Certified Landscape Irrigation Auditor, conducted in accordance with the current IA audit standards for all new, all existing zones on that controller shall be completed as part of the commissioning of the building. An audit report shall be approved by the OSU Landscape Manager or designee.
   a. Prior to final acceptance water audit must be perform and report completed.
   b. Any issue raised by the audit must be corrected by the Project.

2. MATERIALS

   A. All materials and equipment in the system shall be new and be brands and types as down in the Construction Documents.
      i. All products shall be installed in accordance with manufacturer’s instructions and industry standards.

   B. Pipe and Fittings:
Mainline and lateral Pipe - Polyvinyl Chloride 1120, Schedule 40, Type 1, normal impact: IPS, NSF approved; conform to ASTM D1784, 02241.

Pipe sizes ½-inch and 1-1/4-inch are not allowed.

Fitting - Polyvinyl Chloride Type 1, white schedule 40 and gray schedule 80; ASTM D1784, ASTM D2466, or ASTM D2464, as applicable.

Sleeve - Polyvinyl chloride type Schedule 40, ASTM D1784, ASTM D2241. Any other pipe unacceptable.

Nipples and Risers - Polyvinyl Chloride Type 1, one piece schedule 80 gray PVC nipple, threaded both ends. ASTM D1784, ASTM D2464. No snap-risers.

Swing Joint and Fittings - Install double swing joint risers at all rotors as detailed. Swing-Pipe, snap, and "Funnypipe" risers not acceptable.

Flex Riser Assembly (spray heads and MP rotor's only): 12-inch minimum, 2-foot maximum Swing Pipe with transfer barb 90 degree ells at both ends, and a marlex ell below the irrigation head.

Electrical conduit and fittings - All fittings and pipe shall be installed per all applicable electrical code and per Electrical Division 26 00 00. All electrical conduit needs to be hard pipe, no flex pipe.

Gasket pipe and compression fittings are not acceptable.

Irrigation Sleeves

4" or 6" (4" min.) Sch. 40 PVC Sleeves are required where irrigation pipe and/or wires cross under all hardscape surfaces. Sleeves shall extend one foot beyond edge of hardscape surfaces and set at depth in accordance with typical irrigation mainline depths.

Separate sleeves required for mainline and laterals.

PVC Solvent Cement

NSF approved solvent for Class 1245-B&C PVC, through 4". Conform to ASTM D2564. R.G. Sloan Weld-On, or other pre-approved. Ensure that manufacturer's expiration date is not exceeded.

Cleaner and Primer

Industrial Polychemical Service Co., Inc., Weld-On No. P-70, or type as recommended by PVC Pipe Manufacturer

Irrigation Heads:

All turf heads to be 6-inch body. All shrub heads to be either 6 or 12-inch body.

Spray heads shall be professional/commercial grade.

Rainbird, 1800 PRS series

All spray heads shall be installed with flex pipe.

Rotors shall be professional/commercial grade with stainless riser for mid and large size

Small/MP Rotors, Hunter PRS 40 MP body.

Mid- size, gear drive, Hunter I-20 SS or Rainbird 5000 SS.
c. Large gear drive, Hunter I-20 SS or I-25 SS Series.
d. All rotors shall be installed with PVC swing joint assemblies.

iii. Drip systems shall be installed only where conventional spray head systems are impractical, due to
design constraints or other factors. Design Professional shall receive the written approval from the OSU
Landscape Manager via the OSU Project Manager using the OSU Design & Construction Standards
Deviation Form prior to design of systems.

G. Valves

i. Isolation Valves:
   a. Main lines 2-inch and larger shall be Kennedy resilient seated gate valve, C509 or pre-approved
equal.
   b. Main Lines under 2-inch shall be NIBCO T-113-BHW gate valve w/bronze handle or pre-approved
equal.

ii. Automatic Control Valves: Globe type, 200 psi rated, threaded connections, with cross type operating
handle designed to receive operating key: Rainbird PEB-PRS-D Series, or pre-approved equal. Size
according to valve schedule on Drawing.

iii. Shut-Off Valves at Control Valves: USA manufacture, unionized angle-globe type sized to match
mainline. 120 PSI cold water rated, construction to be brass or bronze with bronze cross type handle:
Nibco, Champion or pre-approved equal.

iv. Quick Coupling Valves: New quick coupler valves are no longer allowed. See hose bib valve.

v. Hose Bib Valve: ¾-inch inverted garden valve, heavy duty w/ floating seat, loose key. Superior I-401LK
or pre-approved equal.

vi. Manual Drain Valves are no longer allowed.

vii. Master Valve: Normally open and flanged at both ends. Bermad IR-410-x, IR- 710-x series or pre-
approved equal.

viii. Valve identification tags: Yellow Polyurethane tag with integral attachment neck and reinforced
attachment hole. Tag shall be hot stamped alphanumeric lettering 1-1/8-inch high. Christy or approved
equal.

H. Valve Boxes

i. Planting Areas: Size box to encompass all valves and unions. Black boxes, Green T-Top lids in lawns
and Brown Mulch T-Top lids in plant beds. Boxes shall be set to finish grade and slope of lawn/planter
bed. Box assembly shall be deep enough to fully house valve assembly without components being
buried. Box lid must close with minimum 1-inch clearance over shut-off valve stem in open position.
Rain bird, Oldcastle (Ametek), Carson or pre-approved equal.

ii. Pavement Areas: Traffic rated, mark all lids with permanent "Irrigation" label. Oldcastle Precast or
other pre-approved equal.

iii. Automatic control valve assembly: Standard/Jumbo (12-inch high minimum):
b. Jumbo for 1.5-inch and 2-inch assemblies.

iv. Hose bib: Standard (12-inch high minimum).

v. Splice boxes: 10-inch round and/or standard (12-inch high minimum)

vi. Flow Sensor: Standard

vii. Master Valve: Standard for 2-inch and under valve, jumbo for all others.

Rainbird, Old Castle (Ametek), Carson or pre-approved equivalent.

I. Zone Control Wire

i. Provide according to valve schedule on plans. 14 gauge minimum and verify maximum length of run from manufacturer. Type AWG-UF, bearing U.S. approval. Spare set of control wires to be run to each valve. Colors: Red (control valve), white (looped common), yellow (looped spare common), black (spare control) and blue (looped tracer).

J. Communication Wire

i. Flow sensor communication wire: 19AWG CATS min., PE 89 cable, 6 pair, or approved equal.

ii. Maxicom communication/telecom wire: Weatherproof CAT6 or approved equal.

iii. Master valve wire: 14 gauge minimum. Type AWG-UF, bearing U.S. approval. Orange control and white common.

K. Wire Connections

i. Zone control wires: 3M Brand, DBY, Direct Bury Splice Kit or approved equal.

ii. Communication wires: UR-2 butt splice kit 034005 inside a Super SERVISEAL Closure or pre-approved equal.

   a. Splice is only allowed at the termination to connect to the flow sensor.

L. Utility Locator Wire

i. 14 gauge minimum. Type AWG-UF, bearing U.S. approval. Blue in color.

M. Flow Sensor

i. Rainbird Flow sensor: PVC Tee type sensor sized based on system flow and manufacturer’s selection guide, or pre-approved equal.

N. Backflow Prevention Device

i. Refer to plumbing fixtures, Section 22 40 00.

O. Controller Assembly

i. The University operates Maxicom central control system. All components need to be compatible.

ii. Design Professional shall confirm with responsible OSU Landscape Manager prior to design that there is available space on existing Maxicom CCU/system for the project. New CCU installation shall be done by OSU Landscape.
a. Project to provide new CCU if space is unavailable on current system: Rain bird CCU-28-W or approved equal.

iii. Controller System: The control system assembly consists of a completely pre-assembled control system that is tested for operation and is housed within a cabinet. The components are pre-wired in the cabinet, which is to be mounted on a concrete base using the included template. The only connections required are primary power, dedicated telecom fax line, proper grounding, valve station wiring and flow sensing.

a. Rain bird ESP-SAT-2W or ESP SITE-SAT controller. Available only in 24 station configuration.

1) Use of ESP-SITE-SAT shall be approved by OSU Landscape Manager/designee.

b. Cabinet shall be Stainless NEMA Type 3 rated UL listed 24-inch x 36-inch x 12-inch: Strong Box SB-24SS or approved equal.

1) Mounting template included with cabinet

c. Shall include 12-inch pedestal: Strong box PED-24SS or approved equal.

1) Wall mounted cabinet may be used with pre-approval via OSU Project Manager and OSU Landscape Manager via use of OSU Design & Construction Standards Deviation Request Form

d. Pulse Transmitter: Rain bird PT322, PT5002, or approved equal.

1) With Manufacturer approved transformer.

e. Decoder: Rain bird Pulse decoder, DECPUL, or approved equal.


g. Maxicom surge pipe: MSPI RB, or approved equal.

h. Lab/hospital grade GFCI outlet.

i. Mounting base: cabinet shall have a poured concrete base per manufacturer’s installation details.

j. Base shall have conduit sweeps installed to allow power, telecom, and all control wires.

iv. Controller Grounding Grid: Grid shall consist of 3 grounding rods drive in a 6-foot equilateral triangle and all connected back to the cabinets grounding lug with #6 solid copper wire.

a. Rods/clamps to be covered with 6-inch round box.

b. Copper wire to be buried between connections a minimum of 6-inches.

3. EXECUTION AND QUALITY CONTROL

A. Provide at least one qualified person (approved by OSU Landscape) who shall be present at all times during the execution of this portion of the work, who will direct all work performed under this section. They shall be thoroughly familiar with all the materials and manufacturers recommended installation methods.

i. Identify this person to OSU project manager and OSU landscape representative prior to beginning work.
ii. The identified person must be on the job site. If something arises that causes the identified person to leave the job site all work must cease or be rescheduled until the identified person returns to the job site.

B. Except where more strict requirements are specified in the Construction Documents, conform to the project applicable “Uniform Plumbing Code” as adopted and modified by the State of Oregon.
   i. There shall be no deflection between pipes, valves, unions, and fittings.

C. Extend sleeves 12-inches minimum past all hardscape. Extra length to protect from sign post and stakes, do not cut off.

D. Pipe: PVC Pipe joints to be solvent welded except as indicated on drawings. Cut pipes square, deburr, wipe surface clean from all contaminants. Apply primer and solvent cement and make joints in accordance with manufactures recommendations.
   i. Do not solvent weld pipe when raining or when temperature is below 40 degrees Fahrenheit.
   ii. No fittings are to be closer than 6-inches apart.
   iii. Allow 24 hours cure time before testing.

E. A mainline pressure test shall be conducted prior to line being buried on all new construction for a minimum of 4 hours at 120 psi, or as specified, with no loss of pressure and observed by the Landscape Architect/Design Professional and/or as designated by the OSU Landscape Manager.
   i. Must provide 2 business days' notice for pressure test.
   ii. Pressure test includes all mainline, isolation valves, control valves, and hose bibs.
   iii. Main line and Pressure test must be completed prior to building any lateral zones. Projects can be build out in phases with deviation request.

F. Backfill:
   i. Mainline shall be buried after pressure test to allow all laterals to be built on proper grade and not hung in the air creating deflection in the pipe/valve joints.
      a. Fill mainline with water prior to backfill
      b. Backfill to be free of stones larger than 1-inch diameter
      c. Place fill in 6-inch lifts and compact.

G. Irrigation mainline
   i. Shall be buried 20-24-inches with trace wire, and bedded in soil or sand.
   ii. Trace wire shall have a 3-foot loop in every valve box, hose bib, and spice box on the mainline.
   iii. Mainline shall not run under trees and must have a minimum 6 foot clearance from all trees.
   iv. Mainline shall have a 2 foot clearance from all other utilities horizontally and a 1 foot clearance vertically.
   v. For 90-degree turns in mainline piping, install two 45-degree fittings
vi. Thrust blocks are required for all mainline lager than 2-inch.

H. Valve sizing
   i. Isolation valves shall match line size of mainline
   ii. Shut off at control valve or Zone isolation valves shall be sized based on lateral size, minimum size is 1 inch.
   iii. Automatic control valves shall be sized based on manufacture flow charts.

I. Irrigation control wires
   i. Shall be buried under the mainline where applicable and bedded in sand or soil.
   ii. Spare set of control wires to be run to each valve. Colors: Red (control valve), white (looped common), yellow (looped spare common), black (spare control) and blue (looped tracer).
   iii. If not under mainline, wire must be 20-24-inches deep, covered with 6-inches of sand and marked with detectable underground electric line warning tape on top of the sand
   iv. A short 2-foot coil must be left at both ends of all sleeves.
   v. 3-foot of coiled slack shall be left in all control valve boxes, measured from the top of the valve box lid.
   vi. Every 100 feet of wire run a 1 foot coil must be left.

J. Valve Boxes
   i. Shall be 24-inches from nearest hardscape, lawn edge or shrub bed edge.
   ii. Shall be aligned orthogonally to edges of hardscape.
   iii. Provide brick support and compacted subgrade on the corners.
   iv. Filter fabric wrapped exterior of box to inhibit soil intrusion.
   v. 3 inch depth of drain rock in bottom of box with minimum 2 inch clearance between rock and bottom of valve.

K. Lateral lines
   i. Shall be buried 12-16-inches deep.
   ii. Shall not be stacked/bundled.
   iii. Must have a minimum of 2-inch separation vertically and horizontally between all lines.

L. Irrigation heads
   i. Install heads adjacent to hardscape with 2-inch clearance between head and hardscape.
   ii. Heads should be no closer than 12-inches from building foundation

M. Flushing
   i. Mainline: thoroughly flush line prior to installing electric control valve.
   ii. Lateral: thoroughly flush lines prior to nuzzling.

N. Controller must be installed and operational prior to coverage test and planting.
O. Irrigation coverage Test: witnessed by owners representative and OSU landscape manager or designee.

P. Fall Winterizing Visit: Return to the job site at the beginning of the first winter season to perform a general inspection of the system, test all valves, lines, sprinkler heads, vacuum breakers, repair all leaks and faulty work, check operation of the system, adjust spray patterns for full coverage, drain system, show maintenance staff location of all drain valves and blow out points and restore all areas where trenches have settled.

Q. Spring Start-Up Visit: Return in spring after the first winter season for system check and if necessary, restore system for spring and summer operation. Explain system and operation methods to maintenance staff. Restore all areas where trenches have settled.
Section 32 90 00: Planting

1. BACKGROUND

A. Oregon State University’s historic campus core in Corvallis is based on a plan created in 1909 by the renowned Olmsted Brothers of Boston and is known as one of the most significant public landscapes in the State of Oregon. Its organization, harmony of materials, and maturity give it a sense of substantial quality. It is critical that future development maintain and expand upon the historic development patterns established by the Olmstead Plan and further refined by the Corvallis Campus Vision and the Campus Master Plan, regardless of the scale of a campus improvement.

B. In order to ensure that campus remains cohesive in character as it grows, each increment of growth should embody the qualities of the existing core. This approach requires consistency in the development of buildings and grounds and sensitivity to the scale and character of outdoor space.

C. Campus streets provide the organizational framework for campus development. In addition to accommodating vehicular, pedestrian, and bicycle circulation, they provide tree-lined open space corridors through campus.

D. Building placement is used to reinforce the open space corridors and quadrangles through uniform setbacks and sufficient spacing between structures. Primary outdoor gathering places, including courts, plazas, and gardens, are located near building entries.

E. Quadrangles, framed by buildings, provide the primary usable open space on campus. They are strictly pedestrian oriented with walkways connecting building entries. Pedestrian corridors link the quadrangles to the campus street grid and to other campus open spaces.

2. PLANTING

A. General

i. The campus landscape should adhere to the tenets of the 1909 Olmsted Plan, in order to maximize the plants’ visual qualities and reinforce the campus organization and function.

ii. Plant material selection, placement, and maintenance should focus on the appropriateness to the adjacent land use as well as the materials’ ability to reinforce the campus character.

B. Organization

i. The historic Olmsted pattern of planting should be reestablished and adapted to support current building uses and site requirements. As the campus core expands, planting should be of similar character to that of the historic core.

ii. Large deciduous trees planted in continuous and uniform rows (allées) should line campus streets.

iii. Primary open spaces such as quadrangles should be planted in open lawn framed and highlighted with large coniferous and deciduous trees.

iv. Plantings at building foundations should ideally respond directly to the adjacent architecture. Shrubs should not be taller than the building’s visual base, or obscure the views from primary windows and entries. Shrub beds adjacent to the building should generally have widths approximately 20% of the building’s height.
v. Site grading is important and needs to incorporate the adjacent buildings/areas. Pay attention to how water will move in and through the landscape.

C. Spatial Definition

i. Plants should be used to define building entries, create outdoor space and assist in focusing pedestrian circulation.

ii. Plants alone will not deter pedestrian desire lines or provide significant barriers to circulation. Therefore, plants should be used in conjunction with good site design, effective circulation systems and other elements such as masonry walls.

D. Planting Design

i. Landscape design and components shall be planned for low ongoing maintenance requirements and reduced life cycle costs.

a. Planting designs should specify plant species and varieties that are appropriate for the particular climate and growing conditions of the proposed planting location. Plants shall be grouped with like water requirements on same irrigation zone.

b. Specialty plantings, including perennials, should occur primarily in courts and special gardens. Plants should be selected based on the University’s ability to maintain them.

c. A clear space of at least 16-inches should be provided around all building foundations, foundation drains, area drains, vaults, irrigation control valves, etc. Measure 16-inches from assumed mature size of plants.

d. The landscape plan and specified plant species shall be approved by the OSU FS Landscape Manager or designee prior to the acceptance of the landscape plan.

e. Any changes to the plan requested by the OSU FS Landscape Manager or designee following a review of the plan shall be completed before final approval of the project will be granted.

f. Trees shall not be designed or planted over utilities.

1) Minimum 6-feet clearance from irrigation mainline and lateral and 15-feet clearance from valve boxes.

2) Follow local municipal and utility standards for all other utilities.

ii. The landscape design must accommodate the mature size of the plants selected.

a. Plant materials should remain appropriate in their location as they mature and reach ultimate size.

b. Draft planting plans shall utilize plant symbols that represent the mature size of the specified plant material.

iii. The landscape design must accommodate fire department access to buildings at maturity.

a. 36-inches of clear space must be provided around all hydrants and FDC connections at plant and tree maturity.

b. The landscape design at maturity must allow for ladder truck access to the building.
iv. Continuous plantings of large street trees should remain a primary method of linking the campus together. Tree types and spacing should be consistent within large defined areas. Breaks in species should occur at significant intersections or where there is an obvious change in the character of the surrounding street or architectural context.

v. Flowering trees, and deciduous and evergreen shrubs should be used primarily at the base of buildings to provide seasonal color and variation, reinforce the building’s architectural style, and soften the building’s bulk and mass.

vi. Ornamental grass use is discouraged and may only be uses as small accents within the design.

vii. When adjacent to buildings, trees should be chosen and located to allow sun penetration to the building during the winter and shading during the summer.

viii. Tree plantings and replacements shall be coordinated with an Electrical Design Professional to avoid conflicts with exterior light poles.

ix. All landscape specifications shall meet or exceed the International Society of Arboriculture development guidelines for soil preparation and planting.

x. Finish mulch to be Hemlock or Dark/Chocolate Fir. Compost is not an acceptable mulch.

3. PLANTS


B. Plant material must be free of weeds in containers or root balls. Emerging weed infestations may be cause for rejection prior to planting or within the warranty period.

C. Prohibited plants include all plants listed as noxious plants by the Oregon Department of Agriculture and the United States Department of Agriculture.

D. Trees listed as prohibited street trees in Chapter 4.2 of the Corvallis Land Development Code shall be prohibited as street trees. The OSU FS Landscape Manager or designee may approve exceptions to this rule for locations on OSU-owned streets.

E. All shrubs and trees must be labeled with original nursery I.D. tag and shall be true to form and description.

F. Three inspection points shall be provided for the project Landscape Architect/Design Professional and OSU FS Landscape Manager or designee to select or approve trees at:

   i. the nursery prior to digging
   ii. arrival at project site
   iii. plant layout and installation

G. Trees shall be 2” caliper.

   i. The OSU FS Landscape Manager or designee may grant an exception to the minimum size for unusual species, or availability.
   ii. All trees smaller than 2” must be triple staked.
H. Trees shall be planted in a manner consistent with standard Detail 1 - Tree Planting (below).

NOTES:
- Trees planted too deeply will not be accepted.
- Remove tree ties and stakes one year after planting unless directed otherwise.
- Provide trees planted in lawn with minimum 5 foot diameter bark area.
- Hold bark away from trunk.
- Remove burlap, string and/or wire completely from tree prior to final installation.
- Finish grade is top of topsoil. Mulch is in addition.
I. Two inspection points shall be provided for the project Landscape Architect/Design Professional and OSU FS Landscape Manager or designee to select or approve shrubs at:
   i. Arrival at project site
   ii. Plant layout and installation.

J. Irrigation shall be provided as indicated in standard Detail 2- Tree Root Watering System (below).

4. TURF
   A. The minimum mowing equipment width is 60". Turf areas must be designed to be maintained with this equipment.
   B. Seed shall be Perennial Rye grass blend.
   C. Perennial Rye grass blend may be substituted upon approval from the OSU FS Landscape Manager or designee.
   D. The allowable grass seeding period for OSU campus is March 15 through October 15, as soil conditions permit. Planting outside of this period requires approval by the OSU FS Landscape Manager or designee.
i. If working outside of this seeding window Sod may be required.

E. A minimum 10" wide concrete mow band shall be installed at finish grade adjacent to all structures. A minimum 20" wide mow band shall be installed beneath all fences. Materials other than concrete may be approved by the OSU FS Landscape Manager or designee.

F. Historic lights/light poles in turf shall have a minimum 10-inch wide collar. If lights are adjacent to hardscape, they shall have an eyebrow collar to allow for ease of mowing.

G. No plastic or metal edging shall be permitted or used in any planting or lawn areas. The only acceptable location is around the building foundation to maintain a rock splash strip.

5. SOIL

A. The OSU FS Landscape Manager or designee shall determine if any existing top soil is suitable for reuse prior to the preparation of the landscape plan.

   i. The Design Professional shall contact the OSU Project Manager to receive approval to utilize the existing top soil in the landscape plan.

   ii. All existing top soil approved for reuse shall be used to the greatest extent practicable.

B. Separate top soil (maximum 18" depth) from subsoil during excavation and protect from contamination or compaction. Stockpile and cover reserved soil at a location approved by OSU Project Manager and OSU FS Landscape Manager or designee.

C. The Contractor shall protect existing topsoil and subsoil from compaction during construction.

   i. The Contractor is responsible for alleviating any and all unavoidable soil compaction before topsoil placement or irrigation system installation.

      a. If mulch, rock or other materials is used to mitigate compaction a geotextile fabric or other approved barrier is required between it and native soil.

   ii. Any mulch, base rock, and geotextile fabric installed as part of the construction process or used to prevent soil compaction shall be removed from planting areas and turf areas prior to the placement of top soil.

D. Imported soil is subject to approval by OSU FS Landscape Manager or designee and shall conform to USDA soil texture class “loam” certified within one calendar year.

   i. Imported soil depth minimum when placed on subsoil is:

      a. 24-inches for all turf areas.

      b. 24-inches for turf areas containing shrubs.

      c. 36-inches when placed over rock or fill materials.

      d. 36-inches minimum where trees are planted.

      e. Alternative imported soil depth may be proposed where there are site constraints subject to approval by OSU FS Landscape Manager or designee.

      f. Scarify subsoil and blend subsoil with first lift of imported soil. Install soil in 6” compacted lifts not to exceed 85%.
1) Each lift should have compost amendments thoroughly incorporated.

   ii. The Contractor shall provide OSU a test sample for textural class determination prior to the installation any imported soil.

      a. The test shall be performed utilizing wet sieve soil texture analysis by OSU Central Analytical Lab or other OSU approved lab.

      b. Provide a minimum of two soil samples with the accompanying soil test report from samples obtained randomly throughout the source field location or stockpile.

      c. Submit approved test results at least four weeks prior to soil placement

E. Athletic play areas may include USDA soil texture class sandy loam or other specified soil as approved by OSU FS Landscape Manager or designee.

F. Soil must be free of contaminants and noxious weeds.

   i. If noxious weeds are present, Contractor shall eradicate following the guidelines in Pacific Northwest Weed Management Handbook or the recommendations of the Oregon Department of Agriculture. Control measures shall continue monthly on all emerging weeds for a period of one year from final acceptance.

G. Incorporate 20% by volume organic matter homogeneously throughout the planting area.

   i. Either premix off site prior to placement or mix onsite as beds are filled utilizing the 6-inch lifts for compaction.

   ii. Tilling in one layer of compost after bed is filled with soil is not acceptable.

H. Raw manure is not acceptable as compost.

I. If existing topsoil is salvaged and used, 2-inches of compost should be incorporated at the final lift.

J. Remove all rock and construction debris from planting areas prior to topsoil placement.

K. Irrigation as-built markups must be completed prior to backfilling.

L. Provide an inspection point for project Landscape Architect/Design Professional or OSU FS Landscape Manager or designee for:

   i. subsoil preparation;

   ii. topsoil/amendment incorporation

   iii. finish grades.

6. SOIL VOLUMES

A. All trees shall be provided with the minimum available soil volume required to support healthy tree and tree root growth at maturity.

   i. The minimum required available soil volume shall be determined using the canopy diameter of the selected species at maturity and Figure 32 90 01- Soil Volume Chart below.

   ii. To be considered available, soils:
a. Must be within a 50-feet radius of the tree’s trunk;

b. Must not be growth limiting soils; and

c. Must be directly connected to the tree by a continuous path that is 3-feet in depth and a minimum 3-feet in width.

iii. In locations where soil testing has determined that growth limiting soils are present, to count as available soils, tree growth limiting soils must be either:

a. Removed and replaced to a depth of 3-feet with imported soils that meet the standards for imported soils listed above; or

b. Amended to a depth of 3-feet; method to be determined by OSU FS Landscape Manager or designee.

B. The required available soil volume may be provided in open soil areas or in covered soil areas.

i. Open soil areas are unpaved areas within a 50-feet radius of the tree.

a. To be considered available soil volumes, open soil areas must meet the criteria for available soil volumes listed in Section 32 90 00 6.A.ii.

b. Open soil volumes shall be calculated (in cubic feet) by measuring the open soil area (in square feet) times a demonstrated soil depth of 3-feet.

ii. Covered soil areas are soil areas within a 50-feet radius of the tree that are under pavement.

a. To be considered available soil volumes, covered soil areas:

1) must meet the criteria for available soil volumes listed in Section 32 90 00 6.A.ii, and

2) must be part of a tree well installation that meets the criteria listed in Section 32 90 00 7.

b. Covered soil volumes shall be calculated (in cubic feet) by measuring the covered soil area (in square feet) times a demonstrated soil depth of 3-feet.

c. Where covered soils volumes are used to meet the minimum soil volume requirements the following shall apply:

1) Paving constructed over covered soil volumes shall be reinforced or supported to prevent settlement and cracking of the paving (i.e. vehicle-rated concrete, reinforced concrete, soil cell systems, grid systems, structural soil, permeable/porous paving systems).

2) Soil compaction shall be limited to 85% for standard soils or 98% for structural soils.

C. All trees shall be provided with a minimum open soil area measuring at least 6-feet by 6-feet, surrounding the trunk of the tree. OSU standard tree grates may be used within this area. Refer to Detail 32 90 00 7.D Tree Grate Detail. Alternate proposals may be used if approved by the OSU Project Manager and the OSU FS Landscape Manager or designee.

D. The available soil volume for a tree shall be calculated by adding the available open soil volume (per Section 32 90 00 6.B.i) to the available covered soil volume (per Section 32 90 00 6.B.ii). Calculations shall be made in cubic feet.
E. Soil volumes are considered “available” to a tree only when demonstrated to be available by the soil volume plan and associated details.

![Graph showing Relation of soil volume to canopy volume]  

7. TREE WELL PLANTING STANDARDS

A. A tree well is an assembly of materials used to create a tree planting area that provides the required minimum available soil volume to promote healthy tree and tree root growth in locations where the minimum available soil volume cannot be provided in open soil areas.

B. Trees shall be planted in tree wells:
   i. when covered soil volumes are necessary to provide the required available soil volume, or
   ii. when trees are planted along streets and tree wells are required per Corvallis Land Development Code Chapter 3.36.

C. Tree wells shall conform to the following standards:
   i. Trees shall be provided the minimum soil volume required for the selected species’ canopy diameter as shown in Figure 32 90 01 - Soil Volume Chart. The canopy diameter of the selected species at maturity should be used.
   ii. Paving constructed over covered soil volumes shall be reinforced or supported to prevent settlement and cracking of the paving.
      a. Vehicle-rated concrete, reinforced concrete, soil cell systems, grid systems, or other hardscape systems may be used.
b. Systems or techniques for tree well design not listed above may be used if approved by the OSU Project Manager and the OSU FS Landscape Manager or designee.

iii. Soil compaction shall be limited to 85% for standard soils or 98% for structural soils.

iv. Irrigation shall be provided as indicated in standard Detail 2 - Tree Planting.

D. Where tree grates are required or specified, an OSU standard tree grate shall be used: See Tree Grate detail below/next page. Alternate tree grates may be used if approved by the OSU Project Manager and the OSU FS Landscape Manager or designee.
8. SOIL VOLUME PLAN REQUIREMENTS

A. A soil volume plan shall be required for any tree to be planted if a covered soil volume is proposed to be used to meet any portion of the minimum available soil.

B. The soil volume plan shall be reviewed and approved by the OSU Project Manager and the OSU FS Landscape Manager or designee.

C. A soil volume plan shall be developed by a Design Professional that includes all of the following elements:
   i. Date of drawing or last revision;
   ii. North arrow;
   iii. Bar scale;
   iv. Site address or assessor’s parcel number;
   v. The name, address, telephone number, email address and license number of the project Design Professional;
   vi. The location of property lines;
   vii. The location of proposed building footprints, utilities and irrigation, streets and other paved areas;
   viii. The assigned numbers of all street trees to be planted, corresponding to the soil volume calculation table;
   ix. The location of each open soil volume area and each covered soil volume area considered “available” for each tree; and
x. A table showing the soil volume calculation for each street tree to be planted.
Division 33: Utilities

Section 33 00 00: Utilities
1. Utility Location
2. Requirements
3. Franchise Utilities

Section 33 09 00: Instrumentation and Control for Utilities
PART 1: Metering
  1. General Requirements
PART 2: Meter Specifications
  2. Requirements

Section 33 63 13: Underground Steam and Condensate Distribution Piping
1. General
2. Materials
3. Execution and Quality Control
Section 33 00 00: Utilities

1. Utility Location
   
   A. Above-grade utilities, i.e. power transformers, air conditioning units, should be located away from primary building entries, important building facades and pedestrian routes.
   
   B. Above-grade utilities should not occur within primary street corridors.
   
   C. Utilities should be accessible to maintenance personnel.
   
   D. At grade vaults should be located within paved surface areas, traffic rated, and set flush with adjacent grades and slopes.
   
   E. Above-grade utilities should be screened from public view. Equipment shall be screened in compliance with the Land Development Code Chapter 3.36 or applicable local regulations if outside of the City of Corvallis, and OSU Construction Standard 32 35 00 Screening Devices.
   
   F. Utility conduits and wiring should be underground and routed to provide adequate space for tree lined streets and open space corridors.
   
   G. All piped utilities (water, storm, and sanitary) serving more than one building shall be designed to be fully accessible for maintenance. These utilities shall not be designed to be located under buildings.

2. Requirements
   
   A. A utility locate of the areas within the proposed construction zone shall occur prior to any mobilization of project.
   
   B. All underground utilities shall be designed and constructed per local jurisdiction’s “Design Criteria” and “Standard Construction Specifications”, respectively.
      
      i. Minimum allowable depth of cover for all utilities is 36-inches, unless other design provisions are implemented, and approved by the University approved representative.
      
      ii. Storm water detention and water quality systems shall be based on local jurisdiction criteria, and require approval of the University approved representative.
      
      iii. Volume capacity for detention basins should be calculated based on saturated ground water conditions.
      
      iv. All detention systems should be designed to minimize maintenance, and provide adequate access for cleaning and maintenance activities.
   
   C. All underground piped utilities shall include a continuous #14 wire installed with the utility line to be used for future locates.
      
      i. Wires shall extend above grade and shall terminate at a building wall, the top of catch basins or manholes, or similar, visible locations.
      
      ii. Tracer wiring shall be installed with all utility lines, regardless of material or service. Where multiple electrical conduits are installed in a single concrete duct bank, only one tracer wire shall be installed per duct bank.
D. All projects connecting to existing gravity flow utilities shall include provisions requiring the Contractor to video all new piping outside the building, to one manhole downstream from the new connection.

   i. If the project ties into an existing manhole, or replaces a manhole, then the camera work needs to include the piping to the next manhole downstream.

   ii. The video is to be submitted to the OSU Project Manager upon completion.

3. FRANCHISE UTILITIES

A. All franchise utility underground work requires coordination, review, and approval of the University approved representative.

   i. All work shall conform, at a minimum to all jurisdictional codes and regulations. Minimum depth of cover for all utilities is 36-inches, unless otherwise approved by the University approved representative.

B. Per City of Corvallis Land Development Code requirement (LDC 3.36.60.15.a) for distribution lines, locate all new utilities underground. If existing above ground utilities are within the project limits, then provisions should be implemented by the Design Professional to have the utilities relocated underground unless otherwise approved by the approved representative.

C. If the utility is owned by a franchise, with a recorded easement, then the cost of relocation would be the responsibility of the project. If an easement does not exist, then the cost would be the utility’s responsibility, and a new easement would need to be coordinated through the University approved representative. Refer to Construction Standard 22 30 00 for guidance on specific utility elements.

D. Refer to Construction Standard 01 50 00 Temporary Facilities and Controls for coordinating utilities during construction phase.
Section 33 09 00: Instrumentation and Control for Utilities

PART 1: METERING

1. GENERAL REQUIREMENTS

   A. All buildings shall be metered for electricity, steam, condensate, water supply (potable, fire irrigation and sewer deduction), natural gas, chilled and heating water, and other utilities where applicable. At least one main meter per utility per building or structure is required. Additional sub-metering is encouraged.

   B. The installation of any franchise utility-owned equipment shall be completed in accordance with the utility requirements of the supplier of the utility (i.e., Pacific Power, Consumer’s Power, NW Natural Gas, etc.).

   C. Utility meters shall be integrated with building management systems to allow for monitoring, trending and preservation of records for all utilities.

   D. Main meters shall have local (on site) displays and be located and positioned in a way that they are easily readable.

   E. Meters shall remain powered and operable during construction projects, unless prior permission is granted by the Project Manager and Facilities Services.

PART 2: METER SPECIFICATIONS

1. REQUIREMENTS

   A. Electricity meters: Electricity meters: A system consisting of a building main meter, and submeters to meet Oregon Energy Efficiency Specialty Code (OEESC) which refers to ASHRAE Standard 90.1.

      i. Approved and acceptable building main meter: revenue grade power meters with bi-directional monitoring feature designed for renewable energy applications, allowing measurement of power imported from the utility grid as well as power exported from the renewable energy source, with Modbus RTU communication.

      ii. Approved and acceptable building submeters: Veris E51C2 Bi-Directional Power and Energy Meter, or equivalent revenue grade meter with Modbus RTU communication approved by the OSU Sustainability Office.

      iii. See Section 26 00 00: Electrical for further details.

   B. Saturated Steam meters: Foxboro Flanged Vortex Flow Meter with Hart protocol tolerance.

      i. Steam meters shall be sized and configured for estimated maximum steam flow. Select meter pipe sizes carefully. In some applications, it may be necessary to reduce the meter size relative to surrounding pipe size. This will allow for low flow accuracy while still providing the max flow measurements specific to expected building loads. When pipe sizes are increased to allow for distant future expansion and demand, this is particularly important.

      ii. Meter installation requirements, such as lengths of unobstructed pipe, meter head position, etc., must be strictly followed.

   C. Condensate meters: Foxboro Flanged Vortex Flow Meter with Hart protocol tolerance.
i. Meter installation requirements, such as lengths of unobstructed pipe, meter head position, flooded pipe condition, etc. must be strictly followed.

D. All water supply mains must be metered and meters must meet City of Corvallis and OSU requirements. This includes domestic, irrigation, fire and sewer deduct meters.
   i. Domestic, irrigation and sewer deduct meters on 1” pipe and smaller are to be Sensus SRIIaS
   ii. Domestic, irrigation and sewer deduct meters on 1.5” pipe and larger are to be Sensus OMNI C2.
   iii. Any meter 2” and larger must have a test port plumbed in with valve(s) to facilitate annual meter testing.
   iv. Domestic meters 2” and larger must be installed with a bypass capability to facilitate annual meter testing. Irrigation meters are not required to have a bypass.
   v. Fire systems requiring a double-check backflow assembly, DCDA, also require a “snooper” meter alongside the DCDA to register any usage. These snooper meters are to be Sensus SRIIaS.
   vi. Sewer deduct meters shall only be placed on lines dedicated to equipment that does not send water to storm and/or sanitary sewer drains.
   vii. All meters shall be installed with the Sensus 520M radio transmitter. Transmitters for sewer deduct meters must be wired to an outside location, where transmission signals can be captured by the City of Corvallis tower.

E. Sewer deduction meters: Sensus meters, to meet City of Corvallis requirements. 1” pipe and smaller are to be SRII; 1.5” and larger are to be OMNI-type meters. Meter transmitter unit (MXU) shall be Sensus model 520-R, TouchCoupler-enabled to integrate with City radio-read system.”

F. Natural gas meters: To be provided by the natural gas utility, currently Northwest Natural.
Section 33 63 13: Underground Steam and Condensate Distribution Piping

1. GENERAL

A. All new underground steam and condensate distribution system required as part of the project shall be designed and installed in accordance with Oregon Boiler and Pressure Vessel Law and all applicable codes and regulations.

B. The University will provide a site survey, tied to the University’s survey control network, along the proposed routing of the distribution system. The site survey will include the identification, location, and depth of all existing underground utilities and structures as well as all aboveground utilities, roadways, structures, etc. The survey will be made after the general layout of the system has been determined and should cover the entire length of the proposed system.

C. The University will provide a geotechnical report that will include information on groundwater conditions, soil types, terrain, and soil moisture content in the area of the system will be collected. Information on terrain, precipitation rates and irrigation practices will be obtained if not available from records at the installation. Required information will be obtained through boring, test pits, or other suitable exploratory means. The load-bearing qualities of the soil will also be investigated, and the location and nature of potential soil problems will be identified.

D. This section includes standards and preferences that carry over to basic steam distribution system design.

E. Instructions to Design Professional:

i. Design Professional shall perform all necessary calculations to ensure energy systems will meet Owner’s requirements. Design Professional shall provide these calculations for inclusion in Owner’s project closeout documentation when applicable. Pipe-stress and system-expansion calculations for each expansion compensation elbow using a finite element computer generated three-dimensional analysis. Calculations (including heat loss calculations) shall demonstrate that pipe stresses from temperature changes are within the allowable requirements in ASME B31.1 and the anchors and the guides will withstand the resultant forces. Submitted detailed design layout drawings including the location of all anchors and guides. Layout shall also include all analysis node points. As a minimum, the computer analysis results include node stresses, forces, moments and displacements. Calculations shall be approved, certified, stamped and signed by a registered Professional Engineer in the employ of the underground heat distribution system manufacturer and/or Design Professional.

ii. Condensate return shall be designed with the following preferences in mind:

a. Gravity return condensate when existing conditions permit, this is the preferred method.

b. Appropriately sized condensate receiver with dual pressure powered pumps

c. Appropriately sized condensate receiver with dual electric condensate pumps.

iii. All systems components of the thermal distribution systems shall be listed and rated for media properties and environment installed.

iv. All campus thermal distribution system piping shall be considered “Power Piping” and installed in accordance with Oregon Boiler and Pressure Vessel Code B31.1.

v. Design Professional will include a log of soil conditions along the pipe line right-of-way at pipe depth on the drawings which gives, as a minimum, soil classification, moisture content, soil resistivity and pH,
bearing strength and unstable conditions. Design Professional will provide details at building entries on the contract drawings/construction documents to show pipe elevation, floor and grade elevation, building wall construction and existing equipment. Include location of valve manhole and/or valve boxes, branch run outs, and isolation valves on the contract drawings. Provide details at manhole entries on the contract drawings to show pipe elevations; floor, top, entrance, and grade elevations; manhole wall construction; anchor location and construction; and existing equipment and piping. Utility plans shall reflect plan and profile of all new distribution lines. Plans will accurately/precisely show all portions of system (i.e. valves, expansion couplers/loops, thrust blocks, etc.), schematic plans/drawings will not be acceptable. Plans shall show all known existing utilities and depths of those utilities where crossed. Design Professional shall coordinate with Owner’s Authorized Representative/OSU Project Manager or OSU Construction Manager to acquire necessary information.

2. MATERIALS

A. General:
   i. Any substituted materials must have written prior approval from OSU Facilities and Project Manager via a Deviation Request Form.
   ii. No facility, tunnel, vault, or other structural or wall penetrations shall be permitted without prior written approval from Facilities via request through OSU Project Manager or Construction Manager.
   iii. Carbon Steel: Steam piping up to 10-inches seamless schedule 40. Pipe over 12-inches seamless to be standard. Any and all small bore (2" and under) threaded pipe to be schedule 80.
   iv. Carbon Steel: Condensate piping to be seamless schedule 80 to 6". 8" pipe and larger to be standard unless pre-approved. Any and all small bore (2" and under) threaded piping to be schedule 80.
   v. Seamless domestic pipe shall be supplied by an approved vendor. Import pipe is not allowed unless approved by OSU Facilities and Project Manager.
      a. Direct bury piping system acceptable manufacturers: SS Tuff Pipe.
      b. Direct bury pipe installation shall be done by a supplier-approved contractor using certified welders qualified to do the required welding procedure specified by the manufacturer.

B. Direct Bury Steam and Condensate System
   i. Factory fabricated piping system to have stainless steel carrier pipe, mineral wool insulation, one inch air gap, and a stainless steel outer conduit. Fusion bonded epoxy coated carbon steel products are not allowed.

C. Carrier Pipe
   i. All carrier pipe for steam and condensate shall be 304 or 304L stainless steel A312 ERW Pipe. 10-inches and small shall be Schedule 40. Pipe 12-inches and larger shall be .375-inch wall.

D. Carrier Pipe Insulation
   i. Shall be sectional mineral wool ASTM C547. Insulation thickness shall be 1 ½-inches minimum thickness. Insulation shall be banded every 18-inches with 18ga stainless steel wire. Insulation thickness shall align with current energy standards and codes.
E. Inner Pipe Support
   i. All piping shall be aligned and supported within the outer conduit a minimum of every 6-feet with 304 or
      304L stainless steel spacers. A minimum of 4 spacers per location. Spacers are to be a minimum of ½-
      inches thick.

F. Outer Conduit
   i. The exterior protective jacket shall be 304 or 304L stainless steel A778 10 ga. ERW tube. Field
      connections shall be insulated after the carrier pipe is welded and the outer conduit shall be fully
      welded using a 304 or 304L sleeve made from materials of a minimum thickness that matches the
      outer conduit.

G. Fittings
   i. All changes in direction of the carrier pipe and outer conduit shall be made with fittings. Mitering of the
      pipes is not permitted. When tee branches are smaller than the main they join, weld-o-lets may be used.
      All welded fitting shall be the same materials and thickness as the pipe they are joining.

H. Cathodic Protection
   i. When required, provide cathodic protection for all direct buried steam and condensate piping systems
      per manufacturers installation guidelines. Cathodic testing ports shall be located out of access
      drives/streets. When possible, place testing ports in sidewalks.

I. Anchors
   i. Anchors shall be pre-fabricated onto the pipe units and shall be equipped with drain and vent openings
      at the top and bottom of the anchor plates. Anchor plates shall be a minimum of ¾-inch thick and
      fabricated from 304 or 304L plate welded to both the carrier pipe and outer conduit.

J. Thermal Expansion & Expansion Joints:
   i. Stainless steel piping has a rate of thermal expansion that is roughly 1/3 more than carbon steel.
      Design each system to control the expansion. Where possible, install expansion joints in manholes,
      vaults or buildings.
   ii. Provide expansion loops, elbows, Z-bends, and anchors where required to relieve pipe stress when
      expansion joints cannot be used.
   iii. Design expansion compensation for a minimum or 150 psi working pressure.
   iv. Acceptable expansion joints: Manufacturer Hyspan 3500 Externally Pressurized Expansion Joint.

K. End seals/end glands:
   i. Termination of the outer conduit in manholes, vaults or buildings shall be equipped with an end seal.
      Fabricate end seals from 304 or 304L stainless steel plates(s) welded to the outer conduit and sealing
      against the carrier pipe with high temperature graphite Teflon packing. Install a stainless steel ball
      valve for vents and drains. To be installed on the end seal to assist in testing of the conduit and
      troubleshooting.
   ii. Shall be installed in accordance manufacture’s guidelines.
iii. Each end seal/gland at the point of vault/building entry shall have minimum two ¾” NPT thread ports. One located at 12 o’clock position (top of pipe) and one located at 6 o’clock position (bottom of pipe). A minimum of one ¾” isolation valve for draining/testing conduit section shall be located on downstream leg of pipe run at the 6 o’clock position. A minimum of one ¾” conduit vent shall be located on upstream leg of pipe run at the 12 o’clock position.

iv. Provide embossed brass or stainless steel tag hung by brass or stainless steel chain at each end of each conduit or insulated piping in the manholes and buildings. The tag shall identify manufacturer’s name, date of installation, and manufacturer’s project number.

L. Traps
   i. Traps installed on 65 psi system will return to a flash tank prior to returning to low pressure condensate return system.
   ii. Steam traps to be installed at all “low points” or change in elevation on steam distribution piping as well as no less than every 200-feet.
   iii. Acceptable Manufacturers:
       a. Inverted bucked: Armstrong 800 series or approved equal.

M. Valves
   i. All flanged valves will be raised face, 150-lb meeting ASME standards.
   ii. No bronze or brass valves to be used on any University steam and condensate systems.
   iii. Acceptable Manufacturers: Velan and RP&C
   iv. All steam pressure relief discharge piping must be piped to a safe location outside of the building, vault or tunnel. Drip pan elbow drain lines may be pipe to floor drain.

N. Mud Legs
   i. All mud legs need to have a drain with valve with plug installed.

O. Wall Penetration Sleeves:
   i. Sleeves for foundation wall penetrations shall be fabricated of 10 ga or one-eighth inch (1/8”) thick steel, with two inch (2”) wide collars welded in place, and the entire assembly hot-dip galvanized. Sleeve shall be structurally affixed to wall in conformance with Oregon Structurally Specialty Code, latest edition.

P. Tunnel and Wall Penetrations:
   i. Sleeves for wall penetrations shall be fabricated of 10 ga or one-eighth-inch (1/8”) thick steel, with two-inch (2”) wide collars welded in place, and the entire assembly hot-dip galvanized.
      b. Sleeves shall be required for all penetrations regardless of boring or drilling.
   ii. Piping and all other materials passing through penetrations shall not be subject to building loads.
iii. Design professional shall require the contractor to submit survey and plans for all wall penetrations stating that penetrations shall not impair, waken, or reduce the structural and seismic integrity of the area proposed.

iv. Wall penetration seals:
   a. High temperature elastomeric link type seals compressed with corrosion-protected bolts and compression plates; Thunderline Link-Seal Model “T”, no substitutions.
   b. Acceptable Manufacturer: Link Seal.

Q. Vaults

i. Vaults shall be either reinforced cast-in-place or pre-cast concrete in conformance with all applicable state and local codes.

ii. The wall and the floor of the vault shall be constructed of reinforced concrete not less than 6-inches (152 mm) thick.

iii. Vault dimensions shall be no less than 6-feet wide x 6-feet long x 8-feet high.

iv. Walls and floor of a vault installed below grade shall be designed to withstand anticipated soil and hydrostatic loading. Vaults shall be designed to meet or exceed current seismic standards for the location of installation.

v. There shall be sufficient clearance within the vault to allow for inspection and maintenance of all equipment in the vault.

vi. Vaults and equipment contained therein shall be suitably anchored to withstand uplifting by groundwater or flooding. The design shall verify that uplifting is prevented even where equipment within the vault is empty.

vii. Vaults shall be utilized at all locations in direct bury system with equipment requiring inspection and/or maintenance.

viii. Vaults shall have all buried portions substantially liquid tight and there shall not be backfill within the vault.
   a. For pre-manufactured vaults, liquid tightness shall be certified as part of the listing provided by a nationally recognized testing laboratory.
   b. For cast-in-place vaults, liquid tightness shall be certified in an approved manner.
   c. There shall not be openings in the vault enclosure except those necessary for vault ventilation and access, inspection, filling, emptying, or venting of equipment in the vault.
   d. Top and floor of the vault and the tank foundation shall be designed to withstand the anticipated loading, including loading from vehicular traffic where applicable.
      1) Vaults shall be designed for a minimum AASHTO H-20 traffic loading.
   e. Vault floor shall drain to a sump with designated code compliant electrical circuit.

ix. Vault fluid evacuation system. Design shall be the following:
   a. Preferred design: Gravity drain directly to storm water system.
b. Alternative preferred design: Duplex pumps mounted in remote secondary vault.
   1) Pumps and all associated hardware and fittings shall be UL listed for the media and temperatures of all fluids and incursions within the vault.
   2) Remote vault shall have drain to primary vault sump.
   3) Vault sump floor shall be no less than 24-inches lower in elevation than lowest thermal distribution pipe and/or drip leg, whichever has the least distance to vault floor.
   4) Float setpoints shall be calibrated no more than 6-inches and 12-inches higher in elevation than the sump floor elevations.
   5) Controls shall have automatic, manual, and maintenance options.
   6) Code compliant electrical disconnect.
   7) High water alarm - shall be set no less than 3-inches lower in elevation that the lowest thermal distribution pipe and/or drip leg, whichever has the least distance to the vault floor.

c. Remote vault lid shall have exception to policy for sizing. Lids shall be 12-inches longer and wider than largest installed component in the vault and facilitate ease of removal and maintenance. Alternative secondary design: Vault wall mounted duplex pumps.
   1) Pumps and all associated hardware and fittings shall be UL listed for the media and temperatures of all fluids and incursions within the vault.
   2) Vault sump floor shall be no less than 24-inches lower in elevation than lowest thermal distribution pipe and/or drip leg, whichever has the least distance to vault floor.
   3) Float setpoints shall be calibrated no more than 6-inches and 12-inches higher in elevation than the sump floor elevations.
   4) Controls shall have automatic, manual, and maintenance options.
   5) Code compliant electrical disconnect.
   6) High water alarm - shall be set no less than 3-inches lower in elevation that the lowest thermal distribution pipe and/or drip leg, whichever has the least distance to the vault floor.

x. Where multiple vaults are provided, adjacent vaults shall be allowed to share a common wall. The common wall shall be liquid and vapor tight and shall be designed to withstand the load imposed when the vault on either side of the wall is filled with water.

xi. Vault access lids:
   a. Shall have hinged and locking lids
   b. Lids shall be 12-inches longer and wider than largest installed component in the vault or 48-inches x 48-inches, whichever is greater.
   c. Deviation Request is required if vault lid design is located in roadways (as coordinated via the OSU Project Manager to be approved by Facilities Services).
   d. Access lids shall be designed for minimum AASHTO H-20 traffic loading.
e. When vault sizing allows, vault shall have two access lids, diagonally opposite from each other.
f. Access lid rim shall have a maximum of 18-inches between top of vault and rim elevation.
xii. Vault shall have a fixed access ladder designed and installed in accordance with Oregon Administrative Rules Oregon Occupational Safety and Health Division, Oregon Administrative Rules for fixed ladders. Vault access lid location shall be coordinate such that ladder to vault floor is not obstructed by pipe or equipment.

R. Insulation
   i. All exposed piping must be insulated and comply with state energy code.
   ii. Insulation and jacketing shall be resistant to moisture and mold and shall be resistant to damage or deterioration under the service intended. Materials shall meet the smoke and flame spread ratings required by the governing codes and safety requirements. Aluminum insulation jacketing is preferred.

3. EXECUTION AND QUALITY CONTROL
   A. Installation, testing and inspection shall be in conformance with all state and local code as well as manufacturer’s recommendations.
   B. Contractor shall have 25 years direct experience with installation of direct bury steam distribution systems.
   C. Field Testing
      i. The carrier pipe shall be field tested hydrostatically to 1 ½ times the working pressure of the service or as specified by the manufacturer. After testing, remove all water from the system prior to start-up. The outer conduit shall be hydro tested with air to 10 psig. If any leaks detected, make repairs, repeat pressure test. If piping manufacturer’s testing procedures differ from OSU Design & Construction Standard, the manufacturer’s recommendations may be approved through OSU Facilities and Project Manager.
   D. Wall Penetrations
      i. Ensure that outer conduit is in the center of the hole and that the hole is completely circular. Penetrations should be sealed using a high temperature elastomeric link type seals compressed with corrosion-protected (stainless steel) bolts and compression plates.
      ii. Where wall penetrations are not completely round, a seal plate will be used, fabricated from stainless steel and installed for use with link seals.
   E. Shipping Bars
      i. Shipping bars are installed on the supplied direct bury pipe to keep the outer conduit from rotating. Remove shipping bars prior to field welding.
   F. End Seal secondary piping:
      i. End seals supplied with a stainless steel vent and drain ball valves. The drain valve closed after installation and testing are complete. The vent valve left open. If there is a danger of water reaching the end seal the vent should be piped up to a safe height to ensure it will not have water intrusion into jacket.
G. Bedding and Backfill

   i. All piping shall be bedded as directed by the piping system manufacturer.

   ii. Backfill:

      a. The first 4 inches over the top of the largest pipe shall be as directed by the system manufacturer, and final 12-inch layer shall be approved top soil.

      b. Immediately after all piping is installed in the ditch, make a partial backfill in the middle of each pipe length leaving the joints exposed for inspection prior to the hydrostatic tests.

      c. Place in layers not exceeding 8 inches deep and compact to 95% of standard proctor maximum density at optimum moisture content. Earth backfill shall be free of rocks over 2 inches in diameter and foreign matter.

      d. Interior: All backfill under interior slabs shall be bank sand.

      e. Exterior: Excavated material may be used outside of buildings at the contractor's option.

H. Earthwork shall be in accordance with OSU Construction Standard 31 00 00.

I. All Work under this section will require a final punch list walk thru at project Substantial Completion. The walk thru shall include Contractor, Owner's Authorized Representative, Responsible Maintenance Manager and/or Manager's Designee via the OSU Project Manager/Construction Manager.
Division 34: Transportation/Campus Circulation

Section 34 00 00: Transportation/Campus Circulation

1. REQUIREMENTS
2. DEFINITIONS
3. ACCESSIBILITY
4. SIDEWALKS AND WALKWAYS
5. BICYCLE FACILITIES (ROUTES AND PARKING)
6. MULTI-USE FACILITIES
7. ON-STREET PARKING
8. TRANSIT SHELTER
Section 34 00 00: Transportation/Campus Circulation

1. REQUIREMENTS
   A. Transportation facilities shall include the fundamental elements of a standard public street for vehicles, bicycles, pedestrians, and street trees. Refer to Section 26 00 00 Electrical for lighting requirements.
   B. All transportation facilities on the Corvallis Campus shall be designed to the applicable standards in Chapters 4 and 5 of the OSU Transportation Plan. Refer to Table 34 01 OSU Street Standards – Preferred Street Profiles in the Appendix. Exceptions must be approved in writing by the University Land Use Planning Manager (via OSU Design & Construction Standards Deviation Request form).
   C. Streets shall adhere to the existing rectilinear street grid pattern.
   D. Unless otherwise specified in the OSU Transportation Plan, pavement types, street configurations, and street tree placement shall be consistent throughout street corridors.
   E. Streets shall be continuous and not bridged or encroached upon by buildings or other facilities.
   F. All transportation facilities shall meet or exceed the standards in City of Corvallis LDC Chapter 3.36: OSU Zone, Chapter 4.0 Improvements Required with Development, or other applicable state and local regulations if outside the jurisdiction of the City of Corvallis.

2. DEFINITIONS
   A. Bicycle Facility – Any facility provided for the benefit of bicycle travel, including bikeways and parking facilities.
   B. Effective Sidewalk Width – The total sidewalk width minus any unusable width due to the presence of adjacent buildings, trees, curbs, and any other obstacles that may be installed in the sidewalk; such as, parking meters, bollards, signs, or containers.
   C. Sharrow - A shared-lane marking in the center of a paved travel lane of a street indicating to motorists that bicyclists may use the full travel lane.
   D. Sidewalk – A pedestrian facility constructed of a permanent hard surface parallel to a public or OSU Street, and considered a component of that street.
   E. Walkway – A pedestrian facility constructed of a permanent hard surface that provides for pedestrian access within and through a Development Area. For purposes City of Corvallis Land Development Code 3.36 - OSU Zone, a Walkway is not a Sidewalk.

3. ACCESSIBILITY
   A. All sidewalks and walkways shall first conform to Section 01 10 02 Accessibility Best Practices for OSU and then the 2010 ADA Standards for Accessible Design (whichever is most restrictive).
   B. Exterior ramps shall not be used in new construction.
C. When deemed necessary to provide access to existing buildings, ramps shall be designed to integrate with the architectural design of the building and the surrounding landscape.

D. Walkways and approaches to buildings shall be designed to minimize the need for signage.

E. Where signage is necessary to direct people to accessible entrance(s) of an existing building, signs shall be clear, concise, and sized appropriately in accordance with OSU’s Sign Plan, the City of Corvallis Land Development Code, these OSU Design & Construction Standards, and the 2010 ADA Standards for Accessible Design.

4. SIDEWALKS and WALKWAYS

A. Sidewalks and walkways shall meet or exceed the widths and be located generally as shown in Table 34 01 OSU Street Standards – Preferred Street Profiles (in the Appendix).
   
   i. At a minimum, all sidewalks and walkways shall provide at least eight feet of effective sidewalk width and must be constructed of a permanent hard surface including, but not limited to, concrete, pavers, or brick. (Asphalt is not an allowable surface by City of Corvallis.)
   
   ii. Variations in the width and location of a continuous length of sidewalk and walkway may be granted to preserve significant tree(s), to preserve natural resources, and to accommodate Historic Resources, as long as there is a minimum of six feet of unobstructed passage.
   
   iii. Exceptions must be approved in writing by the University Land Use Planning Manager (via OSU Design & Construction Deviation Form).

B. Sidewalks and walkways shall be continuous and provide complete direct routes to all campus facilities.

C. Where allowed by the Corvallis Land Development Code, curbside sidewalks are desired unless healthy, mature trees are present within a designated tree planting area adjacent to the curb. If healthy, mature trees are present, sidewalks should be located between the mature trees and the OSU building/facility. Removal of any trees are subject to written approval by OSU Landscape Manager.

D. Sidewalks and walkways should minimize conflicts with vehicles or bicyclists. Where there are shared facilities, refer to the Multi-Use Section for Facility sizes. Reference the Appendix for the Pedestrian Facility Size Map.
   
   i. Where bike parking is located next to sidewalk or walkway, the sidewalk/walkway width shall be at least 12-feet to facilitate both modes. Where higher volumes are anticipated, a width of 18-20 feet may be required.

E. Sidewalks and walkways shall meet or exceed the standards in City of Corvallis LDC Chapter 3.36: OSU Zone, Chapter 4.0 Improvements Required with Development, or applicable standards.

5. BICYCLE FACILITIES (ROUTES AND PARKING)

A. Bicycle Routes
i. Bicycle routes shall be consistent with OSU Transportation Plan Chapter 4, including Figure 4-7: Long-Term Bicycle Network, Figure 4-8: Bicycle Facility Types, and Design Guidance Toolbox.

ii. Bicycle routes shall be separate from pedestrian paths and ADA preferred paths, located and designed to avoid conflicts between pedestrians and bicyclists.

iii. Contra-flow bike lanes (lanes designed to allow bicyclists to ride in the opposite direction of motor traffic) shall be provided on one-way streets.

B. Bicycle Parking

i. Bicycle parking shall be conveniently located adjacent to bike routes in well lit, highly visible and secure locations. See Section 32 33 00 Standard Bike Racks for details.

a. Preferred locations include;

   1) Areas immediately adjacent to the bicycle route,
   2) In direct line of sight from the bicycle route and a building/facility,
   3) Between the sidewalk/walkway and building frontage
   4) Beneath building overhangs that are designed to accommodate bicycle parking.

ii. Bicycle parking shall not be located within quadrangles, plazas, or other pedestrian designated areas.

iii. Bike parking facilities and the maneuvering space around the bike racks shall not impede on any adjacent pedestrian travel routes. Accessible/ADA and pedestrian access shall not be constrained by the location or operation of outdoor bicycle parking.

iv. A 5 ft. aisle for bicycle maneuvering shall be provided and maintained beside and between each row of bicycle parking, measured from edge of the 6 foot by 2 foot parking stall.

v. Bicycle racks and lockers shall be securely anchored to a surface. Refer to Section 32 33 00 Site Furnishings of the OSU Design & Construction Standards.

vi. Covered bike parking shall be constructed per the design provided in the Section 32 33 00 Site Furnishings. Alternatively, bike parking covers that match the architectural design of the associated building may be used with written approval by the University Architect (via OSU Design & Construction Standards Deviation Request form).

vii. Curb ramps, where allowed by City Standards, shall be provided near the rack location to discourage users from riding on the sidewalk to access bike parking facilities. Curb ramps shall comply with the 2010 ADA Standards for Accessible Design and Section 01 10 02 Accessibility Best Practices for OSU.

C. In cases where neither the OSU Design & Construction Standards nor City code addresses a situation, the OSU Transportation Plan, state, and federal guidance shall be used to provide guidance for design and construction of bicycle facilities.
9. MULTI-USE FACILITIES

A. The standards width for a two-way multi-use path shall be a minimum of 12-feet where lower volumes are anticipated. In locations where higher volumes are anticipated, a width of 18-20 feet may be required.

B. In locations where multi-use facilities are delineated into separate spaces for pedestrian and bicyclists, a minimum of 8-feet shall be provided for two-way bicycle traffic and a minimum of 6-feet for pedestrians.

i. The bicycle space can be split up for bicyclists traveling in opposite directions of bicyclists that can navigate a shared space.

C. Multi-use paths should be constructed of asphalt to distinguish them from concrete sidewalks and communicate that bicyclists are permitted.

10. ON-STREET PARKING

A. Where allowed by the Corvallis Land Development Code and the OSU Transportation Plan, on-street parking may be replaced with street reconstruction. Should additional width be required for pedestrian, bicycle, vehicle facilities, or tree planting areas, on-street parking will be removed.

11. TRANSIT SHELTER

A. Refer to Section 32 33 00 Site Furnishings for Transit Shelter.
Appendix

**Room and Space Types**
- BASIC LABORATORY DESIGN FOR BIOSAFETY LEVEL3 LABORATORIES
- BUILDING INTERIOR STORAGE
- COLD ROOMS
- COMMUNICATION ROOMS
- INCLUSIVE/ALL USER RESTROOMS
- LABORATORY DESIGNATED EATING AND DRINKING AREAS
- LACTATION/NURSING ROOMS
- LOADING DOCKS AND SERVICE AREAS
- LOBBIES & ATRIUMS – PUBLIC AND CIRCULATION SPACE
- MECHANICAL, PLUMBING, AND ELECTRICAL ROOMS

**Space Use**
- SPACE USE CATEGORIES

**Transportation/Campus Circulation Appendix**
- PEDESTRIAN FACILITY SIZE
- OSU STREET STANDARDS
**Basic Laboratory Design for Biosafety Level 3 Laboratories**

The Biosafety Officer (in collaboration with the Institutional Biosafety Committee) must approve the location and design of any BSL-3 facility, and has final authority to authorize the commencement of BSL-3 work.

The Biosafety Level-3 facility design and operational procedures must be documented. The facility must be tested for verification that the design and operational parameters have been met prior to operation. It is essential that the facility meets the required predetermined standards before putting the biocontainment facility into service.

1. **GENERAL**
   
   A. The laboratory must consist of an anteroom and laboratory rooms.
   
   B. The facility must have gas-impermeable walls, ceilings, and floors. Air gaps under doors are acceptable for directional airflow. If the door gaps are sealed, the laboratory suite must not leak gaseous decontamination materials.
   
   C. Air balance must be set so air from low hazard rooms flows into rooms with higher hazards, and entry into the laboratory requires passage through two doors.
   
   D. The laboratory must consist of high-quality room construction with special consideration given to joints, finishes, and penetrations.
   
   E. All shutoffs (steam, water, natural gas) must be external to containment.
   
   F. All tall and/or heavy fixtures and equipment (e.g., biological safety cabinets, autoclaves, freezers, incubators, etc.) must be fitted with a seismic anchoring system/device engineered to withstand earthquake stresses equal to 7.0 on the Richter scale.
   
   G. The laboratory must be designed for ease of maintenance, so that access to critical mechanical equipment (ventilation ducts, fans, piping, etc.) is outside containment. Access panels are only allowed in some retrofits, and in those cases, the panels must be piano-type hinged and gasketed with gas-tight gaskets.
   
   H. There should be a room for large equipment decontamination. The room should be capable of being sealed for decontamination with gaseous paraformaldehyde and must have a connection to the HVAC exhaust system.
   
   I. Consideration should be given to providing a separate equipment room (to isolate heat load and high hazard equipment like centrifuges) within the laboratory.
   
   J. Consideration should be given to providing a shared prep room within the laboratory.
   
   K. There should be provisions for a comfortable temperature compensating for the heat load from equipment and the gowning requirements for personnel in the laboratory. The temperature is lower for comfort, usually 68°F.
   
   L. CO2 and other specialty gases must be plumbed from outside the laboratory into containment.
   
   M. Work surfaces, floors, walls, and ceilings must be designed, constructed, and finished to facilitate easy cleaning and decontamination.
   
   N. The facility must pass third-party inspection and tests to verify that design and operational parameters have been met. This should be done by a third party.
O. The laboratory must be located away from public areas and corridors used by laboratory personnel who do not work in the BSL-3 laboratory.

P. The laboratory must be separated from unrestricted traffic.

Q. The laboratory should be located away from regions that could impact directional airflow or differential pressure maintenance (elevators, exterior doors, laboratories with variable air volume systems or night setbacks, exterior walls with high wind or temperature fluctuations).

R. An intercom or hands-free telephone must be located in each room and must be connected to a location that has personnel available for emergency response at all times work is being performed in a BSL-3 laboratory.

2. Anteroom

A. The anteroom must consist of two doors for access to the laboratory.

B. Anteroom doors should be interlocked or alarmed so only one door may be opened at a time, or placed sufficiently apart so that one person cannot open both doors at the same time. A manual override should be provided for emergency exit.

C. The anteroom, if functioning exclusively as a clean change room, must have ventilation separate from the laboratories in order to maintain the containment envelope in the event of a ventilation failure.

D. The anteroom must be large enough to provide for storage of clean gowns, laboratory coats, or uniforms that must be donned before entry and be removed before leaving the suite. The anteroom must also provide space for a log book, wall calendar, and a laundry hamper.

E. The anteroom should be designed such that turbulent air currents formed when opening doors are minimized, i.e., doors are perpendicular to each other, anteroom is of sufficient size.

F. The anteroom must have communication capabilities installed.

G. Space must be provided on or near the door for the conspicuous posting of the biohazard warning symbol, a list of personnel authorized to enter the area, and access rules.

3. Floors

A. Floors must be impermeable to liquids, monolithic/seamless, or have welded seams.

B. Floors must be coved up the wall.

C. Floors must be easily cleaned, with chemical-resistant flooring (vinyl, or epoxy with fiberglass reinforcement) with a slip-resistant, smooth, hard finish.

D. For monolithic floors, either a 100-mm-high, readily cleanable, integrally coved sheet flooring base, or a readily cleanable, 100-mm-high, vinyl or rubber base should be used.

E. For epoxy floors, if silicone sealants are used for penetrations, the silicone must be applied after the epoxy has been installed.

4. Walls

A. Suite walls should be full height extending to the structural deck above.
B. Walls must be durable, washable, and resistant to detergents/disinfectants (masonry, gypsum board, fiberglass-reinforced plastic, etc.).

C. Walls must be painted with durable glossy acrylic or epoxy paint.

D. For epoxy paint, if silicone sealants are used for penetrations, the silicone must be applied after the epoxy has been installed.

E. Wall/ceiling penetrations should be kept to a minimum and sealed with non-rigid, non-shrinking, silicone or latex sealant; for fire rated walls, apply sealant before fire stopping.

F. Corner guards and bumper rails must be provided to protect wall surfaces in high-traffic/impact areas.

G. A “pass-through” (for supplies, product, or equipment) requires approval of the Biosafety Officer.

5. Ceiling

A. The ceiling must be washable and resistant to detergents/disinfectants.

B. The ceiling must be painted with durable glossy acrylic or epoxy paint; for epoxy, if silicone sealants are used, the silicone must be applied after the epoxy.

C. The ceiling must be of monolithic construction (i.e., gypsum board, not removable tiles).

D. The ceiling must be high enough over Class II A2 biological safety cabinets (BSCs) to allow for a canopy/thimble connection or the opening of canopy/thimble door(s).

E. Ceiling height should be at least 10 feet to allow for 14 inches of clearance above BSCs.

F. Light fixtures must be surface or independently mounted.

G. If recessed lighting must be used because of ceiling height in a renovation, lighting penetrations are gasketed.

6. Offices and Eating Areas

A. Eating and drinking is prohibited in BSL-3 laboratories. Formal offices should not be included in the laboratory suite.

7. Doors

A. Doors must be self-closing and lockable.

B. Doors should open inward (dependent on Fire Marshall Requirements) or slide open. If sliders are used, they must be made of safety glass, and a trackless design should be considered. Note: Opening sliding doors causes less turbulence than standard doors. Pocket doors must not be used.

C. Door between anteroom and corridor must have door sweep for pest control.

D. Doors inside the suite should allow for an approximately 3/4-inch clearance underneath the door for directional airflow.

E. Door openings should be sized to allow the passage of large equipment.

F. Wall-door frame connection should be made airtight at time of frame installation.
G. Doors and frames must be of solid finish construction, have required fire ratings, and include panic-hardware, hardware appropriate for high-use, and kick plates.

8. Windows
   A. Windows (safety glass, permanently closed, sealed with silicone or latex sealant) should be installed so that the interior of the adjacent room, except change rooms and restrooms, is visible.
   B. Windows must not allow viewing from public areas.
   C. Interior sills must be sloped away from windows for ease of cleaning/minimize dust collection.

9. Eyewash/Safety Shower
   A. An emergency eyewash must be located in each BSL-3 room.
   B. A combination emergency eyewash/safety shower unit must be located in near proximity to places if personnel are exposed to splash hazards (determined during programming).
   C. Emergency eyewash and emergency eyewash/safety shower units must be sited and installed in accordance with Section 5162 of 8 CCR.

10. Shower — Entry/Exit
    A. A shower may be required in ABSL-3 laboratories, insectaries, or with certain agents. The need for a shower will be determined during programming.
    B. When required, the entry/exit shower must be pass-through in design so that traffic flows in one direction, and dirty clothing/personal protective equipment (PPE) must not contaminate clean clothing, people, or equipment.

11. Plumbing
    A. All penetrations must be perpendicular to the surface and must be sealed to be gas-tight.
    B. Penetrations must be sealed with non-rigid, non-shrinking, silicone or latex sealant; for fire-rated walls, apply sealant before fire stopping.
    C. All pipes into the BSL-3 laboratories should be secured to prevent movement.
    D. Fixtures must be resistant to corrosion of bleach and other disinfectants.
    E. Back-flow prevention devices must be installed on all faucets (including industrial water).
    F. 6-inch P-traps should be installed if significant changes in pressure could occur.
    G. All pipes must be identified by use of labels and tags.
    H. Water supply control should be located outside the containment area.
    I. Plumbing should discharge directly to a sanitary sewer.

12. Sinks
    A. Handwashing sinks must be located in each room near the exit.
B. Sinks must be hands-free. Infrared sensors are preferable, but may not be suitable for all laboratories. In cases where infrared sensors cannot be used, knee-operated sinks are preferable to foot-operated.

C. Each sink must have chemical-resistant traps (for disinfectants), a coved backsplash, and a hot-cold water, pre-mixing faucet.

D. Each handwashing sink must be accompanied by a paper-towel dispenser and a hands-free soap dispenser mounted within easy reach.

13. Autoclave

A. Pass-through to the anteroom or support room outside containment.

B. Autoclave must be equipped with interlocked doors.

C. Decontamination cycles should be determined during programming; gravity and liquid cycles are typical.

D. Appropriate autoclave size should be determined prior to purchase.

E. The body of the autoclave must be located outside containment to provide easy access for maintenance.

F. Sufficient space adjacent to the contaminated (input) door must be present for waste collection.

G. Control panels should be located internal and external to containment.

H. Bioseals or other equivalent means should be used to create a seal at the wall.

I. The floor under the autoclave must be monolithic, seamless, or heat-sealed, coved, and water-tight.

J. Floor penetrations, if essential, must have a water and gas-tight seal at the monolithic floor.

K. The walls and hard ceiling must have epoxy paint.

L. Exposed pipes should be insulated.

M. The autoclave should be seismically anchored.

N. Fire sprinkler heads, if in the canopy, should be rated higher than the steam temperature.

O. A curbed corrosion-resistant basin should be installed to prevent leakage.

P. A canopy hood is provided over the exit door of the autoclave to contain heat and steam.

Q. The installation must be signed off by a professional engineer.

R. The autoclave room must have a minimum of 10 air changes per hour.

14. Life Safety

A. Fire alarms must be clearly audible above ambient noise levels (low-frequency alarms for animal facilities).

B. A wall-mounted ABC Dry Chemical fire extinguisher must be mounted near the exit door of the anteroom.

C. Laboratory-safe refrigerators or metal flammable cabinets must be used to store flammable/combustible materials.

   i. New flammable cabinets should be equipped with self-closing doors in accordance with 2021 NFPA 1 Section 66.9.4.3
15. Alarms
   A. Alarms must be provided for:
      i. Fire hazard
      ii. Ventilation failure
      iii. Differential pressures below 0.05” wg
      iv. -80°C ultra-cold freezers
      v. Intrusion detection systems
   B. Alarms must be connected to the building control system and to campus public safety department.
   C. Alarms must be audible and visible throughout the laboratory.
   D. Alarms should be differentiated from each other so that each can be easily identified.
   E. Alarms should be on UPS power.

16. Vacuum System/Pump
   A. Vacuum lines are protected with liquid disinfectant traps and HEPA filters, or their equivalent. Filters must be replaced as needed. An alternative is to use portable vacuum pumps (also properly protected with traps and HEPA filters).
   B. If an individual vacuum pump is used, it should be located in the laboratory. Noise and maintenance issues should be addressed.
   C. Self-contained, portable autoclavable vacuum systems are preferred.

17. Electrical
   A. Emergency power must be provided for:
      i. HVAC (including controls)
      ii. Alarms
      iii. Emergency lighting
      iv. Biological safety cabinets
      v. Storage freezers
      vi. Incubators
   B. UPS power should be provided to alarms, and when possible, to biological safety cabinets.
   C. An independent circuit should be provided for each biological safety cabinet.
   D. Wall/ceiling penetrations should be kept to a minimum and must be sealed with non-rigid, non-shrinking, silicone or latex sealant; for fire-rated walls, apply sealant before fire stopping.
   E. Junction boxes should be cast and/or sealed airtight (e.g. closed cell foam compatible with gaseous paraformaldehyde).
F. Light fixtures are surface- or pendent-mounted.
G. Circuit breakers are located outside containment and are labeled.

18. Heating, Ventilation, and Air Conditioning (HVAC) Systems
A. In most cases, the HVAC system should be Constant Air Volume (CAV). Variable Air Volume (VAV) is not recommended.
B. Electronic direct digital controls are used to manage the system.
C. Recirculation of exhaust air must not be allowed.
D. A dedicated exhaust system is required.
E. The outside exhaust must be dispersed away from occupied areas and air intakes, or the exhaust must be HEPA-filtered. Recommend locating the exhaust stacks on the roof and discharging upward at a velocity greater than 3,000 fpm.
F. An exhaust HEPA is required (see HEPA filter section).
G. The need for a redundant exhaust fan should be determined by users, in order to allow continuing work.
H. Air supply and exhaust system capacity must be ≥ 125% of the laboratory’s requirements to provide for future adaptability and flexibility.
I. The HVAC system must create directional airflow drawing air from rooms/areas of low hazard into rooms/areas of higher hazard.
J. Inward directional airflow must be maintained by providing 15% more flow of exhaust airflow than supply air (USDA) (minimum 200 cfm – Jennette, 2000), and sufficient to maintain the differential pressure between rooms in 0.05 – 0.20” Wg range.
K. The air balance must accommodate biological safety cabinet canopy/thimble connection or Class II type B2 cabinet exhaust requirements.
L. Inward directional airflow must be able to be verified before entry. Install a device(s) to indicate/confirm directional airflow into the laboratory (e.g., 0 – 0.20” Wg magnehelic gauges, digital differential pressure monitors, or both).
M. The BSL-3 lab must not become positively pressured if the exhaust system fails. Whenever possible, electrically interlock the supply and exhaust fans.
N. Exhaust ductwork must not be positively pressurized.
O. Supply and exhaust dampers should be gas-tight and closable from outside the facility to facilitate decontamination with gaseous paraformaldehyde.
P. Local visual and audible ventilation system failure alarms are required for laboratory personnel.
Q. Air supply diffusers must be located so that airflow at the biological safety cabinet face is unaffected (laminar diffusers preferred).
R. Ductwork should be located external to the laboratory; if exposed in the laboratory, ductwork is clear of walls to allow for cleaning, maintenance, and leak testing.
S. Ductwork should be gas-tight 316 stainless steel up to the HEPA filter (if present).

T. All ducts must be constructed in a leak-tight manner with seams and joints usually welded airtight. The Biosafety Officer will determine if exhaust ductwork is to be welded.

U. If the exhaust ductwork is welded, recommend welded joints for all connections except for the damper(s) (use flange and bolt connections for quick change-out in the future).

V. Coil units (for supplemental cooling) should not impact cleaning or provide a breach of containment.

W. Limit elbows whenever possible to reduce the amount of background noise generated.

19. HEPA Filters

A. HEPA filters must be "bag-in, bag-out," and the housing must accommodate gas decontamination and filter testing (gas-tight dampers and housing).

B. HEPA filter housings must be no more than five-feet high in order to facilitate filter change-out.

C. When HEPA filters are installed, a magnehelic gauge or other pressure-monitoring device must be installed, with the display placed in the most accessible location that is practical, to measure pressure drop across the filters.

D. A HEPA may be required on the autoclave exhaust, ultracentrifuge vent, and sewer vent.

E. HEPA filters should comply with DOE-STD-3020-97 (or latest edition).

F. Arrangements must be made to permit periodic leak testing of exhaust system HEPA filters. The system should comply with ASME AG-1.

20. Laboratory Furniture and Casework

A. Laboratory furniture and casework must be sturdy, and capable of supporting anticipated loading and uses.

B. Laboratory furniture and casework must be spaced so that areas around and under benches, cabinets, and equipment must be accessible for cleaning.

C. Benchtops should be impervious to water and resistant to acids, alkalis, organic solvents, and moderate heat.

D. Benchtops should have marine/drip edging for spill control.

E. Modular, mobile casework should be used for future flexibility.

F. Laboratory furniture and casework should be designed with ergonomic considerations (e.g., adjustable work-surface heights, selection of biological safety cabinets, adequate knee clearances for seated work, adequate toe clearances for standing work, wall cabinet heights, etc.).

G. Fixed casework, if used, must be sealed/caulked to the walls on installation to facilitate cleaning and prevent harborage for vermin.

H. Fixed casework, if used, should be installed before the coved flooring so that the coving can extend up toekicks.

I. Closed cabinets rather than open shelving should be used for storage.
J. In BSL-2 and 3 laboratories, chairs and other furniture should be covered with a non-fabric material that can be easily decontaminated.

K. Tall or movable cabinets/shelves should be seismically anchored.

L. Cabinets/shelves should have angled tops or be built up to the ceiling to facilitate cleaning.

21. Security

A. Access controls should be provided to record entry and exit times and dates.

B. Palm scan, proximity card, keypad entry with codes unique to each worker, cardkey, or equivalent, should be used.

C. Access to mechanical and support areas must be limited.

D. Security measures must meet the requirements of the Select Agent Regulations if the facility is to be used for select agent work or storage.

E. Security measures must equal or exceed the guidance set forth in Appendix F of the latest version of the CDC-NIH’s Biosafety in Microbiological and Biomedical Laboratories. Note: USDA has specific security requirements; refer to USDA Security Policies and Procedures for Biosafety Level-3 Facilities, DM 9610-001.

22. Communications

A. An intercom or hands-free telephone must be located in each room and must be connected to a location that has personnel available for emergency response at all times work is being performed in a BSL-3 laboratory.

B. Wall/ceiling penetrations must be kept to a minimum and must be sealed with non-rigid, non-shrinking, silicone or latex sealant; for fire-rated walls, apply sealant before fire stopping.

23. Commissioning

A. Commissioning should be performed by a third party in the presence of the Biosafety Officer.

B. The Biosafety Officer will furnish checklists for the containment features to be evaluated, dependent on the facility design. Initially, the facility must pass a series of inspections and tests to meet standards that have been pre-developed, authorized, and specified in the design and construction documents before biohazardous agents are used in the facility. These are in addition to the desired outcomes by the commissioning team identified prior to initiation of construction activities.

C. A properly designed and constructed biocontainment facility, including its structural and mechanical safety systems, must meet predetermined performance criteria and be operational upon completion of construction. The integrity of the critical components of the biological containment systems shall be verified by the testing and certification requirements listed below.

D. Certification of the facility, including structural components and safety systems, must be included as part of the overall commissioning processes normally undertaken to verify that the design and construction meet applicable standards, and that the facility can operate in accordance with the design intent.

E. Commissioning testing must also be performed without degradation to the facility or mechanical system that is being tested.
F. All equipment and materials should be tested/evaluated prior to installation; duplicate testing is recommended.

G. BSCs must be certified in accordance with NSF 49 after the BSC is anchored in its final location.

H. All HEPA filters must be tested to meet NSF 49 after installation.

I. Integrity of seals must be demonstrated by visual inspection.


K. The autoclave installation must be found to be proper as attested by the sign-off of a Professional Engineer.

L. The autoclave must be tested to verify that it meets specified standards:
   i. Thermometers are calibrated
   ii. Clocks and timers are calibrated
   iii. Biological indicators are used to verify the autoclave's effectiveness

M. The operation of backflow preventers must be verified

N. The ventilation system must be tested by:
   i. Ventilation ductwork and HEPA housings must pass pressure-decay testing under ASHRAE SMACNA Standard 126-2000 (Method of Testing HVAC Air Ducts)
   ii. Measurements of airflow at each supply and exhaust diffuser
   iii. Smoke testing to visually verify limited turbulence at face of BSC
   iv. Smoke testing to visually verify airflow from areas of low hazard to areas of higher hazard
   v. Verification that air system failure alarms (exhaust, supply, room pressure) function and annunciate properly
   vi. Air balance report must be provided to and verified by the Biosafety Officer

O. Additional environmental protection (e.g., personnel showers, HEPA filtration of exhaust air, containment of other piped services, and the provision of effluent decontamination) should be considered if recommended by the agent summary statement, as determined by risk assessment, the site conditions, or other applicable federal, state, or local regulations.

24. BMBL Requirements

A. Biosafety Level 1
   i. A door
   ii. A sink for hand washing
   iii. Designed for easy cleaning.
   iv. Benchtops impervious to water and resistant to acids, alkalis, organic solvents, moderate heat, and chemicals used to decontaminate.
v. Laboratory furniture capable of supporting anticipated loading and uses
vi. Accessible spaces between and under benches, cabinets, and equipment
vii. Windows fitted with fly screens (if they can be opened).

B. Biosafety Level 2

i. BSL-1 requirements and good practices
ii. Lockable, self-closing, fire-rated door that opens inward
iii. Located away from public areas
iv. Appropriately installed biological safety cabinets
v. Readily available eyewash station that complies with the requirements of Chapter 4 of this Guide
vi. Adequate illumination for all activities
vii. Consideration of inward flow of air without recirculation to spaces outside of the laboratory
viii. Seismically anchored autoclaves.
ix. Good Practice for BSL-2 includes:
   a. Floors with a slip-resistant, smooth, hard finish; are liquid-tight or monolithic/seamless or have welded seams; and that have a wall coved up 4-inches, or a cove-base installed to create a water-tight seal to the floor
   b. Walls that are durable, washable, and resistant to detergents/disinfectants (use durable glossy acrylic or epoxy paint or equivalent)
   c. Protection of exposed corners and walls from damage by carts
   d. Wall/ceiling penetrations kept to a minimum and sealed with fire-retardant material
   e. Douse shower unit in near proximity. The safety shower/eyewash must comply with the requirements of Chapter 4 of this Guide
   f. Floor drain for autoclave
   g. A canopy hood located over each end of the autoclave.

C. Biosafety Level 3

i. BLS-2 requirements and good practices
ii. The laboratory is separated from areas that are open to unrestricted traffic flow within the building, and access to the laboratory is restricted. Passage through a series of two self-closing doors is the basic requirement for entry into the laboratory from access corridors. Doors must be lockable. A clothes-changing room may be included in the passage way.
iii. Each laboratory room contains a sink for handwashing. The sink is hands-free or automatically operated, and is located near the room exit door.
iv. The interior surfaces of walls, floors, and ceilings of areas where BSL-3 agents are handled are constructed for easy cleaning and decontamination. Seams, if present, must be sealed. Walls, ceilings, and floors should be smooth, impermeable to liquids, and resistant to the chemicals and disinfectants normally used in the laboratory. Floors should be monolithic and slip-resistant. Consideration should be given to the use of coved floor coverings. Penetrations in floors, walls, and ceiling surfaces are sealed. Openings such as those around ducts and the spaces between doors and frames are capable of being sealed to facilitate decontamination.

v. Benchtops are impervious to water and are resistant to moderate heat and the organic solvents, acids, alkalis, and those chemicals used to decontaminate the work surfaces and equipment.

vi. Laboratory furniture is capable of supporting anticipated loading and uses. Spaces between benches, cabinets, and equipment are accessible for cleaning. Chairs and other furniture used in laboratory work should be covered with a non-fabric material that can be easily decontaminated.

vii. All windows in the laboratory are closed and sealed.

viii. A method for decontaminating all laboratory wastes is available in the facility and utilized, preferably within the laboratory (i.e., autoclave, chemical disinfection, incineration, or other approved decontamination methods). Consideration should be given to means of decontaminating equipment. If waste is transported out of the laboratory, it should be properly sealed and not transported in public corridors.

ix. Biological safety cabinets are required and are located away from doors, from room supply louvers, and from heavily traveled laboratory areas.

x. A ducted exhaust air ventilation system is provided. This system creates directional airflow, which draws air into the laboratory from "clean" areas and toward "contaminated" areas. The exhaust air is not recirculated to any other area of the building. Filtration and other treatments of the exhaust air are not required, but may be considered based on site requirements and specific agent manipulations and use conditions. The outside exhaust must be dispersed away from occupied areas and air intakes, or the exhaust must be HEPA-filtered. Laboratory personnel must verify that the direction of the airflow (into the laboratory) is proper. It is recommended that a visual monitoring device that indicates and confirms directional inward airflow be provided at the laboratory entry. Consideration should be given to installing an HVAC control system to prevent sustained positive pressurization of the laboratory. Audible alarms should be considered to notify personnel of HVAC system failures.

xi. HEPA-filtered exhaust air from a Class II biological safety cabinet (BSC) can be recirculated into the laboratory if the cabinet is tested and certified at least annually. When exhaust air from Class II BSCs is to be discharged to the outside through the building exhaust air system, the cabinets must be connected in a manner that avoids any interference with the air balance of the cabinets or the building exhaust system (e.g., an air gap between the cabinet exhaust and the exhaust duct). When Class III BSCs are used, they should be directly connected to the exhaust system. If Class III BSCs are connected to the supply system, it is done in a manner that prevents positive pressurization of the cabinets.

xii. Continuous flow centrifuges or other equipment that may produce aerosols are contained in devices that exhaust air through HEPA filters before discharge into the laboratory. These HEPA systems are tested at least annually. Alternatively, the exhaust from such equipment may be vented to the outside if it is dispersed away from occupied areas and air intakes.
xiii. Vacuum lines are protected with liquid disinfectant traps and HEPA filters, or their equivalent. Filters must be replaced as needed. An alternative is to use portable vacuum pumps (also properly protected with traps and filters).

xiv. An eyewash station is readily available inside the laboratory.

xv. Illumination is adequate for all activities, avoiding reflections and glare that could impede vision.

xvi. The Biosafety Level-3 facility design and operational procedures must be documented. The facility must be tested for verification that the design and operational parameters have been met prior to operation. Facilities should be re-verified, at least annually, against these procedures as modified by operational experience.

xvii. Additional environmental protection (e.g., personnel showers, HEPA filtration of exhaust air, containment of other piped services, and the provision of effluent decontamination) should be considered if recommended by the agent summary statement, as determined by risk assessment, the site conditions, or other applicable federal, state, or local regulations.

xviii. Laboratory separated from areas that are open to unrestricted traffic flow within the building, and access to the laboratory is restricted.
Building Interior Storage

1. GENERAL
   
   A. The following information is for specific room and space types and is in addition to all previously stated standards listed in Divisions 01 - 34.

   B. All previously noted accessibility requirements per OSHA and/or NEC must be followed in these spaces.

2. REQUIREMENTS
   
   A. Building Storage is required in all new construction to house all building specific and required extra items; paint, carpet, lighting, filters, etc.

   B. Room size shall use the general rule of 0.75 sq. ft. per 100 sq. ft. of building space (net or assignable space) with a minimum room size of 10 ft. x 12 ft.

   C. Flooring shall be sealed concrete.

   D. General LED lighting is required with wire guards on fixtures.

   E. Ventilation
      
      i. Basement locations: ventilation only, no heating or cooling necessary.

      ii. Attic and/or Penthouse locations: careful consideration should be given to the amount of ventilation and/or heating and/or cooling that is required to provide an appropriate environment.

   F. Shelving is required for efficient storage. Shelving type required will be determined by the design team in consultation with the OSU Project Manager and FS Maintenance during design.

   G. A Minimum of two (2) 20 amp duplex electrical outlets shall be provided. Both must remain accessible and shall not be located on walls with shelving.

   H. Access shall be provided by door from hallway.

   I. NO sharing of program is allowed. Construction Overstock Rooms may not double as custodial closets, etc.
Cold Rooms

1. GENERAL
   
   A. EH&S should be consulted to review arrangements for providing fresh and exhaust air during period of occupancy and for storage of hazardous materials or compressed gasses inside Cold Rooms.
   
   B. Cold Rooms used only for the storage of non-hazardous materials do not require ventilation in addition to that specified by the manufacturer.
Communications Rooms

1. GENERAL
   A. The following information is for specific room and space types and is in addition to all previously stated
      standards listed in Divisions 01 - 34.
   B. Refer to Division 27 sections on Communications for more guidance.
   C. All previously noted accessibility requirements per OSHA and/or NEC must be followed in these spaces.
      Refer to Construction Standards 01 10 02 Accessibility Best Practices for OSU for guidance.

2. REQUIREMENTS
   A. All work shall comply with OSU Construction Standards Division 27 (Campus Wiring Standards). No
      substitutions allowed.
   B. Registered Communication Distribution Design Professional (RCDD) certification is required for anyone
      designing or specifying information technology space, pathways or cabling subsystems.
   C. There are four major areas that must be accommodated in the design of a facility: Space; Power; HVAC;
      Pathways; Cabling.
   D. NO sharing of space is allowed. These spaces may not double as a custodial closet, Alarm Panels, power
      breaker panels; storage, etc.
   E. Coordination with OSU Information Services/I.T. Infrastructure Services is required during design.
   F. Communication reach-in spaces shall have at a minimum one 36-inch door that swings out of the space
      with flush thresholds. Double 36-inch doors are preferred.
   G. The TSER and TER may be combined to optimize space planning; this method is preferred.
   H. Building Entrance Facility (BEF): This I.T. space is where the communications cabling enters the building
      from the campus tunnel or conduit system. Each building is required to have this space located near the
      electrical service entrance. This location is where primary and secondary protection is installed on all
      metallic cabling entering the building to protect building occupants and equipment from stray voltages,
      currents, and lightning strikes. This room must provide adequate space for the protection as well as cross
      connects to the building backbone cabling system. If the TSER is not combined with the TER described
      below, no special environmental conditioning is required beyond the general building HVAC.
   I. Main Distribution Frame (MDF). This is a centralized and conditioned I.T. space that houses
      telecommunications equipment common to the building as a whole. Such equipment includes: Riser
      cabling subsystem, horizontal cabling subsystem; telephone system modules; local area networking
      equipment; specialized network services; other building-level telecommunications equipment. Only one TER
      space per building. The minimum space size being 12’x14’.
   J. Telecommunications Rooms (TR): This is a centralized and conditioned I.T. space that houses equipment
      similar to MDF space but provides a much more limited function; typically serving a building level. The
      equipment in a TR provides service only to a floor or part of a floor within a building. The TR shall be centrally
      located to minimize cabling lengths. TR space sizes shall be at a minimum 10’x12’. Larger rooms are
      required depending on floor space of a building and services offered within the building.
i. TR wall construction shall include plywood backboards of 3/4" AC fire rated plywood, 8' tall, width is to be determined by project.

ii. Coordinate the installation of basket tray pathways with all other construction within telecommunications room.

K. All I.T. spaces require air conditioning on a 24-hour-a-day, 7-day-a-week basis with standby power. The environmental limits of these rooms are 70°F to 75°F (70°F set point) and 30% to 55% relative humidity. Rooms must have a minimum illumination of 50 foot candles measured 1 meter form finished floor. If these rooms are located below grade, they must be equipped with a sump pump system on a standby power source. These rooms shall not be located under locations that would introduce water (kitchens, restrooms, etc.). Also, water, sewer, and/or steam lines are not allowed to pass through either the spaces. The doorways shall be a double door with 36" leafs that outward swing, that are lockable, that has removable mullions, and the threshold shall be flush with the finished floor.

L. Pathways

i. BEF spaces shall be equipped with at least three 4" conduits at a minimum; stubbed to the campus utility tunnel for provision of campus telecommunications services to the building.

ii. Building pathways shall consist of cable trays in hallways or other common and direct paths through the building. Conduits from station locations shall stub into the cable tray. The pathway shall stub into the serving BEF/MDF/TR. There shall be at least one spare 4" conduit running from each TR to the building MDF.

iii. All conduits and pathways shall be designed in accordance with ANSI/TIA/EIA 569-B. Note: Conduit bodies (LB’s) are not allowed and strict adherence to bend radius shall be followed.

iv. Work Area Outlets will be served by a minimum of 1" conduit from the cable tray. Bend radius must be observed, ANSI/TIA/EIA 569-B.

v. Work Area Outlets will be equipped with a 4" deep square box with a single gang mud ring.

vi. Additional pathway requirements will be outlined during the detailed design process.

M. Information Technology Cabling and Contractor Prequalification's.

i. Per OSU Construction Standards Division 27 (Campus Wiring Standards). No substitutions allowed.
Custodial Closets

1. REQUIREMENTS

A. The following information is for specific room and space types and is in addition to all previously stated standards listed in Divisions 01 - 34.

B. Multi-story buildings must have at least one 150 sq. ft. room for supply storage with 72 linear feet of shelving. This shall be provided in addition to requirement C. The 150 sq. ft. Custodial Closet is preferred to be on the ground floor.

C. Single story buildings requiring custodial services and remaining floors of multi-story buildings require a minimum size -- 100 sq. ft. per floor with a minimum of 40 linear feet of shelving.

D. Remodeling activities are not to result in the reduction of available custodial space below the minimum space standards outlined above, and to the extent possible, remodeling projects shall be viewed as opportunities to improve substandard facilities.

E. NO sharing of program is allowed. Custodial Closets or storage areas may not double as a storage closet for non-custodial materials. Do not locate building support systems such as electrical, telephone, HVAC controls, or computer network within Custodial Closets or Storerooms.

F. Floor type (preferred) or wall mount type slop-sink with anti-siphon valve and clean out shall be provided.

G. Two (2) 20 amp electrical outlets shall be provided.

H. A minimum of 36 inch wide door that opens into a hallway shall be provided. Automatic closures are not permitted.

I. Tall ceilings, 10 feet or higher, are needed for ladders and extension poles.

2. CLOSET LOCATION

A. Minimum of one custodial closet shall be located within 50 feet of the primary rest room area.

B. Locate custodial closets to avoid exiting into carpeted hallways whenever feasible.

3. CLOSET DIMENSIONS

4. CLOSET SHELVING, HANGERS, & ACCESSORIES

A. Minimum five (5) each adjustable shelves shall be provided per closet. Shelves shall measure a minimum of six (6) feet x 16 inches wide and shall support a minimum of 50 lbs. per sq. ft. Shelves shall be a minimum of 3/4 inch thick and shall be supported by double standards. The maximum shelf height shall be 6 feet as measured from the floor.

B. Each shelf is to a allow 12 inches clear height to next shelf.

C. Two mop hangers at 6 feet off finish floor shall be located over the floor / mop sink.

D. Four (4) additional mop hangers shall be provided at 6 feet off finish floor within the room.

E. 3/4 inch brass coupling and stainless steel hose bracket shall be provided; Fiat 889-CC or Fiat 832-AA.
5. CLOSET PLUMBING
   A. A floor drain is required in each closet; to be installed at the lowest point of sloped flooring.
   B. 1/2 inch isolation ball valves are required on hot and cold water.
   C. One floor type mop sink with a stainless steel strainer, anti-siphon valve, and clean out shall be provided in each closet. Provide a floor sink with a permanently attached, waterproofed splash protection at a minimum of 2 feet above sink on both walls.
   D. Faucet:
      i. 40 inches from finish floor and centered over mop sink.
      ii. Wall mounted service type.
      iii. 6 inch spout with integral vacuum breaker.
      iv. 3/4 in. threaded hose outlet.
      v. Adjustable centers.
      vi. Integral check arms.
      vii. Chrome plated.

6. CLOSET ELECTRICAL
   A. Each closet shall be provided with two (2) 20 amp electrical outlets on two (2) separate walls. All outlets must have GFCI protection.
   B. Lighting shall be controlled by occupancy sensor.
   C. Lighting is to be placed in an area where it will not be hit with mop handles when using the sink and is to have a protective lens or plastic / wire cover to protect bulbs from accidental contact with mop handles.
   D. HVAC shall be provided to custodial closets. Venting shall be provided for closet to accommodate chemical storage and/or battery charging equipment.
   E. Ventilation to the outside is required if the closet will be used to charge batteries of larger equipment.

7. CLOSET FINISHES
   A. Floor:
      i. Acceptable flooring materials are: (the four items below need to line up)
         a. Resilient, seamless safety flooring.
         b. Light colored 8 inch x 8 inch non-glazed quarry tile.
         c. Sealed concrete.
         d. All flooring and base coving shall be fully sealed and floor shall be properly sloped to floor drain.
   B. Wainscot shall be provided and shall be light colored, 4.25 inch x 4.25 inch glazed ceramic tile and/or Fiber Reinforced Plastic (FRP). Wainscot shall extend 4 feet from finish floor.
C. Paint shall be light colored, semi-gloss exterior enamel.

D. Wall assemblies are to use appropriate materials for wet conditions such as wonder board, hardy board, etc.

8. **SIGNAGE**

A. Label “Custodial Closet” for room name on floor plan(s), not “Janitor Closet”.
Inclusive/All User Restrooms

1. GENERAL

   A. DFA and UFIO, with Capital Planning & Development (CPD) seeks to advance OSU’s commitment to diversity, equity, inclusion and belonging by providing gender inclusive / all user restrooms across the Corvallis campus. The development of this Standard is in process. In the interim, the Design Professionals are to work with the Project Manager, who will connect with the OSU CPD committee, to confirm status of this Standard as the Design Professional develops the project’s design.
Laboratory Designated Eating and Drinking Areas

1. GENERAL
   A. The following information is for specific room and space types and is in addition to all previously stated standards listed in Divisions 01 - 34.
   
   B. All previously noted accessibility requirements per OSHA and/or NEC must be followed in these spaces. Refer to Construction Standards 01 10 02 Accessibility Best Practices for OSU for guidance.

2. REQUIREMENTS
   A. For all new laboratory buildings and major laboratory remodels, accommodations should be made to provide clean spaces that are designated as safe eating and drinking areas.
   
   B. Designated eating and drinking areas should be physically separated from any location where laboratory chemical, biological or radioactive materials are used or stored.
      i. Physical separation can be accomplished by providing a door that prevents direct access between a designated eating/drinking area and a material use or storage location.
      
      ii. The designated area must also be under positive pressure to the material use or storage location and be labeled as a clean space.
      
      iii. A designated eating and drinking area could include but not be limited to a separate common lunch or break room per laboratory suite or floor OR personal office spaces that are separate from material use and storage locations.
      
      iv. Eating areas should be large enough to accommodate the expected number of employees in each laboratory area that it will serve.

3. REGULATIONS AND STANDARDS
   A. OAR Chapter 437, Division 2, Subdivision Z
   
   B. OSU Campus Policy, EH&S, Biosafety Manual
Lactation/Nursing Rooms

1. GENERAL
   A. The following information is for specific room and space types and is in addition to all previously stated standards listed in Divisions 01 - 34.
   B. Mothers returning to the workplace after childbirth face challenges to express medically beneficial breastmilk while also reentering the workforce. Companies that provide lactation rooms in the workplace help these employees achieve both of these goals. Public facilities increasingly provide Lactation and Mother’s rooms for nursing due to growing demand. The dramatic health benefits for infant and mother have influenced these mothers to dedicate long hours to pumping and storing breast milk when they are not with their babies. Many of these mothers return to work after just 6 to 12 weeks, and they need a dedicated place where they can comfortably and efficiently collect and store breast milk in the work place. This needs to be a calm restful environment for an efficient and safe pumping session.
      i. Exceptions:
         a. Disregard reference to Wellness Rooms.
         b. See privacy lock information below.
         c. Chair to be comfortable, a task chair suitable for a counter is applicable only if it is the second chair within the space.
         d. OSU does not offer multi-unit rooms.

2. D. The overall design is to be a calming environment with a soothing wall color palette. MINIMUM PHYSICAL ROOM REQUIREMENTS
   A. Size needs to accommodate 6 ft. x 7 ft. maneuvering clearance, casework, and furniture. Refer to Section 01 10 02 Accessibility Best Practices for OSU.
   B. Location: In an area that is safe, private and accessible to all. Where possible, these rooms should be proximate to bathroom facilities.
   C. The room must have a lockable door with pin-code access – Schlage C0-200 series with keypad, with interior lock.
   D. Provide adequate HVAC, well-placed electrical outlets, and a network connection.
   E. Sound privacy is important. Specify carpeting (carpet tiles), fabric acoustic panels, upholstered furniture, or other sound dampening materials to minimize sound transmission.
   F. The room must be plumbed with a sink and faucet combination deep enough to wash bottles and pump parts. Gooseneck kitchen-type faucets are recommended.
   G. A counter area must be provided; 20" deep by 32" wide minimum; with a minimum 30" wide clear knee space beneath the counter; provide above counter electrical outlets.
   H. Provide storage for paper towels and cleaning supplies.
I. Provide a place to hang clothing (hooks, hangers) and a wall mounted, full length mirror.

J. Provide a cabinet or shelving for personal items that is separate from supply storage.

K. Provide electrical outlet(s) near chair and side table.

L. Provide dimmable lighting where possible.

3. OWNER FURNISHED, OWNER INSTALLED (OFOI) FURNITURE & ACCESSORIES

A. One comfortable chair (preferred); upholstered preferred; must have arms. If a task type chair is provided, it must have arms, lumbar, tension, height adjustments, and casters. Fabric or material designed for easy cleaning or wiping.

B. One under counter size refrigerator for milk storage.

C. One small side table large enough for pump and table lamp, minimum size of 18-inches x 18-inches.

D. One lamp, table or floor.

E. Space for signage external to the room (In addition to the room sign) provided by the Family Resource Center.
Loading Docks and Service Areas

1. GENERAL
   A. The following information is for specific room and space types and is in addition to all previously stated standards listed in Divisions 01 - 34.
   B. All previously noted accessibility requirements per OSHA and/or NEC must be followed in these spaces.

2. REQUIREMENTS
   A. For each campus building or building complex, a designated building service area is to be established. Each service area shall provide facilities / locations for loading, package delivery, garbage / trash collection, and parking for maintenance and service vehicles.
   B. Building service areas shall be located on the least public façade.
   C. Dumpster facilities / locations shall be incorporated into a loading dock. In the absence of loading dock, these sites shall be near a building entrance (but NOT the main entrance) and shall be screened from view by an appropriately designed fence and/or vegetation. All screening shall be consistent with the standards of the local jurisdiction. For the OSU Corvallis campus, the standards are outlined in Chapter 3.36 of the Corvallis Land Development Code.
      i. For Corvallis campus, reference Republic Services or current hauler, for size of contracted dumpsters and recycling carts as coordinated with Manager of OSU Recycling Program via OSU Project Manager.
      ii. For Corvallis campus, reference Republic Services or current hauler, for truck access and turning radius requirements.
   D. Elevated loading docks should be equipped with dock guards per OSHA fall protection requirements and signage should identify a designated driver waiting area. Consult with EH&S for approval on the dock guard design and placement via the Project Manager. Building loading docks/service areas shall not be near building air intakes.
   E. Walkways and drives that serve loading areas shall be designed and constructed to withstand heavy vehicle traffic.
   F. Mail delivery may be located within designated building service areas. If so, space for convenient vehicle parking shall be included.
   G. These spaces must be well lit for personal safety as well as use in the evening hours for OSU FS Custodial.
   H. Protection is required at the rear wall of loading dock to prevent damage to the facility by vehicles.
   I. Refer to Construction Standards 01 10 02 Accessibility Best Practices for OSU for guidance.
Lobbies and Atriums – Public and Circulation Spaces

1. GENERAL

A. The following information is for specific room and space types and is in addition to all previously stated standards listed in Divisions 01 - 34.

B. Public and circulation spaces include such spaces as hallways, corridors, reception areas, lobbies, atriums, etc.
   i. Latex eggshell paint with low or no VOC is to be used as public areas walls accumulate many smudges and are washed often. Satin Sheen is to be used for doors, trim work, painted casework, etc.
   ii. Hallway ceilings are to be accessible in all locations to allow for future modifications.
   iii. If tall furniture must be in these spaces, they should be evaluated for height and weight to determine if they should be secured to the wall using common earthquake restraint practices.
   iv. Lighting of circulation spaces is to be at low-levels with occupancy sensors that provide increased light levels when needed based upon occupancy.
   v. Flooring:
      a. If carpeting is used, only carpet tiles shall be specified with appropriate consideration for durability and traffic levels. NO broadloom carpet or the type that requires dry cleaning methods allowed.
      b. NO rubber surfaces with textured ‘dots’ installed at entries.
      c. Hard surface floors such as concrete, VCT, or linoleum products are easier to maintain in hallways.
      d. NO wood floors unless Owner approved.
   vi. Design guidelines for Audio Visual provisions within public atrium spaces that could be used for gatherings include the following:
      a. Portable video production equipment needs power and signal connection to any installed audio and video systems. (Camera and microphone inputs; power)
      b. Depending on the size of the space, atrium spaces may require floor and/or wall boxes to supply multiple locations for recording systems and microphones.
      c. Control room systems.
      d. Atrium spaces should be designed with signal/power paths to control rooms and associated distribution systems.
   vii. Atrium accessibility for equipment
      a. Interior access into the atrium and within the atrium shall accommodate at a minimum a 32 inch wide high lift that extends 26 feet.
      b. The finish floor shall be constructed with materials to support the weight of a minimum 32 inch wide high lift that extends 26 feet.
Mechanical, Plumbing and Electrical Rooms

1. GENERAL
   A. The following information is for specific room and space types and is in addition to all previously stated standards listed in Divisions 01 - 34.
   B. All previously noted accessibility requirements per OSHA and/or NEC must be followed in these spaces.

2. REQUIREMENTS
   A. Weather-Tight Construction required for all construction surrounding mechanical, electrical, or water vulnerable equipment.
   B. NO sharing of program is allowed. These spaces may not double as custodial closets, storage, etc.
   C. Electrical rooms must be sized for the equipment to be housed by using the largest dimensions from potential vendors to ensure that all components fit within the room with proper clearances.
   D. In mechanical and electrical rooms, any components requiring routine service or maintenance must be installed or mounted below 6 feet in height. The installation of any component above 6 feet requires onsite review and explanation with OSU FS Maintenance and/or OSU Electrical Supervisor prior to installation.
   E. A hose-bib must be provided in each mechanical room.
   F. Elevator access is required to penthouse and basement locations; NO mechanical room access is allowed by use of a ladder in new construction.
   G. Mechanical and electrical rooms must be provided with a campus phone.
   H. Mechanical and electrical rooms require the installation of a minimum of one spare / un-used data jack to monitor control system(s) from a portable computer.
   I. Mechanical room door width must be 40 inches to 42 inches. Double doors are preferred and must have a removable mullion.
   J. Space shall be provided for storing a minimum of one (1) full change of filters.
      i. Filter storage may require wall shelving if space above unit is not adequate or not protected.
      ii. Filter storage on the ground is NOT acceptable.
   K. Storage may be located on top of a unit if the space is dry and protected.
   L. All mechanical rooms shall have watertight floors with all penetrations fully sealed.
      i. Mechanical room floors shall contain floor drains.
      ii. Slope floors to drains.
      iii. All mechanical rooms require an epoxy or waterproofed floor with Epoxy or waterproofing extending up walls 6 inches at a minimum.
   M. All mechanical rooms shall have adequately primed floor drains located in close proximity to those pieces of equipment most likely to leak or require draining for servicing or replacement.
N. All below grade mechanical and electrical (transformer) rooms shall have an access path and adjacent areaway of sufficient size to allow for the removal of the largest piece of equipment without disassembly of the equipment. Large equipment shall be removed via the areaway rather than elevator. (Housing)

O. In the main facility mechanical room, provide dedicated space for the following:
   i. Storage of O&M manuals and as-built information
   ii. Layout space for large drawings
   iii. Wall area for valve charts, fire sprinkler zoning, etc.

3. Lighting:
   A. 5 foot-candles of emergency lighting shall be provided and programmed to remain on at all times for safety.
   B. Manual switch controls shall provide lighting to a level of 50 foot-candles at 30 inch elevation when lights are on.
      i. These occupancy sensor controls are to have a 30-minute minimum delay for safe
Space Use Categories

1. Classrooms
   A. (100 Series) General purpose classrooms, lecture halls, recitation rooms, seminar rooms, and other spaces used primarily for scheduled non-laboratory instruction.

2. Laboratory Facilities
   A. (200 Series) Rooms or spaces characterized by special purpose equipment or a specific configuration that ties instructional or research activities to a particular discipline or a closely related group of disciplines.

3. Office Facilities
   A. (300 Series) Offices and conference rooms specifically assigned to each of the various academic, administrative and service functions.

4. Study Facilities
   A. (400 Series) Study rooms, stacks, open-stack reading rooms and library processing spaces.

5. Special use Facilities
   A. (500 Series) Military training rooms, athletic and physical education spaces, media production rooms, clinics, demonstration areas, field buildings, animal quarters, greenhouses, and other room categories that are sufficiently specialized in their primary activity or function to merit a unique room code.

6. General Use Facilities
   A. (600 Series) Assembly rooms, exhibition space, food facilities, lounges, merchandising facilities, recreational facilities, meeting rooms, child and adult care rooms, and other facilities that are characterized by a broader availability to faculty, students, staff, or the public than are special use areas.

7. Support Facilities
   A. (700 Series) Computing facilities, shops, central storage areas, vehicle storage areas, and central service space that provide centralized support for the activities of a campus.

8. Health Care Facilities
   A. (800 Series) Facilities used to provide patient care (human and animal)

9. Residential Facilities
   A. (900 Series) Housing facilities for students, faculty, staff and visitors to campus.

10. Unclassified Facilities
    A. (000 Series) Inactive or unfinished areas, or areas in the process of conversion.